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Cover photo:
Burrow Road EA Tunnel — Courtesy of Abergeldie Coomplex Infrastructure

Australasian Tunnelling Society is sponsored by Engineers Australia and the Australasian Institute of Mining and Metallurgy.

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Chairmans Report

The Society continues to provide a regular and varied series of technical sessions in our state groups. It is encouraging to see senior representatives from the major players in the tunnelling industry happy to share their time and expertise with our membership.

This has been a quiet year for other activities as we have been basking in the success of our last National Conference held in Melbourne and our last Tunnelling Short Course held in Sydney, both of which give us the confidence to undertake similar events in the future.

Our 14th National Conference "Development of Underground Space" is to be held over 8 — 9 March 2011, Sky City, Auckland, New Zealand and plans are well under way for this. There are some exciting new tunnelling projects on the drawing boards for New Zealand so we are confident that there will be plenty to talk about and to attract delegates from both sides of the ditch.

Activity in Australia has been largely limited to Brisbane with the major Airport Link project underway, the Clem7 finished and operating and the Northern Link in the tendering process as I write. Melbourne has the Northern Sewerage project, Auckland the Victoria Park Tunnel and Adelaide it's Desalination Plant. Sydney on the other hand is quiet with the State Government constantly changing its mind on major infrastructure projects. The cancellation of the Sydney Metro which had us all excited was especially galling.

"The History of Australian Tunnelling" an ATS publication edited by David Lees was released this year and has been selling surely. This is the second ATS publication the first being *"The history of the development of predictions for hard rock tunnelling machines"* compiled by David Sugden AO.

A number of ATS members attended the World Tunnelling Congress (WTC) in Vancouver where we had a most impressive stand promoting Sydney as the venue for the 2014 WTC. The stand was sponsored and manned by Business Events Sydney who is giving us excellent support. The decision on where the WTC is to be held will be made in Helsinki in May 2011.

Simon Knight — Chairman ATS

EDITOR'S NOTE

I hope you enjoy the latest edition of our Journal with your **FREE** CD of *Australian Tunnelling Conferences* compiled by Allan Henderson.

Certainly tunneling projects are on the increase in Australia with a definite emphasis on Brisbane but also in Auckland NZ which indicates a strong interest for our next conference to be held in Auckland in March next year. Also there is a large number of desalination projects going ahead — all with interesting tunneling aspects especially for inlet and outlet water pipes.

It is also most exciting to see how many mining projects are developing underground with many surface and open pits exploring there ore at depth even with the scare of the Government's mining tax.

The David Sugden Award saw a good response this year with several excellent papers submitted and I am please to publish the winning paper by Ritesh Mahajan in this edition of the journal.

I was most excited to see the publication of the book *The History of Australian Tunnelling* earlier this year. Copies of the book can be obtained from our secretary at Engineers Australia. I will keep publishing new material on historic projects and welcome any input from members on these and current works both for the journal and the website.

David Lees — ATS Editor

14th Australasian Tunnelling Conference 2011

Development of Underground Space

8 – 10 March 2011, Sky City, Auckland, New Zealand

The race is on!

- **Over 100 abstracts received!**
- A great sprinkling of international submissions and a wide variety of topics and issues will be presented.
- Keen interest from the industry suggests a multitude of suppliers, constructors and designers will exhibit at the event.

The Conference Organising Committee is working hard to meet the raised expectations of a fuller, more meaningful conference to mark the start of the Second Decade of the 21st Century and to set a standard for the 2014 ITS Conference in Sydney.

We have the highest of expectations insight for all presenters and excitedly begin the countdown! We encourage all tunnelers, infrastructure owners and developers, and users to mark their diaries for 8-10 March 2011 in Auckland and contribute. We look forward to welcoming you and facilitating a network fiesta with ample exposure to the state-of-art of developing the underground.

