

# SCANNING THE HORIZONS

The Newsletter on Leading Edge Spatial Technologies

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## Industrial Survey Case Study

### Summary

AAM Industrial Surveyors are tasked with a variety of projects that involve supplying accurate 3D as-built information about a structure; deformation monitoring of surfaces subject to wear, and mapping objects in motion.

This case study describes a package of works, dubbed 'Measure, Monitor, Map', undertaken at BlueScope Steel's Number 5 Blast Furnace at Port Kembla during their Reline Project. This case study demonstrates some of the methods that AAM regularly deploys across sites where accurate 3D as-built information, surface deformation monitoring, or just generally difficult surveys, are required.

### Measure

Multiple terrestrial laser scanners were deployed for a fast 3D survey of the entire Number 5 Blast Furnace. Over 120 scans and 1 billion points were captured during furnace operation. The accurate and dense point data was used with CAD design software as an as-built reference.

### Monitor

Laser scanning and close-range photogrammetry were utilised for monitoring surfaces that are subject to wear from raw material interaction. These surfaces have been surveyed at various stages of their life and compared using inspection software. Highly-visual graphs quickly reveal areas of concern.

### Map

Close-range photogrammetry was relied upon to map the trajectory of raw material entering the Number 5 Blast Furnace. An accurate understanding of the shape of material flow assists BlueScope Technologists better utilise the furnace.

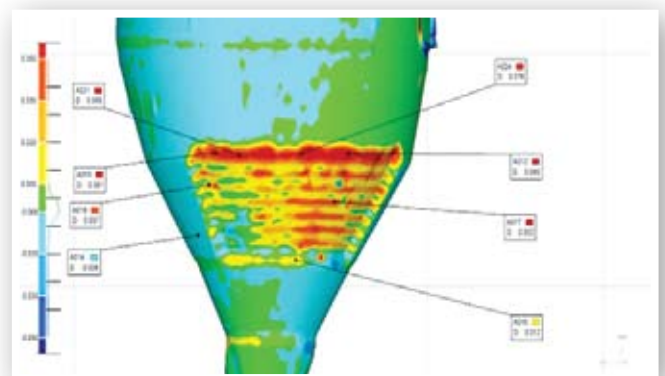


Above: High-resolution 3D point cloud from one of AAM's terrestrial laser scanners.

## Key Features and Benefits of Industrial Measurement by AAM:

- Multiple instruments for performing sub-millimetre measurements
- Terrestrial laser scanners for fast 3D as-builts at  $\pm 5\text{mm}$ ; easily integrated into common CAD packages
- Laser tracker for precise surface inspection at  $\pm 0.05\text{mm}$
- Close-range photogrammetry for remote measurement at  $\pm 0.1\text{mm}$
- Industrial metrology software for fast turn-around deformation analysis

Below: Surface deformation analysis of the interior of a material bin using specialised metrology software and dense 3D point cloud data.



# Industrial Survey Excellence Recognised



AAM was the recipient of both the 'J.K. Barrie Award: Best Industry Project' and the 'Infrastructure and Construction Award'.

The J.K. Barrie Award represents the pinnacle of achievement in the spatial industry and is the highest award the National Judges can confer. The winning submission was entitled: The 'Measure, Monitor, Mapping Campaign' on BlueScope Steel's Number 5 Blast Furnace Reline Project.



## Rail Project Embraces LiDAR and GIS

**Challenge:** Assess rail options and eliminate non-viable possibilities. Constraints were identified and quantities evaluated for each section of potential track using GIS and geospatial data.

**Solution:** The LiDAR derived terrain products and ortho imagery provided datasets which contributed vital data of known accuracy in areas of no data or greater risk.

Existing information incorporated into this project from other sources included: existing track status; road crossings; water crossing; land use; terrain type; ground conditions; tunnels; viaducts.

### Data sourced from AAM for this project

#### Phases 1 and 2 ~1300 linear km

+/- 25cm vertically accurate LiDAR data for rail concept design work

This included a staged delivery and multiple projections of:

- full set of all ground points and thinned data
- engineering contours in DGN format
- 1m ground ESRI terrain dataset
- laser intensity image

#### Phase 3 ~400 linear km

25cm vertically accurate LiDAR data and orthorectified 40cm imagery for basic engineering and feasibility rail design work.

