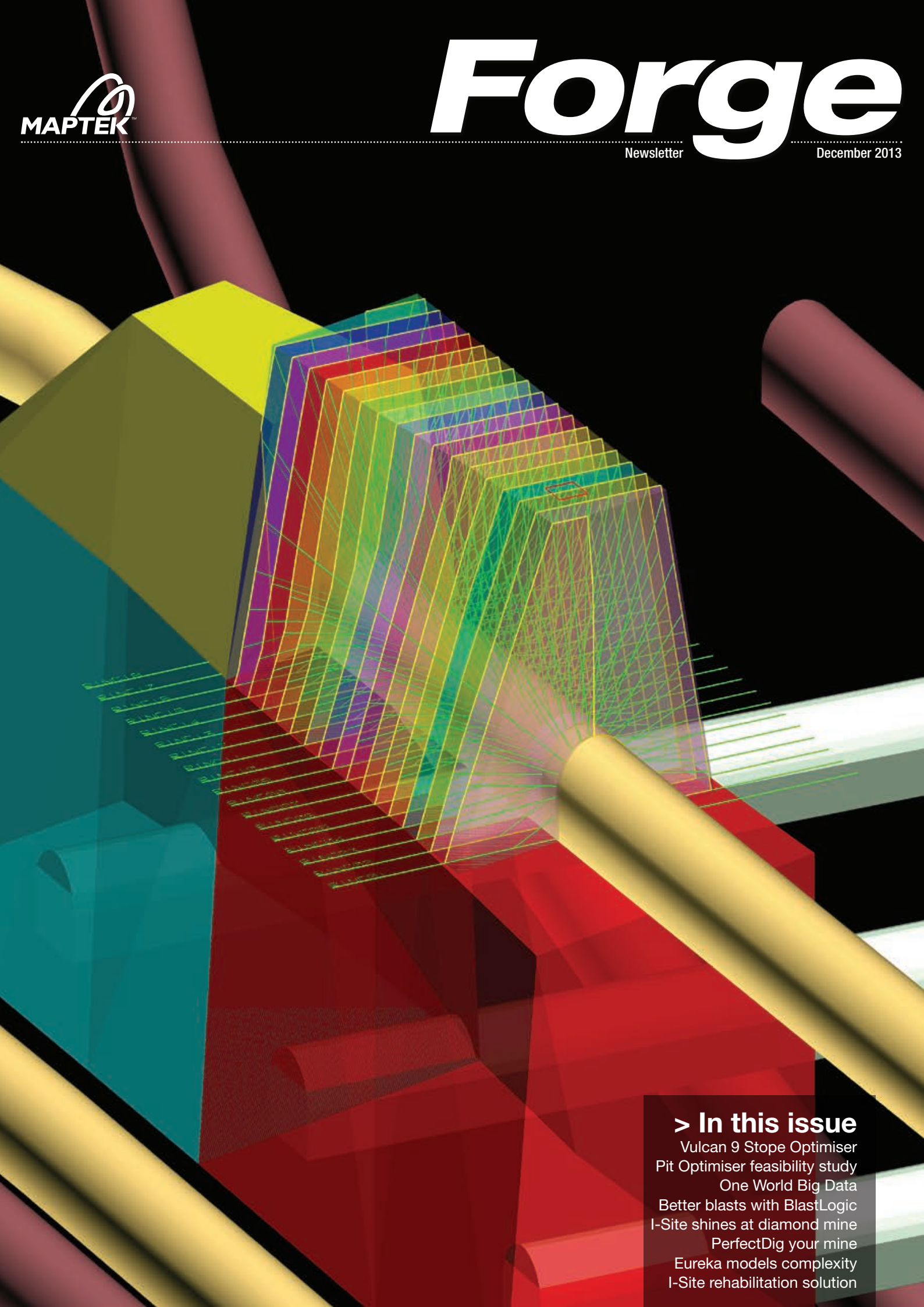




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Pit Optimiser feasibility study
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Better blasts with BlastLogic
I-Site shines at diamond mine
PerfectDig your mine
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I-Site rehabilitation solution

Forge

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Want more?

 More information available online

 Video

 Detailed article

 Photo gallery



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In this issue

During 2013 Maptek has made solid investment into products and services that add value to miners. New functionality and upgrades to existing software architecture result in exciting technology that unlocks the value in spatial data.

Vulcan 9 has entered a new phase as the most flexible and powerful technology partner for mining. I-Site R&D continues to focus on improvements to survey workflow and functionality. PerfectDig provides field-ready conformance data of digging against designs, and BlastLogic delivers a measurable increase in drill and blast productivity.

At the close of the Australian users conference and looking ahead to the South American event, Maptek CEO Barry Henderson emphasised the significance of connections with our customers.

'Users conferences are important venues for hearing directly from customers. This is just one way to tell us what you need, and I encourage everyone to talk to our technical services staff. The more feedback we receive from you, the better we can make our products.'

In November, we were saddened to hear of the death of Peter Manning, a valued supporter of Maptek for many years. Southern Geologic NZ has been a well-respected consultant in the coal industry, and Peter will be missed.

We wish you the best for the holiday season. Contributions are welcome for the March 2014 issue of Forge. Contact forge@maptek.com



Vulcan 9 released soon

Customers can see the benefits of Vulcan 9 at roadshows, regional forums and online.

Available from December, Vulcan 9 will provide a significant boost in processing power. Users will benefit from new tools to improve modelling and mine design.

Implicit Modelling - Combine implicit modelling with existing Vulcan tools to rapidly generate accurate geological models.

Object Attributes - Access unlimited information about objects on demand for faster reserving and design.

Stope Optimiser - Dynamic 3D approach to a 3D problem. Save time on manual stope generation.

Locally Varying Anisotropy (LVA) - Apply LVA to improve results when modelling complex stratiform orebodies.

Users will experience immediate productivity gains when running Vulcan 9, particularly when working with large data.

Customers can see Vulcan 9 at dedicated networking events.

December 3 - Reno, Nevada

December 4 - Mexico City, Mexico

December 5 - Elko, Nevada

December 10 - Perth, Western Australia

December 11 - Saskatoon, Canada

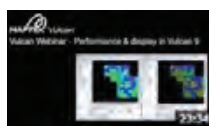
December 12 - Vancouver, Canada

Our 2014 tradeshow calendar on the back page shows where you can see Vulcan 9 live.