Keynote Presentations

- **Professor Giovanni Barla, Turin Polytechnic University** never fails to infuse his audience with his enthusiasm and love for underground soil/rock mechanics and we look forward to his address.
- **Alan Morris, Project Manager for the XRL Tunnels , Mass Transport Railway Corporation, Hong Kong** will provide an overview of tunnelling in Asia while also outlining his views on where our industry finds itself in terms of technical developments.
- **Professor Arnold Dicks**, Chairman of the ITA Contractual Practices Group and Australian delegate to PIARC in tunnel ventilation, safety and environment will address operational issues in particular in vehicular tunnels.

Sponsorship

Showcase your business at the Conference by sponsoring the event. The sponsorship package contains a variety of levels and should you wish to discuss any of the levels, develop a package to suit your budget, or if you have any enquiries, please do not hesitate to contact event management.

Trade Exhibition

A Trade Exhibition will be held in association with the event. The exhibition will provide an excellent opportunity for companies to display their products and services to the participants.

Tours

Start or finish your Conference experience with scheduled tours of the Auckland region. Tours will include Conference related sites and tours of indulgence.

Pre Conference Master Class

An opportunity for immersion into European thinking and approaches with Giovanni Barla, Turin Polytechnic University.

Event Management: The AusIMM

For further information including sponsorship and exhibition opportunities, please contact:
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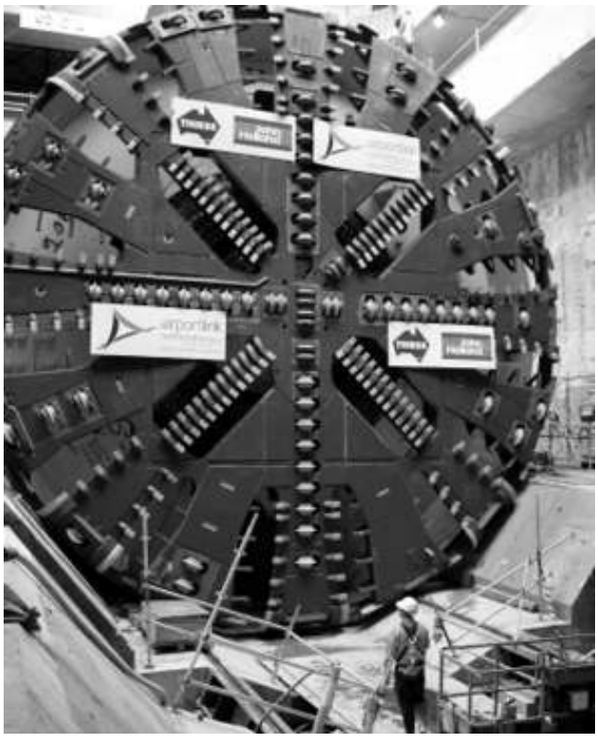


Airport Link tunnelling bores ahead

The Airport Link Project team was joined by Queensland Premier Anna Bligh in June to witness the lowering of Australia's largest tunnel boring machine (TBM) cutterhead into the ground at Kalinga Park, Queensland. The 12.48 m cutterhead was lowered underground by a gantry crane into the six-storey tunnel launch box in preparation for the scheduled launch of the first TBM in July.

Ms Bligh said the lowering of the 220 tonne cutterhead represented a significant step towards the start of the TBM tunnelling for Airport Link. "Soon the TBM will begin its journey from a giant launch box which measures 105 m long by 35 m wide and six storeys deep. A 300-strong team worked around the clock for 18 months to construct the box," Ms Bligh said.

The first TBM was named Rocksy by local residents. The second TBM named Sandy was launched in August to commence excavation in the westbound mainline tunnel.

Thiess John Holland Project Director Gordon Ralph congratulated the project team on the successful launch of the 3,600 tonne machine. "Today Sandy joins the project's other TBM Rocksy who has been boring away in the eastbound tunnel since mid-July and is progressing well," Mr Ralph said. "Rocksy has already excavated more than 100 metres of tunnel and installed 53 complete concrete rings, forming the permanent lining of the tunnel. At peak production,

both machines are expected to excavate up to 85 metres of tunnel per week. Stage one will see the front half of

Rocksy and Sandy tunnel approximately 130 metres each, whilst the rear of the machines are assembled within the launch box,' Mr Ralph said. "Tunnelling from Kalinga Park to Lutwyche will take approximately 12 months, working around the clock, seven days a week," he said.