# LiDAR Datasets: Penang

Penang Island is well known for its sandy beaches, fine food and great tourist activities. However it is also a complex landscape which poses significant engineering issues for its safe management and planning.

The 700,000 residents (plus innumerable visitors) are largely huddled around the coast line of the 293km<sup>2</sup> island. This produces an interesting mixture of high-rise towers and heritage buildings located in the coastal plains at the foot of the highlands. Given the significant tropical rainfall and typical planning pressures associated with urban sprawl and the need to alleviate traffic congestion, the Planning Authorities have a challenging task before them.

Their task is now a little easier and the outcomes more reliable as AAM has just delivered a detailed LiDAR project defining all of Penang Island. This high-precision survey was delivered in record time and to exacting client-standards. Well honed processing techniques and experienced data processors meant that the DTM, contours and intensity imagery were delivered in just 14 days after capture started and just 3 days after the final data arrived from Penang into our Kuala Lumpur office.



## Recent AAM Survey Projects of Note

- **Underground Mine Surveying 3D As-Built:** Over 100 terrestrial laser scans for drift condition survey of coal mine; +/-5mm accuracy; survey traverse carried over two levels; flexible deployment of survey crews to minimise impact on production
- **Deformation Analysis:** Six monthly return visits; ROM RE wall and tunnel deformation analysis; Terrestrial Laser Scanning (TLS) and conventional survey
- **Rail Corridor As-Built Mapping:** 200km rail survey using AAM purpose-built trolley using RTK-GPS detail survey of furniture along corridor
- **Heritage 3D As-Built:** Over 100 laser scans of heritage-listed building; comprehensive CAD modelling; several days of conventional detail survey; cadastral boundary survey
- **Process Plant:** Four repeat visits; over 150 TLS laser scans; +/-5mm accuracy; 200 Site-See virtual tours; 100 billion points
- **Coke Ovens Battery Survey:** TLS utilised in the condition monitoring of coke batteries on round-the-clock process environment; 5mm accuracy
- **Steel Mill Shutdown:** Deployed teams for around-the-clock industrial surveys for over 40 shutdowns at steel mill during 2010. Three teams for around the clock operation
- **Mobile Mapping Imaging:** 700km of continuous geocoded spherical imagery at 10 frames per second; parking bay mapping from desktop

# GIS: Putting the “I” into Integrated Shoreline Management Program

AAM Pty Ltd and RS&GIS Consultancy Sdn Bhd are currently involved in an enabling project to coordinate, acquire and disseminate a single database to serve a multitude of pivotal professional analyses for a 150km section of coastline in Malaysia.

**Challenges:** Shorelines present complex environmental and engineering issues to those charged with their management. These issues are becoming more difficult and more political, particularly in SE Asia where people are only now seeing the multi-faceted benefits of coastal zones. People are competing for more access to their coastlines for tourism, recreation, aquaculture and transport uses, at the very same time as sea level change and other environmental factors are imposing their presence.

Government Authorities are called upon to make decisions to address these competing needs, whilst still ensuring the longevity and viability of shorelines. For these policies to be based on informed decisions, the complex nature of shorelines means that a wide range of professionals are required to address the numerous issues.

**Solution:** AAM Pty Ltd and RS&GIS Consultancy Sdn Bhd are currently involved in an enabling project to coordinate, acquire and disseminate a single database to serve a multitude of pivotal professional analyses for a 150km section of coastline in Malaysia.

The Integrated Shoreline Management Project's GIS (ISMP-GIS) supports data acquisition and collation of existing data, integrating all geospatial information into a common reference system and framework. This benefits both the Consultants engaged for specialist studies, and the Agencies with an interest in the deliverables from this Project.

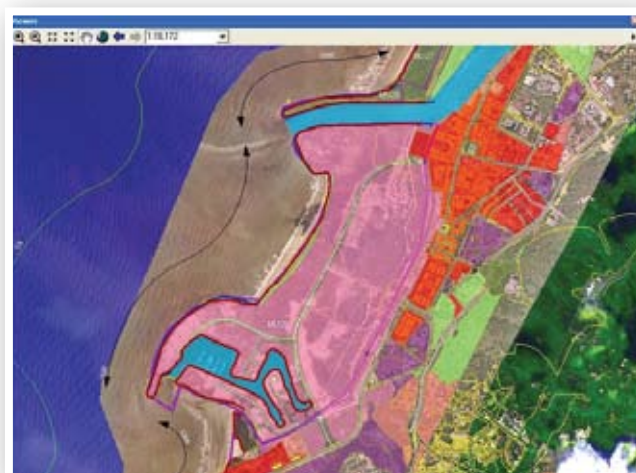
The ISMP-GIS geodatabase is a current, comprehensive, detailed, and accurate resource to support the full-range of current and future end-users and their study support requirements, whilst **establishing a database model for all future coastal zone management projects** in Malaysia. The ISMP-GIS has been developed using ESRI ArcGIS 9.3.1.