You can also watch videos and webinars highlighting tools and benefits of Vulcan 9 at www.youtube.com/user/MaptekVideo



Vulcan 9 webinar
What's new



Vulcan 9 webinar
Performance & display



Underground design
in Vulcan 9



APCOM 2013

As gold sponsor of APCOM, Maptek recognises the importance of the international event for sharing ideas and learning for geostatistics, mine planning and optimisation.

The 36th session of APCOM, which focuses on applications of computer and operations research in mining, was held in Porto Alegre, Brazil in early November.

Maptek presented papers in the Production Planning stream, covering the simulation of fleet dynamics and congestion analysis, quality management principles for blast processes, and techniques for extra large datasets for mineral exploration.

'Participating in an event like APCOM is valuable to Maptek because it provides a showcase for the latest innovations in the mining industry and a chance to discuss new ideas and emerging trends,' said Marcelo Arancibia, Vice President of Maptek South America.

'As a long-time attendee, I enjoy witnessing the next generation of mining professionals challenging well established paradigms and pushing the boundaries of what is possible.'





Vulcan training in Senegal

Maptek Technical Services staff from Edinburgh office recently conducted Vulcan training for geologists at Teranga Gold's Sabodala Mine in Senegal, West Africa.

Following a basic grounding in Vulcan, 10 of the geologists at the mine learnt techniques for applying the latest geological and block modelling tools.



Vulcan training in India

Maptek provided Vulcan training to the open cast and geological divisions of Central Mine Planning and Design Institute in their offices in Ranchi, India during September.

This company manages all the geological modelling and mine planning for Coal India Ltd, the largest coal producer. Additional training is being provided in late November to the underground mining and exploration divisions.

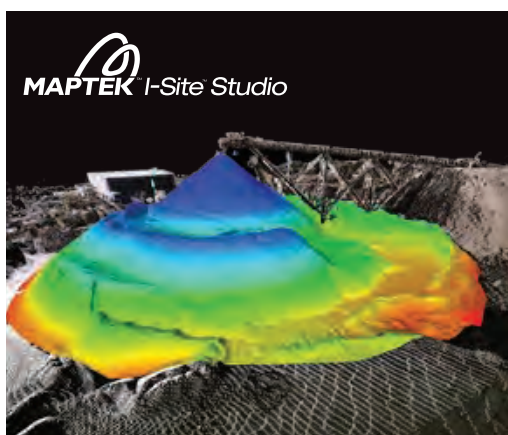
Vulcan student recognised

Maptek's commitment to education continues with Mining Education Australia (MEA) incorporating Vulcan as a standard component of the curriculum for mining engineering students.

Maptek donates Vulcan licences and time with technical services personnel to provide students with a solid foundation in Vulcan software before entering the workforce.

At the recent national awards ceremony, Curtin University graduate Mark Ren took third prize. Mark used Vulcan to impress the judges with his project, 'Using clustering methods for block aggregation in open pit mine planning'.

MEA is a joint venture between Curtin University, The University of New South Wales, The University of Queensland and The University of Adelaide.



Webinars

Join Maptek experts for webinars on subjects ranging from product overviews to specific tools and applications.

Don't forget – if you are unable to participate in the live event you can view the recording later from our website.

January 16 - Vulcan Geostatistics Tools

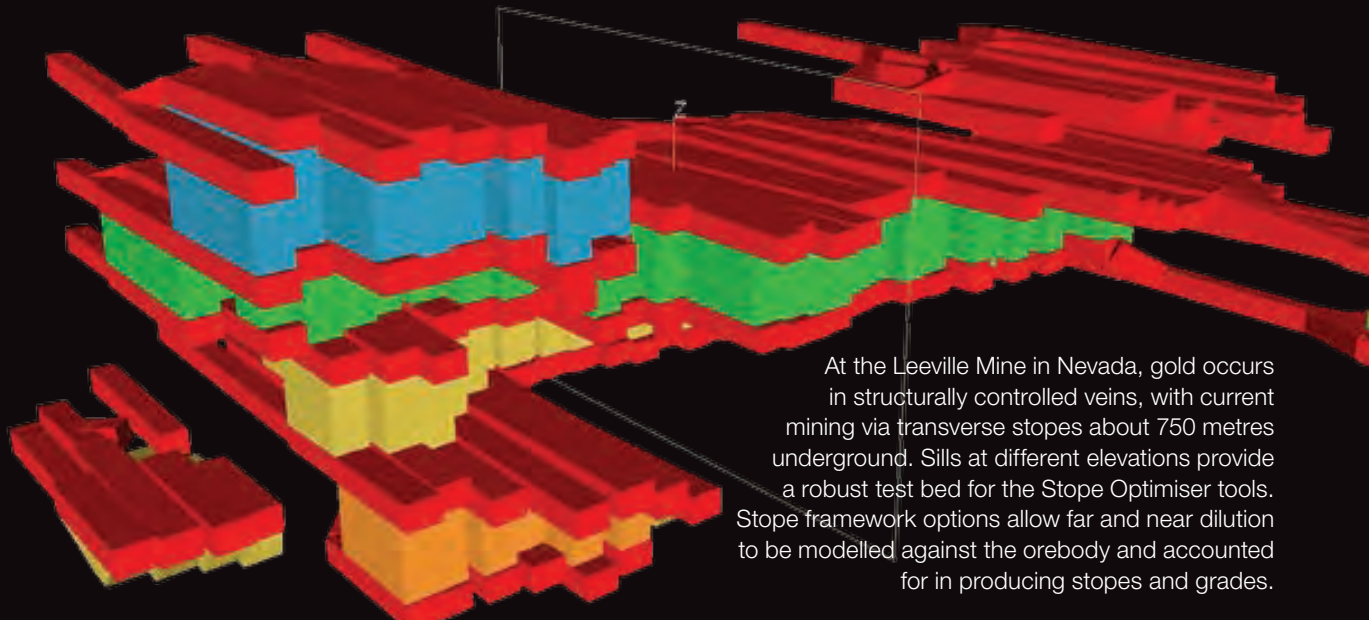
February 20 - New Tools in I-Site Studio 5, Tips & Techniques

March 20 - Vulcan Plotting Tips and Tricks

April 17 - PerfectDig Your Mine

May 15 - Vulcan Training - Advanced Triangulations

Register for and view webinars at www.maptek.com/webinars/



At the Leeville Mine in Nevada, gold occurs in structurally controlled veins, with current mining via transverse stopes about 750 metres underground. Sills at different elevations provide a robust test bed for the Stope Optimiser tools. Stope framework options allow far and near dilution to be modelled against the orebody and accounted for in producing stopes and grades.