Extensive monitoring of the ground conditions, vibration and noise will be carried out during excavationResidents will receive direct notification two weeks prior to the TBMs approaching their property and the community relations team will conduct regular doorknocks as tunnelling progresses. "These measures will be undertaken to try to limit the disruption to local residents as much as possible," he said.

With TBM tunnelling now in full swing, the project's innovative 1.8km overland conveyor system is also operational. "Transporting up to 2,600 tonnes of rock and soil per hour, the conveyor will be covered to minimise dust and runs 24/7 from Kalinga Park to the project's spoil handling facility on Nudgee Road, significantly reducing the number of spoil trucks on local roads," Mr Ralph said.

A massive 274m cavern is also under construction which will form a Y junction for the Lutwyche Road off-ramp. When complete it will be the largest cavern built in Brisbane

The Airport Link project is being constructed together with the Northern Busway (Windsor to Kedron), and the Airport Roundabout Upgrade Project. The combined Airport Link projects are the largest road infrastructure projects currently under construction in Australia. When it opens in mid 2012, Airport Link will be the first major motorway connecting Brisbane city with the airport and northern suburbs, avoiding up to 18 sets of traffic lights.

Big Pour at Brisbane's Airport Link Tunnel

More than 2800 cubic metres of concrete was poured during a marathon engineering effort overnight in April at the Airport Link site at Kedron. Workers spent 15 hours pouring the concrete at the site, opposite the Kedron Park Hotel, to create the roof for an early section of Australia's biggest tunnel project.

The Kedron section is the middle piece of the Airport Link tunnel. A team of 50 concreters, engineers and labourers began work at 10pm in what was one of Australia's largest continuous concrete pours. It took 380 concrete trucks to deliver the concrete, arriving every two minutes — or 37 trucks an hour — at the Gympie Road work site.

Four concrete pumps were used and 300 cubic metres of concrete was poured every hour until about 8am the following day. The concrete makes up the roof of a "surface level" connecting tunnel at Kedron, which is covered by soil and landscaped into the bigger project. This section of tunnel will ultimately take motorists travelling south on Gympie Road to Toombul and Brisbane airport, if they turn right, or the city.

The concrete slab joins another section of tunnel roof already been laid beneath the Kedron Brook.

The second of Australia's largest Tunnel Boring Machines arrives

Airport Link's second $45 million Tunnel Boring Machine (TBM) arrived in Brisbane in April.

The 3,600 tonne TBM, purpose-built for Australia's largest ever infrastructure project was delivered from Germany in three container shipments.

At 195-metres long, the TBMs are nearly twice the length of a football field and feature the largest ever disc-cutters to operate in Australia. At 12.48 metres in diameter, the cutting head is equivalent to half the width of an Olympic swimming pool.

TBM Fast Facts:

- $45 million each
- 195metres long
- 3 months to assemble
- can cut through rock 6-8 times harder than concrete
- 22 people to operate each TBM.

New tunnel to offer Lutwyche Road relief

The Airport Link will enable 40,000 fewer cars on Lutwyche Road by 2012. One set of two-lane tunnels is just beneath Lutwyche Road and makes up the Northern Busway, a project the Government says will provide 47,000 bus commuter trips each day by 2016, taking hundreds of cars from Lutwyche Road.

Together the $4.8 billion Airport Link project is Australia's largest infrastructure project and includes the Northern Busway beneath Lutwyche Road; the Airport Link tunnel project, which runs 20 to 30 metres deeper underground and the new overpass at the Brisbane Airport from the East West Arterial Rd.

The twin three-lane underground tunnels of the Airport Link toll project will connect to the twin, two-lanes of the Clem7 project at Bowen Hills after a brief above-ground road section near Bowen Bridge Road.

Heading north from the Truro Street tunnel entry point is a shorter two-lane, 12-metre wide bus tunnel which will take buses underground from Lutwyche Road to a new bus station at Lutwyche.