Data was migrated from existing hardcopy and digital datasets. AAM collected new datasets to supplement those already available. These **new datasets included high quality airborne LiDAR and digital orthophotos**. From the raw LiDAR data, RS&GIS derived valuable information layers such as contours and building models.

In the past, each government authority or each Consultant would acquire the data they needed to address their immediate project specific requirement. They would design their survey, collect the data, utilise it in their work, and then discard the data after their report was published. Apart from the obvious waste of resources with this approach, it meant that different Professionals were making their decisions based on different datasets. This ISMP-GIS approach means that **every Consultant engaged on this project is utilising the same dataset, reducing the likelihood of conflicting views based solely on conflicting or use different datasets**. The project has enjoyed significant economies as data is used multiple times and remains in a homogeneous dataset to be enjoyed by subsequent consultants for the foreseeable future.

The ISMP-GIS forms a sound foundation for the establishment of an Integrated Coastal Zone Management (ICZM) GIS, as the authorities see the benefits available to shoreline management and extend it to the entire Coastal Zone. The ISMP-GIS over this geographic region thus readily becomes a subset of the more holistic ICZM-GIS. Once again, the “I” comes to the fore, as those responsible for the Coastal Zone are using datasets which are integrated with those used for Shoreline management.

This approach has forever embedded the “I” into this Integrated Shoreline Management Program.



# LiDAR Data for Rail Design

## Rail Project

**Size:** >400km long corridor and ~4km wide

**Location:** Australia: Floodplains to rugged terrain

## Project Description

LiDAR data with +/-25cm vertical accuracy were acquired for rail planning and design. Processing techniques were utilised to compute aircraft trajectories removing the need to deploy field survey crews and GPS bases during the acquisition phase.

## Timeframe Details

**Contract signed:** October

**LiDAR captured:** November

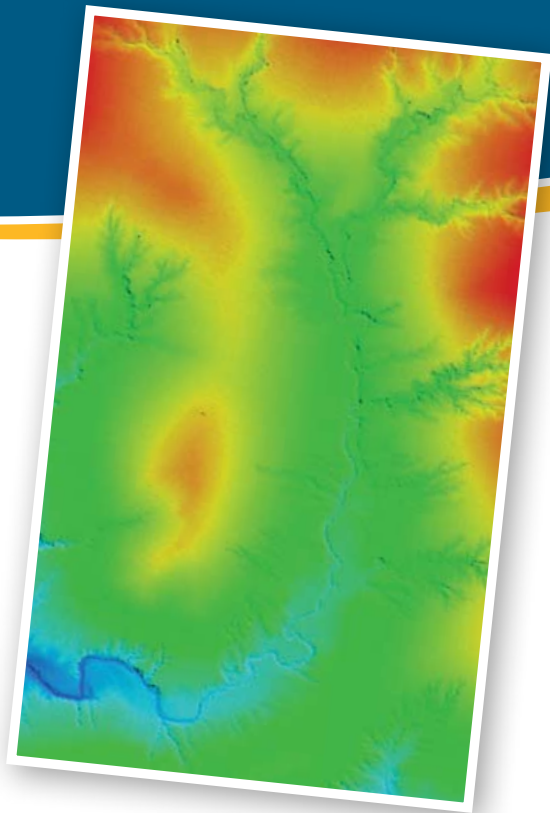
Final delivery of all products within 5 weeks

## Data Capture Time Frame

21 hours of high altitude flying was completed in 13 days with cloud and rain periods delaying capture. Two different airports were utilised to efficiently capture the project, minimising aircraft ferry time and maximising data capture time given the challenging weather conditions

## Deliverables

2m contours and laser intensity imagery



## Accuracy Validation

Reference point sites were analysed with field survey spot heights collected in flat open clear areas. Analysis of the surveyed points indicated the data was well within the 0.25m vertical accuracy project specifications.