Stope Optimiser generates value

Maptek™ Vulcan™ 9 includes significant Stope Optimiser enhancements, streamlining strategic and tactical applications for short and medium term planning.



Stope Optimiser in Vulcan 9 allows users to generate a stope design delivering expected ore grade. The tools target productivity for different mining methods.

Vulcan 9 features stope output saved directly as triangulation attributes, giving immediate, right-click access to data. Colouring data by attribute produces easy to understand results. Hovering over triangulations displays the results as a datatip.

The new Prism method joins Slice and Fixed methods in an enhanced stope generation toolbox. The optimisation floats in the orebody without being constrained by levels.

In Vulcan 9 Stope Optimiser will take level drift centre lines at any orientation in an orebody. Strings that match drainage or access routes can also be used as bounding factors.

Flexible options

Vulcan 9 introduces greater flexibility in stope layout, which is ideal for stratigraphic and horizontal deposits. Strips and blocks can be used to guide mining; variable strip and block sizes and orientation are allowed. Sub-stoping allows primary and secondary drive and pillar shapes to be defined.

Stope Optimiser accounts for geological structures that can cause overbreak into a stope. An annealed stope shape within a nominated distance of the modelled wireframe snaps to the surface.

Stope Optimiser will evaluate whether an expanded stope should be accepted in preference to a minimum offset from the structural surface voids.

Users can choose 3 reserve evaluation modes. Fast (model and stope shape framework are orthogonal) and slow (model and stope shape framework have a rotation offset) typically report more metal/value. They are 5-10 times faster than precise mode (traditional mine planning method) but are less sensitive to sub-cell approximation.

Processing & reporting

New rules allow stopes to be split on a grid, centred, or at a distance from hanging wall or footwall. Stopes can be smoothed to eliminate gaps and sub-stope corners can be adjusted. Stope shapes can be re-labelled based on grid or strike length.

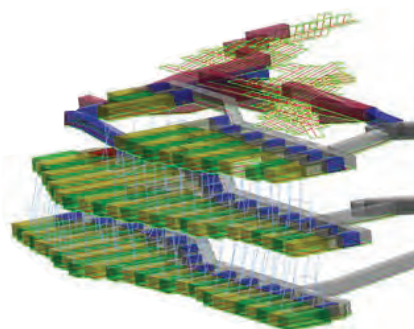
Expanded design options allow flexing of spacing, location and offset, over multiple zones. Sorted results guide designs; all or the best design can be output.

Stope Optimiser provides a dynamic 3D approach to a 3D problem. It saves time on manual stope generation, improving confidence in results.

Filters can be applied to the processing of the stope shapes, allowing block model variables to constrain the shapes. Naming options include coordinates, levels and reference lines. Reporting includes separate options for undiluted, diluted and dilution volumes.

Vulcan 9 Stope Optimiser provides underground designs that take into account all realisations, generating the best stope at the selected confidence.

*Thanks to Chris Alford, Alford Mining Systems
Extract from paper presented by
Robert Slade at Maptek Users
Conference, Brisbane, 2013*



Head and cutoff grade options allow dynamic choice between bulk and selective mining to achieve the average grade required

Pit Optimiser adds the third dimension

Maptek™ Vulcan™ Pit Optimiser was the ideal solution for assessing the economic value for a coal project and providing the basis for detailed design and scheduling work.



When MEC Mining was asked to complete a feasibility study for a steeply dipping resource in a complex metallurgical coal project, Vulcan Pit Optimiser provided the solution.

The deposit contained 5 seam groups, 3 major overthrust faults and shears, and normal faults in a single pit. Information supplied included a block model, economic assumptions and a geotechnical assessment. Margin rankings provided some clarity on basal seam and economics.

The primary goals were to define the location of the final highwall, low wall and basal seam. In this instance of multiple occurrences of single overlapping seams, Pit Optimiser provided a 'shortcut' to the basal seam. Running advanced reserves in Vulcan validated the volumes and the final block model.

Assigning variables

Variables for cost and revenue were assigned in the block model, including volume of coal recovered after mining losses, and mining coal to ROM, product tonnes, processing and rail costs.

A variable was created for each price point before haul roads were digitised, to derive a waste cost per block, a critical requirement when mining waste at depth.

Six price thresholds were set and profit was assigned to each block. Vulcan Pit Optimiser was run on a 30 x 30 x 5 metre block size.

By flagging the variable 'Pit', grade shells could be run to generate a shell for each price increment to guide staging for early mining and final shell extents.

Mining stages were designed based on the Vulcan Pit Optimiser shell sequence which delivers optimum NPV.

Pit Optimiser delivers superior results to margin ranking by adding the third dimension. With outputs provided as images, the tool promotes instant acceptance and confidence in the results.

Better coal recovery

In this project Pit Optimiser showed the low wall changing dynamically between seams as mining moved along strike. Duplicates which might not

otherwise have been recovered using margin ranking were included in the optimisation.

Following the staged mining shells, MEC incorporated haulage and in-pit dumping considerations into the sequence to ensure the most profitable coal recovery.

Tips & tricks

Trimming the block model to remove blocks outside the pit shell cut run time from 1.5 hours to 10 minutes.

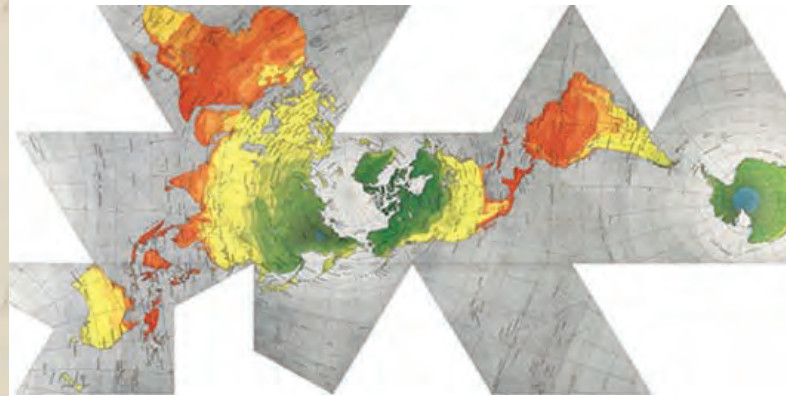
Pit Optimiser setup panels allow users to enter and calculate economic value. Alternatively the economic value can be assigned through block model variables, as was the case in this project.