Thousands make history at Clem 7 opening

Most of the 50,000 people who flocked to the opening of Brisbane's Clem7 road tunnel wanted to be a part of history. They ran, walked, traveled by bus and were even pushed through the 4.8km tunnel — Brisbane's first major road tunnel and the largest of its kind in Australia.

The crowd abounded with families with children in strollers, couples arm-in-arm and the elderly who had only ever dreamed of such a magnificent construction in their city. They were allowed to the lowest point, where the tunnel sinks up to 60 metres below the Brisbane River. In total, the Clem7 stretches 6.8km from Woolloongabba to Bowen Hills, connecting suburbs north and south of the river and avoiding 24 sets of traffic lights.

One hundred vintage cars were the first non-construction vehicles to enter the tunnel. The convoy travelled through on Saturday, ahead of yesterday's fun run and community open day.

About 5000 people who participated in a 10km fun run were the first members of the public to enter the tunnel by foot. Their efforts raised $100,000 for the Royal Children's Hospital Foundation.

Brisbane City Council had been forced to close online registration for the opening day when numbers reached 50,000 people — but several more thousand were estimated to have turned up and walked through the tunnel between 9.30am and 3pm.

One hundred vintage cars were the first non-construction vehicles to enter the tunnel. The convoy travelled through on Saturday, ahead of yesterday's fun run and community open day.

Clem7 'cuts cross river congestion'

The Clem 7 tunnel has eased congestion on two of Brisbane's river crossings, including slashing seven minutes from the most popular route, Brisbane City Council says.

However, drivers continue to lament increased problems on roads leading to the tunnel.

More than 20,000 fewer vehicles each day are using the Story Bridge to cross Brisbane River, a drop of 18 per cent, the council says.

Lord Mayor Campbell Newman said the drop in vehicle numbers had reduced travel times on the bridge, which links Kangaroo Point to Fortitude Valley.

Cr Newman said travelling from Ipswich Road to Lutwyche Road via the Story Bridge now took 14 minutes, compared to 21 minutes earlier in the year.

The same route but departing from Shafston Avenue, Kangaroo Point, now took 11 minutes instead of 14 minutes, he said.

Council's figures showed 13,834 fewer vehicles — 9 per cent — used the Captain Cook Bridge between the city and Kangaroo Point since the tunnel opened.

Cr Newman said the tunnel had also reduced traffic volumes on Ipswich Road (by 27.2 per cent), Gipps St (by 14.6 per cent) and the Pacific Motorway (by 9.8 per cent). However, the impact was expected to be greater.

When the toll was first applied to the $3 billion Clem 7 tunnel, which links Bowen Hills in the north and Woolloongabba in the south, only 20,000 vehicles a day used it. That was well below operator RiverCity Motorway's estimation of 60,000 vehicles a day.

The company was forced to extend a reduced toll period and in July cut the toll by more than 50 per cent to $2. Now, an average of 30,000 trips are made via the tunnel each day, according to the council.

Councillor Newman said the tunnel offered the quickest route for travel between Lutwyche Road and Woolloongabba or Kangaroo Point, at six and four minutes respectively. "These time savings have also flowed over to our bus network, meaning even daily public transport users are reaping the benefits that the Clem7 is having on getting Brisbane moving again," Cr Newman said. The new Route 77 bus service from Eight Mile Plains to Chermside, which runs through the tunnel, also cut travel time from 55 minutes to 39 minutes.

Kim7 raises $115,000 for cancer research

RiverCity Motorway renamed the Clem7 the Kim7 for one day in July and donated the $2 toll to the appeal, along with an extra $1 for every motorist.

The 35,000 motorists who drove through the Kim7 tunnel on Friday 23rd July helped raise $115,000 for the Kim Walters Choices Appeal's fight against breast cancer.

The toll company said the 35,000 motorists who used the tunnel on Friday was around 3500 more than the Thursday, and about 5000 more than the average Monday to Friday total.

Kim Walters Choices fundraising coordinator Linda Grieve said the funds raised would help thousands of women, men and their families receive the ongoing support they need while going through a traumatic time.