## Benefits

Terrain assessment of large area completed in a rapid, accurate and cost effective manner

# GeoEye-1 Satellite Data for Energy Project

## Timeframes

- New data capture for 160km<sup>2</sup> completed in 4 weeks

## Input Data

- 2 single GeoEye-1 scenes
- 20 and 26 degrees off nadir
- Each image 4 band pan sharpened ~2Gb in size

## Deliverables

- 50cm satellite orthoimage (ecw ~250Mb; TIF 2Gb)
- DEM dxf ~110Mb
- 2m contours: 80Mb – 15Mb per tile (each tile 5km x 7km)
- DEM of breaklines and spot heights

## Benefits

Satellite derived products are cost effective in remote or dangerous locations; relative positional accuracy excellent for many project stages.



# Off The Shelf Data

Datasets in the following locations have been added to the **AAM GeoExtra data library:**

- Broome – Aerial Imagery
- Port Hedland – Aerial Imagery
- Melbourne – 3D models
- Sydney – Pictometry
- Sunshine Coast – Pictometry
- PNG, NZ, Africa – Satellite data

**“AAM’s GeoExtra data service has helped our engineering, flooding and acoustic projects on numerous occasions**

across Australia. We have used the service for accurate, consistent and reliable terrain data from LiDAR.

We receive our datasets via FTP in a quick turnaround and importantly at a great price.”

**Cardno Project Manager**

Airborne RADAR derived terrain datasets now available:

- Portions of PNG
- NSW – Tweed to The Entrance
- Mount Lofty and surrounds – Sth Australia
- Broken Hill – Mildura – Oyuyen

Contact **data@aamgroup.com** for pricing and related information or request customised new capture.

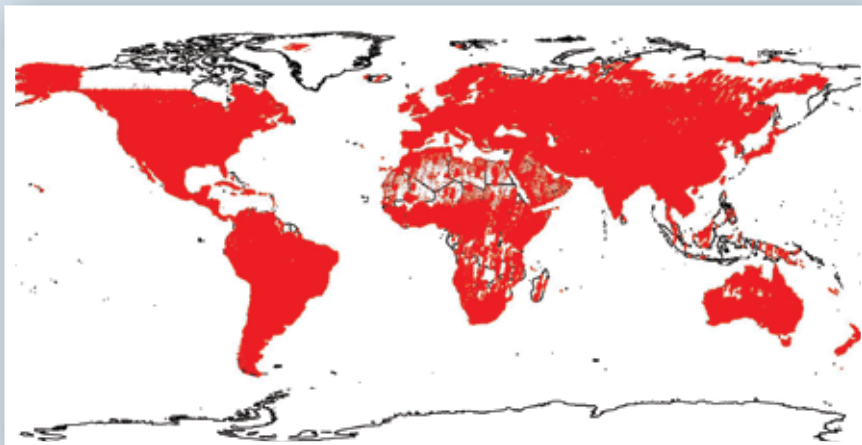
**GeoExtra™**  
Data



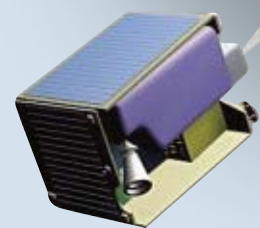
## Imagery and Terrain Datasets for Greenfield and Brownfield Sites

Given that we have 10 aircraft, 7 cameras, 5 LiDAR sensors and supply multiple satellite and airborne RADAR products, we can satisfy your project’s imagery requirements. From archive satellite data to the latest high resolution photo maps imaged multiple times per year, we can assist your project.

*Below: RapidEye’s global coverage as at October 2010*



The recent and extensive 50cm GeoEye and 5m RapidEye imagery coverage in archive is being widely embraced.



Ask us to review the archives over your area of interest – simply send a shp file or Google Earth™ placemaker to **imagery@aamgroup.com**

To appreciate the advantages of RapidEye products watch our new mini movie and download the latest brochure:

**www.aamgroup.com/rapideye**



# LiDAR – A Source for 3D Building Data

Building footprints have long been a valuable layer in urban GIS's but the continual move to 3D GIS databases has made these 2D vectors obsolete. Sophisticated urban data users now demand 3D buildings to support 3D spatial analysis.

Photogrammetry remains the most common method of deriving high definition, precision 3D buildings... trained operators stereo-digitise the required level of detail on each and every building. However this is a time-consuming approach which does not suit every requirement nor large projects with short timeframes.