Vulcan Pit Optimiser provided the sequence of resource development, final highwall location, basal seam and coal recovery strategy around major faults. This allowed MEC Mining to deliver accurate mining plans quickly and within budget.

*Thanks to Ted Boulton, MEC Mining
Extract from paper presented at Maptek
Users Conference, Brisbane, 2013*

One World. Big Data.

LiDAR and imaging technologies capture the natural and built environments in unique ways. 3D spatial visualisation provides a reality mirror for confident decision making.



A history lesson

In the early 1940s, 2 photographs were published which for the first time brought viewers to a single point above Earth to see all of the continents.

One World, One War (left) depicted the rapidly growing conflict of World War II, while the *Fuller Projection Map* (right) is the only flat map of the entire surface of the Earth which reveals our planet as one island in one ocean.

Buckminster Fuller intended his projection map to be unfolded in different ways to emphasise different aspects of the world. In the late 1960s, Fuller was particularly involved in creating World Game®. This large-scale simulation aimed to help humanity better understand and benefit from the world's resources.

Fuller's World Game was to be played inside the Geoscope, an immersive environment for Earth information. The Geoscope was a tool for a more mature technological time, offering experiential opportunities to discover vast amounts of information in geospatial context.

Fuller's Geoscope was predictive as the first interactive geo-environment that would take advantage of the computing power that is available to us now.

The now

Spatial disciplines 'mirror' our physical world in its digital counterpart. Innovations in 3D printing, numerical control and self-assembly robotics enable the realisation of digital 'bit based' models. 3D printers can fabricate increasingly complex artefacts from human organs to tall buildings to coral reefs.

This interplay between the physical and digital worlds creates an arena in which innovation can take place, and opens exciting opportunities for developing new knowledge economies.

The spatial industry dramatically reshapes the way we view infrastructure and asset management. Imagery, point cloud and survey data collated from the natural and built environment are structured into models, which can be augmented by precision data of the physical world.

The result is rich, full lifecycle models offering a multiplicity of applications and facilitating high level collaboration between stakeholders.

The multi-dimensional data modelled and tested can be visualised so that we can make best use of it in specific tasks such as simulating floods or seismic risk.

The future

Visualisation of rich data can be delivered through many metaphors - animated 3D scenarios, info-graphics, reports or logic diagrams. These must be fit for purpose. For example, a map of the London Underground is better for catching a train than an interactive 3D model of the city.

Super computer clusters and cloud computing will service the increasingly complex models and massive demands for data storage, computation and visualisation. As the spatial industry matures, greater diversity will continue to drive innovation and opportunity.

Thanks to Richard Simpson, Spatial Industries Business Association (Queensland)

Extract from Keynote Address to Maptek Users Conference, Brisbane, 2013

Vast amounts of data are collected during the process of exploring for minerals, developing a resource model and mine plan, conducting feasibility and approval studies, and constructing, commissioning and operating a mine. The challenge is to recognise where the value lies in this body of data and take advantage of the convergence of computing, global communication, visualisation and simulation tools to develop systems to apply it profitably.



Invest in Yourself

at the 2013 Maptek Users Conference



'The strat modelling workshop with Peter Odins was great. It was exactly what I was looking to get out of the conference.'



'The technical presentations and workshops provided a wealth of information, most of which I can use in the very short term.'



Maptek staff and customers met for 3 days of product demonstrations and networking in Brisbane recently. The technical program included case studies, presentations and workshops on the latest Maptek technology.

Customer presentations covered applications of Vulcan, I-Site and BlastLogic for improving productivity. Maptek displayed the latest tools available in Eureka exploration software, and explained how PerfectDig compares designs with as-builts in the field.

Vulcan 9 talks highlighted what users can expect from implicit modelling, stope optimisation, underground ring design, stratigraphic modelling and performance enhancements.

Users received a preview of tools under development and participated in a feedback forum to close the event.

Maptek was saddened to hear of the recent death of Peter Manning. Peter was a valued contributor to Maptek users conferences for many years.





'Great cross-section of input that broadened my knowledge of different mining processes and features of Maptek software.'

'There are some remarkable developments happening now, or about to happen. The 3D scanner technology and applications are magical.'



Blasting with accuracy and confidence

Maptek™ BlastLogic™ targets productivity at surface mines by delivering immediate access to all operational drill and blast data for analysis.



Wesfarmers Curragh Mine introduced BlastLogic in 2012 to optimise drilling contract resources, providing improved collation and assessment of as-drilled data, a single reference for all drill and blast data, and increased accuracy for charge placement.

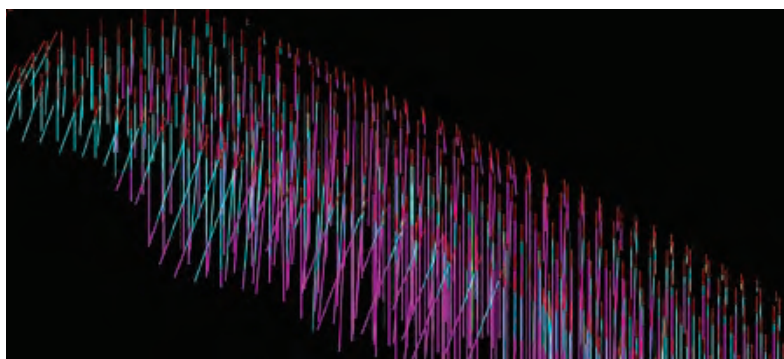
The mine covers approximately 12,600 hectares in Queensland's Bowen Basin, producing around 8.5 mtpa metallurgical coal for export and 3 mtpa steaming coal for domestic consumption.