Kim Walters Choices was established at the Wesley Hospital in Brisbane in honour of the wife of former Brisbane Broncos captain Kevin Walters. Mrs Walters died of breast cancer in 1998, aged just 30, leaving behind three children.

CLEM7 Australia's safest tunnel

The 6.8 kilometre Clem Jones Tunnel (CLEM7) is one of the largest infrastructure projects ever to be undertaken in Queensland. Built as a solution to Brisbane's inner city gridlock, the tunnel under the Brisbane River, which connects north-south traffic, has five connection points with a sixth planned for the Airport Link in 2012.

Promoted as one of Australia's safest tunnels, CLEM7's range of safety features and systems in the tunnel was designed to provide the safest driving environment possible. Due to the large scale of the project, CLEM7 required an excessive amount of quality communications and control cabling for the communications and traffic management infrastructure.

More than 250 cameras positioned at various locations are monitored 24 hours a day. Should a traffic accident occur within the tunnel, the cameras will provide accurate monitoring which in turn will assist in quick vehicle accidents or breakdown responses and in addition, playback of the footage will help determine the cause of the accident.

Taking control

The individually controlled electronic signage, cameras, traffic signals and messaging are operated by up to 40 technicians from the intelligence heart of this major infrastructure facility — the Tollway Control Centre. Located at the northern end of the tunnel, the interior is similar to something you would see in a futuristic sci-fi movie, with hundreds of visual aids and computer controls.

The people who made it happen

In order to make the cameras and direction and variable speed signs operable, sophisticated high bandwidth communications cables were needed to transmit and receive signals from the Tollway Control Centre and the tunnel. The CLEM7 mechanical and electrical subcontractor, UGL Infrastructure, recruited communications infrastructure and cabling specialist company, Madison Technologies, to supply all of the required copper and optic fibre cables. Madison Technologies has worked with UGL Infrastructure on several Australian projects in the past, including the Sydney Lane Cove Tunnel; and their portfolio of cables deployed throughout traffic management and control systems for most of the major arterial connection roads in south-east Queensland and across Australia has helped build their reputation as a company who delivers solutions on time and within budget.

The project involved liaising with UGL Infrastructure to determine the cabling needs for the tunnel. This was a lengthy process, and as plans changed, so did the cabling infrastructure requirement. A state of the art cabling system was designed, enabling continuity of communications traffic for signalling, speed signs, warnings and other forms of electronic messaging without interruption.

Equal to 23 times the length of the tunnel, the optical fibre cable installed in CLEM7 also needed to be brought to the surface to allow access by the Department of Transport and Main Roads for inspection and testing. In addition to supplying all the cabling, Madison Technologies supplied all of the required connectivity and jointing products, along with specialised tooling to provide a total end to end solution which ensured the integrity of the entire cabling system.

Using new technology

According to Madison Technologies' Managing Director, the CLEM7 project created the opportunity to introduce a Swiss made product to Australia. The R&M security level 2 socket had never been used in Australia for this type of application. The security feature of the socket ensures that cables cannot be switched over, therefore guaranteeing that a whole system crash cannot transpire.

"Securing this part of the CLEM7 project highlights the fact that Madison Technologies remains the leader in Australia for infrastructure communications solutions," said Managing Director of Madison Technologies, David Redfern.

"The successful on time delivery and under budget supply of the communications cabling system for CLEM7's traffic control and management system is testimony to Madison Technologies' capabilities when it comes to rolling out large scale infrastructure projects" said Mr Redfern.

Clem Jones, a former Lord Mayor of Brisbane after whom the landmark tunnel is named, was the pioneer and a visionary who transformed Brisbane from a sleepy country town into a modern vibrant city through the deployment of essential infrastructure. Acknowledging similarities in communications infrastructure requirements, Mr Redfern added, "We are on the cusp of a communications infrastructure explosion in Australia and Madison Technologies is extremely well placed to participate at all levels. Our innovative approach and our attitude to customer service have been benchmarks of the business since its inception and will continue to be so."

Green light for Northern Link Road Tunnel

A new $1.7 billion road tunnel linking Brisbane's western and northern suburbs has been given conditional approval by authorities. The 7km Northern Link Road Tunnel will not require the resumption of any houses and will be subject to 34 environmental conditions.