Recent advances in software and processes have meant that **LiDAR can now offer a viable alternative to derive the 3D building outlines.** LiDAR derived buildings do not suit all applications as they are more generalised than those obtained by photogrammetry, however, they can be defined automatically and refined manually to the level that the project application demands.

LiDAR is a powerful measuring tool capable of collecting vast numbers of highly accurate ground and building measurements every second. **LiDAR surveys offer very high point density over very large areas in very short timeframes.**

These attributes make LiDAR a useful tool for broad scale, rapid data collection and modelling. The modelling of terrain and surface features from LiDAR is possible due to the high density, uniform accuracy and 'complete' coverage of the LiDAR point cloud. Traditionally models created from LiDAR have taken the form of gridded elevation data or triangular irregular networks.

The DEM modelling capabilities of these datasets are proven, however, in terms of GIS analysis the data storage capabilities and attribution potential of these formats are very limited.

This need for more sophisticated 3D building model geometries, over large project areas, can be addressed by extracting building models from LiDAR datasets. AAM has developed processes that are capable of rapidly creating 3D building models over dense urban project areas. The workflow supports the rapid broad scale creation of building models for generation of 3D GIS layers.

The advantages of this LiDAR modelling approach is that it is a very fast and relatively accurate way to create analytical, attributable GIS data. The disadvantages are that models created are more generalised and less photo realistic than other tertiary modelling techniques such as photogrammetry which can deliver high definition models.

These datasets are proving valuable for town planning and flood modelling to name just a few.

**Benefits and Features:** The trade ups are creation time, cost, and data coverage; the trade offs are detail, quality, photo realism and completeness of the finished model.



# Virtual Mine Sites – The Future

Mine sites are big, complex, hostile environments, making the task of running a mine site a challenging exercise.

**Challenge:** Sound decision making is critical to ensure the mine site runs safely and efficiently, whilst maintaining its social and environmental responsibilities. One poor decision could lead to catastrophe – financial, environmental, or worse.

The decision making process on a mine site is typically a collaborative effort, and mine managers rely on input from key technical experts - geologists, engineers, environmental officers and the like to help reach the best outcome. Often it is up to the mine surveyor (or nowadays GIS Officer) to furnish these various technical experts, and management, with a range of spatial information datasets to assist in the decision making process.

Satellite imagery, aerial photography, digital terrain models (from aerial photogrammetry or airborne LiDAR) are but some of the datasets mine site staff use in their daily functions, which feed into the decision making process. But with the broad range of spaceborne, airborne and terrestrial data acquisition technologies now available to aide the decision making process, the challenge is not necessarily lack of content, but the ability to harness and interact with all of the spatial information that is generated, from a common interface.

**Solution:** AAM is attempting to overcome this challenge with K2Vi, which stands for Key to Virtual Insight. K2Vi is a 3 dimensional virtual reality software platform, which allows the user to generate highly realistic, interactive 3D environments from a wide variety of GIS, CAD and raster formats. **Potential applications include:-**

## Virtual Mine Tours for Training and Inductions

The routine, yet vitally important task of site inductions for staff, contractors and visitors to a mine site could be improved immensely by taking people on a virtual tour of the mine before entry. In the interests of “Zero Harm”, all parts of the mine could be viewed in realistic detail for people to get an understanding of the layout of the mine and potential hazards before entry.

## Environmental Compliance

In addition to the goal of Zero Harm to people, authorities demand that mining operations cause minimal harm to the environment. The ability for a mining company to adequately demonstrate its rehabilitation activities throughout the life of the mine (and following mine closure) is essential for compliance purposes. Depicting a rehabilitation plan in a realistic, Virtual model is an effective approach to describe to authorities what the expected outcomes of a rehabilitation plan will be.

Details for scenarios [‘Disaster Planning – What if?’ and ‘Equipment Monitoring in Real-time’] are available as case studies at:

[www.aamgroup.com/industry-solutions/mining.cfm](http://www.aamgroup.com/industry-solutions/mining.cfm)

**The primary benefit of creating a “Virtual Mine site” with K2Vi is that it provides an excellent communication and decision making tool.** The virtual model allows technical and non-technical people alike to understand potentially complex problems and concepts within a familiar environment, and not just from the same perspective, but from any perspective!

Visit [www.aamgroup.com/mining](http://www.aamgroup.com/mining) for the link to our ‘Virtual Mine’ YouTube video.