Significant faulting and 4 seams ranging from 1.8 to 6.5 metres thick pose challenges for coal recovery. Drill and blast breaks more than 100 million cubic metres of burden every year.

BlastLogic provided the key to accurate drill and blast for maximising productivity and minimising coal loss.

Creating a single source of data realised immediate benefits. Increased accuracy of charge placement and separation of holes allowed Curragh to get optimum value from its drilling contracts.

Correct hole placement and separation is vital for improving wall control. Daily collar accuracy reports help Curragh easily identify holes drilled outside of specification before equipment leaves the area.



Modelled surfaces allow export of coal holes for updating charge depths, mine designs and burden volumes for scheduling

Reviewing drillhole depth against modelled surfaces in 3D streamlines assessment and identification of redrills.

BlastLogic field tablets save more than 20 hours a week in dip data entry. Updating drill patterns and charge rules on-the-fly keeps the blast crew up to date with variations to the plan.

BlastLogic allows Curragh to optimise explosive products used by reviewing historical data for hole conditions and blast performance. Topography, coal surfaces and videos can be attached to reports.

Curragh now experiences greater consistency across drilling and can monitor daily progress.

Curragh can proactively manage hard dig operations, quickly identify areas of concern and address equipment wear and tear or material loading issues before they become critical.

In addition, accurate data helps protect the coal hard cap and toe.

‘With Maptek help on site and support from management we’ve been able to confidently roll out BlastLogic. It is now an integral part of our drill and blast process.’

Near term goals include tighter conformance of the design-implementation-reconciliation process. Taking advantage of the new BlastLogic interval loading tools will help Curragh evaluate and manage through-seam vibration and other sensitive blasts, as well as create an accurate geological database.

‘Access to accurate drilling data provides confidence that the blast design meets desired outcomes.’

Looking ahead, Curragh anticipates that options such as the tie-up tool will provide further improvements for modelling blasts and managing consumables.

*Thanks to Peter Rodrigues
Wesfarmers Curragh*

*Extract from paper presented at Maptek
Users Conference, Brisbane, 2013*

I-Site shines on diamond mine

The Maptek™ I-Site™ 8800 laser scanning system helps De Beers track and manage pit surfaces, ore stockpiles and waste dumps at the Venetia Mine in South Africa.



In 2006 the De Beers survey team began using I-Site laser scanning to survey the pit and stockpiles, upgrading to the I-Site 8800 laser scanner in 2012. The longer range scanner surveyed the pit more efficiently, and handled the large stockpiles with ease.

De Beers Venetia Mine, in Limpopo Province, is close to the border of Botswana and Zimbabwe. The mine opened in 1992 and produces about 3 million carats per year, making it the leading diamond producer in South Africa.

Challenges

With a pit measuring more than 2100 m x 1300 m and still expanding, there is a continual problem with overspill material falling from the top benches onto ramps and benches below.

This needs to be measured for month end reconciliation, which could not be achieved accurately or safely before I-Site technology was introduced.

Rehabilitation on waste dumps is an integral part of the Venetia operation. Despite their vast area of 6.7 million square metres, the dumps are easily measured with the long range scanner. Plans can continually be updated to track progress.

Solution

I-Site Studio™ software is used to create a pit surface for month end production calculations.

Toes and crests, and contours from this surface are applied to generate various plans for different departments.

The pit surface is important for identifying the amount of waste and ore mined. This is measured by making the waste and ore block models part of the overall volume calculations.

I-Site Studio is used to model Venetia's 9 ore stockpiles and generate volumes in the order of 7.1 million cubic metres.

Benefits

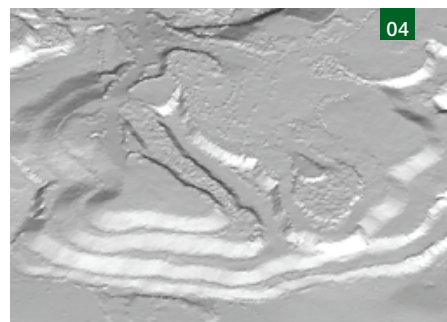
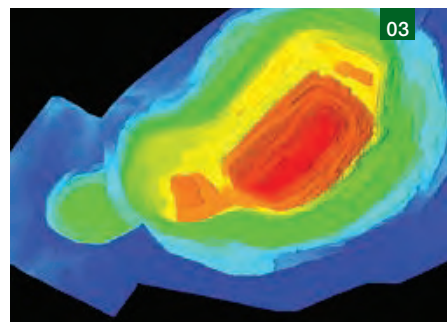
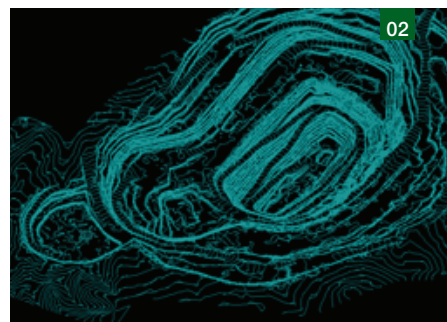
Previously, surveyors had to enter every loading area to record material being loaded. The long range scanner requires far fewer setups, which saves time and minimises safety issues.

Measuring the rehabilitated waste dumps with a GPS or Total Station typically took 1 day. This was cut to 3 hours with the I-Site 8800 long range scanner, with fewer setups reducing the physical effort as well.

'One of the biggest advantages of the Maptek I-Site 8800 laser scanner is the integrated telescope, making orientation and registration of the data seamless.'

'I-Site Studio is easy to use - especially for combining surfaces, which can be very difficult in other software.'