Co-ordinator-General Colin Jensen granted the approval, saying the conditions were the most extensive and stringent ever for a transport infrastructure project in Queensland.

Brisbane City Council is proposing to build the twin-tunnel underground toll road linking the Centenary Motorway at Toowong to the Inner City Bypass at Herston.

The government has spent more than two years doing environmental checks and has taken hundreds of public submissions. The conditions cover issues including surface impacts, the widening of streets and air quality levels.

The construction of the tunnels is now expected to start by December this year. The project will be funded jointly by the council, state and federal governments. The Federal Government will invest $A500 million in the project.

The Brisbane City Council has received three tenders for construction of the Northern Link tunnel.

Brisbane tunnel's canopy structure mimics trees

Brisbane's newest major infrastructure project, the CLEM7, has become a symbol of the city's reputation for design excellence. Since the city's first major road tunnel opened, all eyes have been set on a series of three distinctive canopy structures conceived by AECOM's Design + Planning team for Brisbane City Council.

AECOM associate director James Dorrat said the canopies for the CLEM7 tunnel were designed to be iconic while also functional for tunnel users. "The canopies' distinctive sculptural design and flowing forms mimic the protection of Brisbane's expansive subtropical shade trees," said Dorrat. "Metal louvres set within the structures filter sunlight, transitioning motorists' eyes as they enter the tunnel."

Each canopy is supported by complex rolling steel trusses covered in metallic copper-coloured architectural panels which have been individually cut and fitted to match the complex curves. At night the canopies are washed with coloured light which enhances the copper tones of the metal panels.

The largest of the canopies, located at Bowen Hills on Brisbane's northside, is made up of 2,000 unique pieces and weighs 230t. AECOM principal Mark Fuller hopes the canopies become a long-lasting legacy of Brisbane's design expertise and the city's forward-thinking approach. "The CLEM7 canopies exemplify Brisbane's maturing urban landscape and AECOM is proud to have contributed so strongly to such a significant project," said Fuller.

The CLEM7 is the first component of the city's TransApex vision for Brisbane City Council. RiverCity Motorway Group contracted the design and construction of the tunnel to Leighton Contractors and the Baulderstone Hornibrook Bilfinger Berger Joint Venture (LBB JV).

AECOM and Parsons Brinckerhoff teamed as lead designers of the CLEM7 tunnel, while AECOM's Design + Planning team provided specific architectural, landscape and urban design for the project, including the design of the entry canopies.

Kingsford Smith tunnel back on the table

Brisbane Lord Mayor Campbell Newman has resurrected a plan to build a tunnel under Kingsford Smith Drive as traffic on the congested arterial road continues to worsen.

Cr Newman confirmed the tunnel option, which was part of his original TransApex tunnel plan prior to his election in 2004 but shelved shortly after he took office, was back on the table. If built, the tunnel would link traffic from the Gateway Motorway and Australia Trade Coast to the Inner City Bypass.

"We are looking at all the options," Cr Newman said. "You can widen it [Kingsford Smith Drive] out over the river, but I don't particularly like that.You can widen it and put a public transport corridor like a bus lane or a ultimately light rail over the water. Or you can build a tunnel. They are the only options you have got."

Current traffic projections predict 71,000 vehicles a day will use the riverside stretch of Kingsford Smith Drive by 2026, up 22 per cent from today's figure of 58,000.

While no firm decision on a Kingsford Smith tunnel had been made, Cr Newman said Brisbane City Council officers started looking at early design options last year.

Before he was first elected in 2004, Cr Newman had proposed a $800 million, 3.9 kilometre underground 'Kingsford Smith Drive Duplication', which would connect to the Inner City Bypass near the Breakfast Creek Hotel. The tunnel project was shelved in 2005 in favour of Airport Link and the Go Between Bridge, with both projects currently under construction. But Cr Newman said times had changed, due largely to the Hamilton Northshore high density and retail project being built by the river near Kingsford Smith Drive.