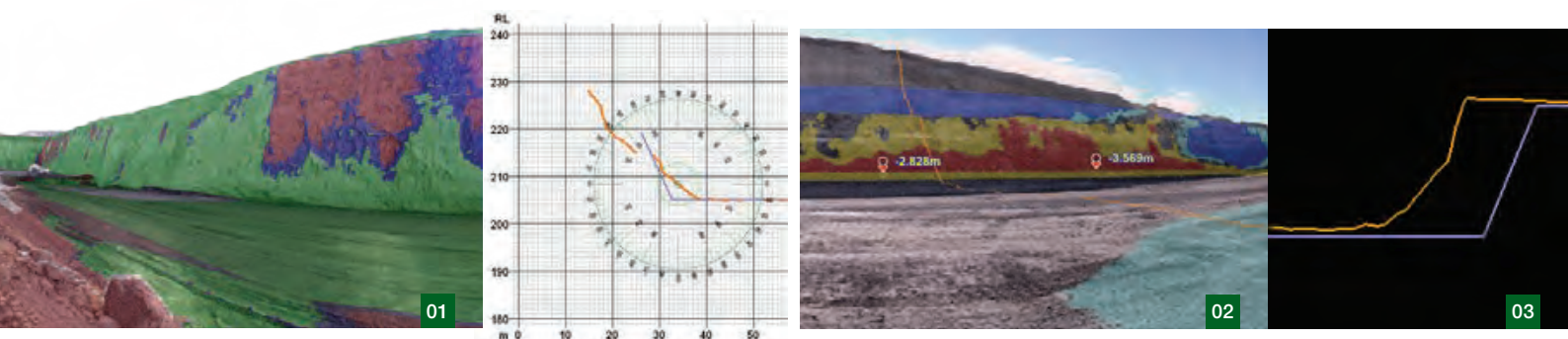
*Thanks to Gerhard Smith
Mine Surveyor, Venetia Mine*



- 01 Overspill material is measured for EOM
- 02 Contour maps are handed off to planning
- 03 Pit model provides accurate surfaces
- 04 Scanned surfaces help monitor waste dumps

PerfectDig your mine

Maptek™ PerfectDig provides a true 3D, non-topographic comparison of as-built surfaces against design for improving drill & blast, contract management and site practices.



Improve drill & blast

PerfectDig allows stakeholders to assess blast results and adjust patterns for future activity.

Comparing overhang structures and identifying patterns improves blasts. Viewing the results of a pre-split blast which resulted in remaining material (*image 1*), highlights issues such as poor fragmentation, over pressure or face bursts.

Measures to avoid these factors can be taken into account in the next drill pattern design.

Result: Better understanding of blast results to improve blast patterns.

When overburden remains after a blast, there is potential for poor fragmentation, casting and vibration. Poor performance impacts downstream processes such as chopping the wall, and increases the wear on equipment excavating to specification.

Result: Cost effective use of equipment, fewer repairs and reduced downtime.

Manage contracts

For bulk handling contracts, all stakeholders should clearly understand requirements and deliver accordingly.

By tracking excavation progress, PerfectDig gives early indications for design conformance (*image 2*).

Results are available in less than 10 minutes, reducing excavation downtime. The traditional process takes 2-3 hours.

Survey pegs are still needed to identify the starting point for batters. PerfectDig provides feedback for maintaining correct position along the entire wall to better guide contractors.

There is no need for surveyors to return after excavation, replace pegs and assess whether the correct batter has been achieved.

Working several areas a day, PerfectDig saves 1315 hours a year - a \$74,250 labour expense.

Result: Contracts can be managed in near real time. Save \$74,250 on labour.

Avoid bad practices

Rapid feedback ensures batters meet design, avoiding loss of commodity and perpetuation of bad practices.

This batter (*image 3*) has not met design, with potential for propagating errors to subsequent levels, resulting in loss of commodity. If the batter is not checked until after excavation machinery leaves the area, productivity is lowered.

The block model has an average material density of 2.0, yielding 3.5 g/t gold. The difference in volume between the design and as-built is 938 cubic metres.

$$\begin{aligned} 938 \times 2.0 \times 3.5 \times 0.03215 \\ = 211 \text{ oz of gold @ } \$1300/\text{oz} \\ = \$274,300 \text{ LOST} \end{aligned}$$

Conveying critical design conformance information before machinery is moved out improves profitability.

Result: Avoid potential loss of income of \$274,300.

Timely contract management
1315 hours

Early detection
\$74,250

Avoid loss of commodity
938 m³

Early detection
\$274,300

Eureka unravels complex structures

Maptek™ Eureka™ provides drillhole and seismic tools within an integrated platform for viewing and modelling exploration data. New modelling tools will be released soon.



Eureka uses the Radial Basis Function (RBF) methodology as a tool for understanding structurally complex deposits. RBF is a form of implicit modelling.

Input data

Design strings, points, ribbons, drillholes, triangulations and scans - and any combination of these - can be used as input for the modelling process.

A surface is created from the input data; the constituent points form on the surface. For drilling data, Eureka creates a surface from drillhole points matching assay values or formation codes.

Drillhole data

Image 1 shows a surface representing high grade layers within a banded iron formation. The Maptek Vulcan™ ISIS database was accessed by Eureka. The surface was generated from iron assay values exceeding 60% Fe.

A slice shows the iron assays contained within the surface (*image 2*). Values on the drillholes of 60% or greater are displayed as orange; less than 60% are grey.

Using ribbons

Interpretation ribbons can now be used for better control of the resultant model.

Ribbons can be used like strings or points to add data points, but they differ from strings in that they have 2 sides. This is represented by double-sided colouring (*image 3*).

Ribbons may also be used individually to create surfaces from complex and overturned strings. The surface obeys the direction of the ribbon, with the inside of the surface matching one side of the ribbon and the outside matching the other.

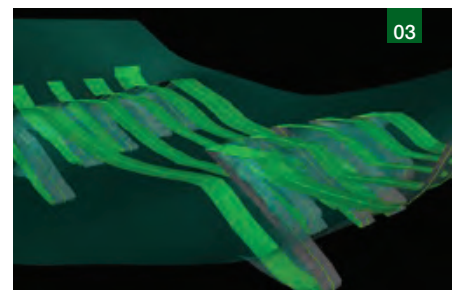
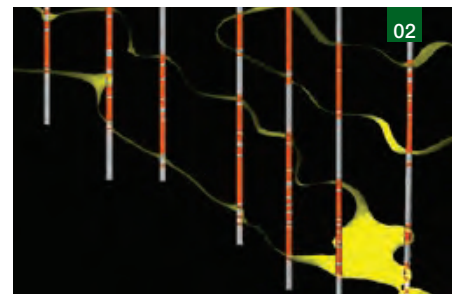
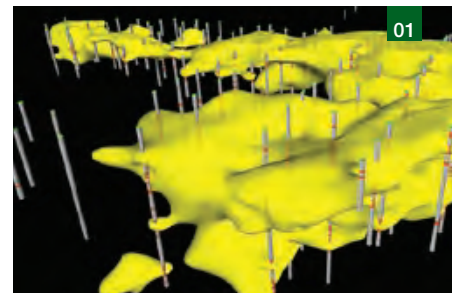
Anisotropy & ellipsoids

Ellipsoids influence the model by deforming the space in which the sample points sit. The model then becomes stretched or contracted in the directions of the ellipsoid.

The size of the ellipsoid has no influence; the ratios between the directions of the ellipsoid, as indicated by the coloured bands, control the orientation, as well as the ratio between different axes in the ellipsoid (*image 4*).

Ellipsoids are particularly useful for modelling steeply dipping deposits, as they direct the surface generation along the trend of the deposit. Multiple ellipsoids can be used in combination to honour local structural trends.

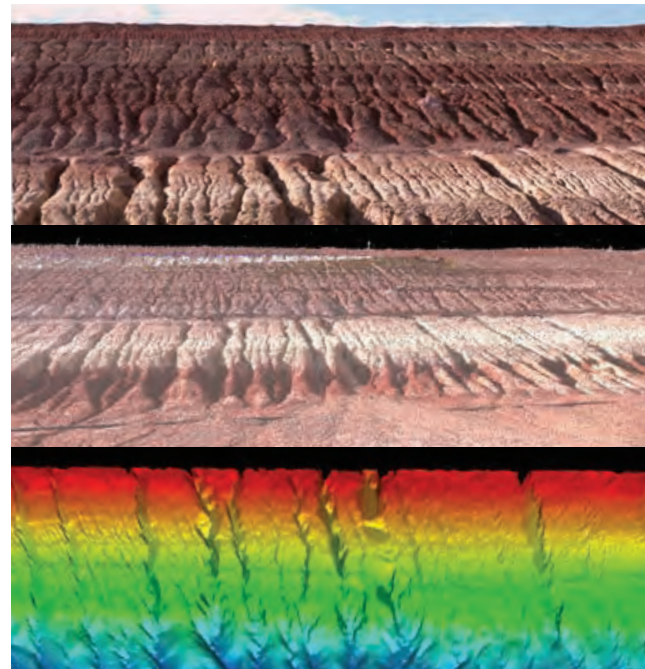
Borehole graphics, seismic and implicit modelling modules can be added to a base Eureka licence. For further information, email eureka.sales@maptek.com.au



- 01 Model of high grade layers within a banded iron formation
- 02 Iron assays within the surface
- 03 Ribbons are ideal for creating surfaces in complex and overturned deposits
- 04 Ellipsoids control surface trends in a deposit

I-Site solution gains regulatory approval

Maptek™ I-Site™ has provided a solution for monitoring landforms and vegetation that is gaining acceptance from authorities signing off on mine closure plans.



Quantitative assessment of rehabilitation performance is one of the most critical aspects in mine closure and obtaining sign-off and relinquishment from regulatory authorities.

To gain final approvals, post-mine landforms must be safe, stable and sustainable. Current rehabilitation techniques do not provide quantitative monitoring data for stability and landform evolution, making it difficult for regulators to approve mine closure plans.

Soilwater Group, based in Perth, Western Australia, has implemented a new rehabilitation monitoring approach using the I-Site™ 8800 laser scanner and I-Site Studio™ software. Rapidity and ease of use was a major consideration in implementing I-Site technology.

The new approach involves detailed landform surveys that can be used for auditing post-built

landforms; identifying problematic and unstable rehabilitation; quantifying erosional features; determining fill rates of surface water management features; and measuring and monitoring floristic parameters over time.

Traditional techniques involve onerous and costly data capture at isolated points or transects across the post-mine surface. In comparison, laser scanning with I-Site allows users to rapidly visualise, measure and process data over larger areas than previously physically possible.

Through I-Site technology, Soilwater is able to pinpoint the erosional and rehabilitation processes occurring within a mine site over time.

This improved understanding enables the regulators to more rapidly evaluate rehabilitation performance and function so

that critical decisions regarding the longevity and closure of a site can be made.

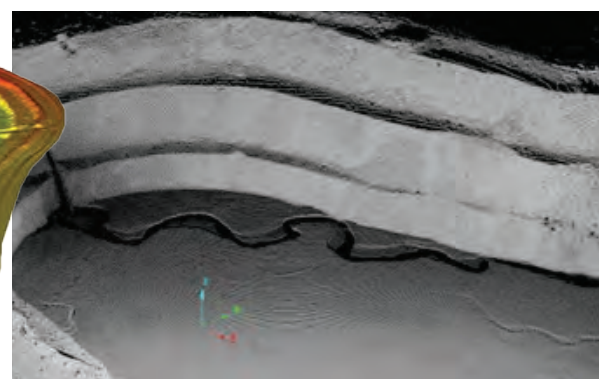
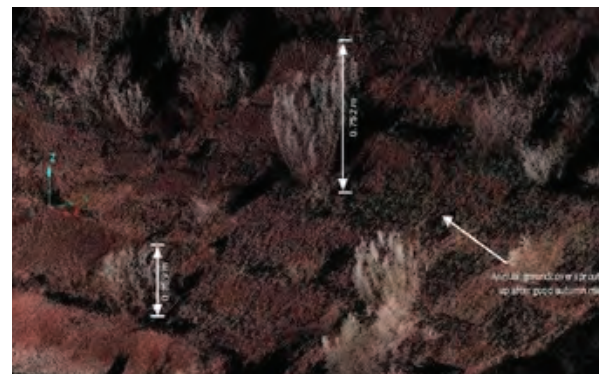
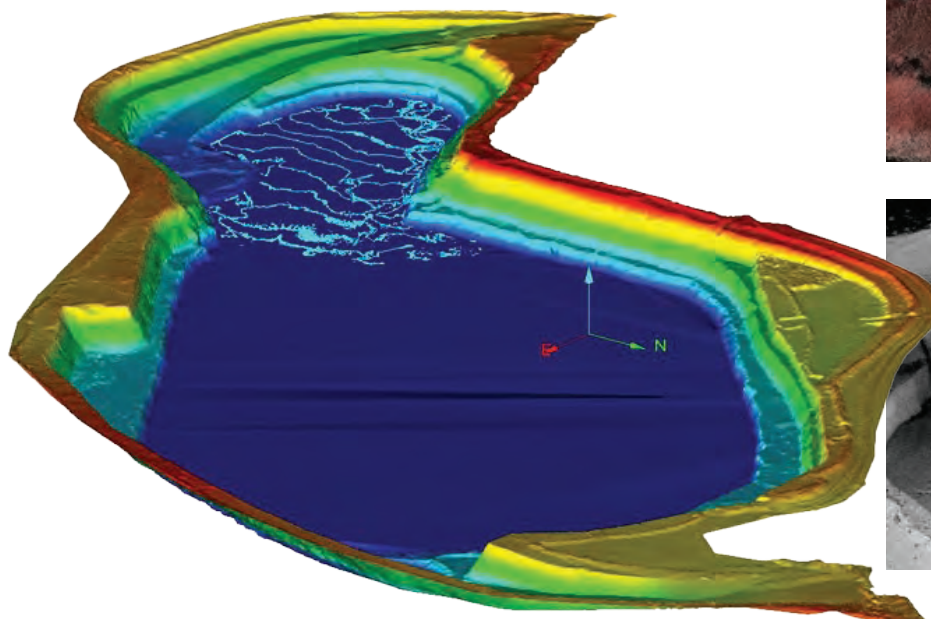
Soil matters

Australia's arid climate means that stability is the most critical aspect influencing rehabilitation success and overall closure of a mine site, as rainfall runoff is exacerbated by dry soils and low vegetation cover.

In the early years of rehabilitation accurate, quantitative measurement and monitoring is therefore critical. Surface erosion carries away seed of revegetation species (limiting revegetation potential); fills surface drainage features (decreasing overall structural stability of post-mine landforms); and results in unwanted sediment loss.

I-Site technology makes measuring and monitoring of these surface processes easy and routine, which is ideal for rehabilitation and closure.

I-Site technology enabled Soilwater to model a previously unattainable surface for an in-pit tailings dam. By scanning the release point from a remote stand-off, Soilwater was able to create a Digital Elevation Model with 1 cm contours, providing evidence of the size of the beaching effect for monitoring.



I-Site allows slope shape, angle, length and setback to be compared to the rehabilitation design. Surface soil parameters such as the percentile of rock and exposed soil can be quantified, and surface erosion and deposition monitored.

Overlaying photographic imagery on the point cloud proved invaluable for differentiating between ground and vegetation in complex areas.

When filtering unwanted parameters, tiling different windows in I-Site Studio makes it easy to distinguish between soil, rocks and vegetation. High resolution Digital Elevation Models (DEM) can be constructed showing all landform features.

The volume of any or all rills and gullies can be precisely determined to quantify erosion and filling rates of water management structures.

Comparing surfaces year on year using the *Colour by distance* option in I-Site Studio allows the rate of erosion and deposition to be measured to millimetre accuracy.

Measuring erosion depth and volume of soil lost without having to walk the surface is a huge advantage. Scans can be taken year after year without interfering with natural processes. Generating volumes for comparing the current landform to the as-built removes guesswork, and is easy to replicate over a large area.

Plant cover

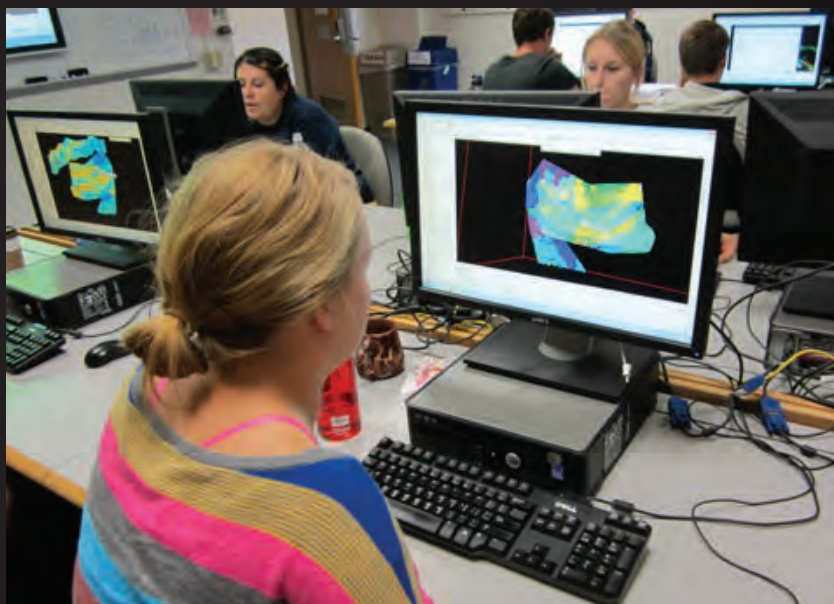
I-Site point cloud data allows Soilwater to estimate plant height and growth rates, foliage cover and plant density. These parameters are critical for successful rehabilitation of post-mine landforms, particularly in stabilising surface soils, and are often used as completion criteria to assess performance.

Floristic parameters are generally measured and monitored using a quadrant or point/line transect approach, and are expressed per unit area. Given that a high resolution I-Site scan acquires more than 1000 points per square metre, the resulting point cloud can be used to identify the majority of emerging and establishing species.

Accurate data

Large amounts of quantitative data allow Soilwater to more accurately plan rehabilitation and closure activities. This data can also be used to audit all rehabilitation and mine closure earthworks to ensure conformance to design. Scans of general mine site areas can determine volumes of soil materials that can be directly input into cost estimation software to accurately determine mine closure costs.

*Thanks to Celine Mangan, Soilwater Group
Extract from paper presented at Maptek Users Conference, Brisbane, 2013*



Vulcan training for economic geology students at the University of Wisconsin - Eau Claire

Maptek Calendar

January 27-28

AME BC Roundup
Vancouver, BC, Canada

February 3-6

African Mining Indaba
Cape Town, South Africa

February 9-12

International Society of Explosives Engineers
Denver, Colorado, USA

February 23-26

SME
Salt Lake City, Utah, USA

March 2-5

PDAC International Convention
Toronto, ON, Canada

April 2-4

X Conferencia Internacional de Minería
Chihuahua, México - Booth 198

May 11-14

CIM Convention & Exhibition
Vancouver, BC, Canada

June 5-6

Elko Mining Show
Elko, Nevada, USA

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