Above ground, council has started work on a three-stage widening of Kingsford Smith Drive, with the $14 million first stage near the Gateway Motorway getting underway before Christmas.

Brisbane's Cross River Rail

Brisbane commuters may have access to underground shops once a planned new 19km cross-river rail project is completed.

The state government is planning to build an $8 billion underground rail tunnel from near Woolloongabba under the Brisbane CBD to Bowen Hills.

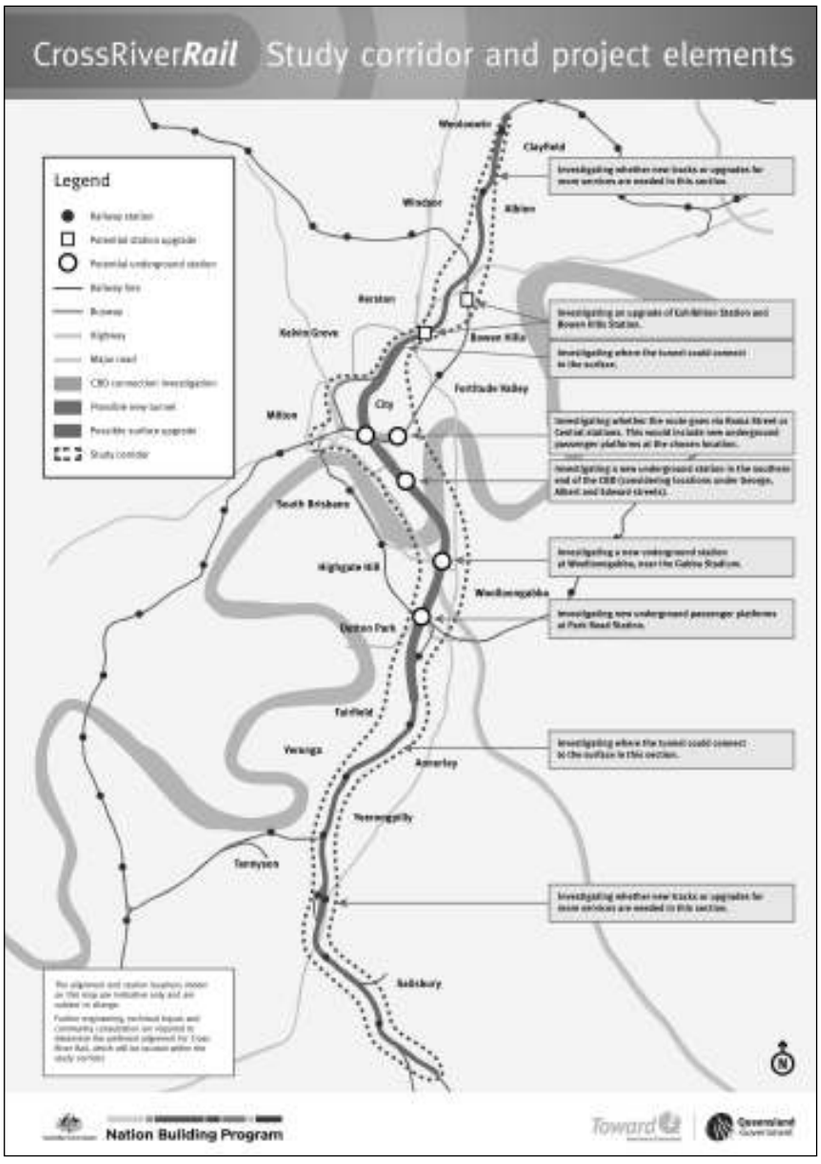
The study aims to find a new north-south connection in the inner-city. A 19km proposed corridor would include a tunnel under the Brisbane River and new stations, running from Salisbury, in Brisbane's south, to Wooloowin, in the north, via Woolloongabba, the CBD and Bowen Hills.

Demand for inner Brisbane rail services is tipped to jump from 59 — for the current morning peak hour — to 92 by 2016.

That number is predicted to climb to 141 by 2026, a demand that cannot be met by existing rail lines and stations, the Cross River Rail study found. Ms Bligh said the private sector could help fund the project and open underground shops for commuters.

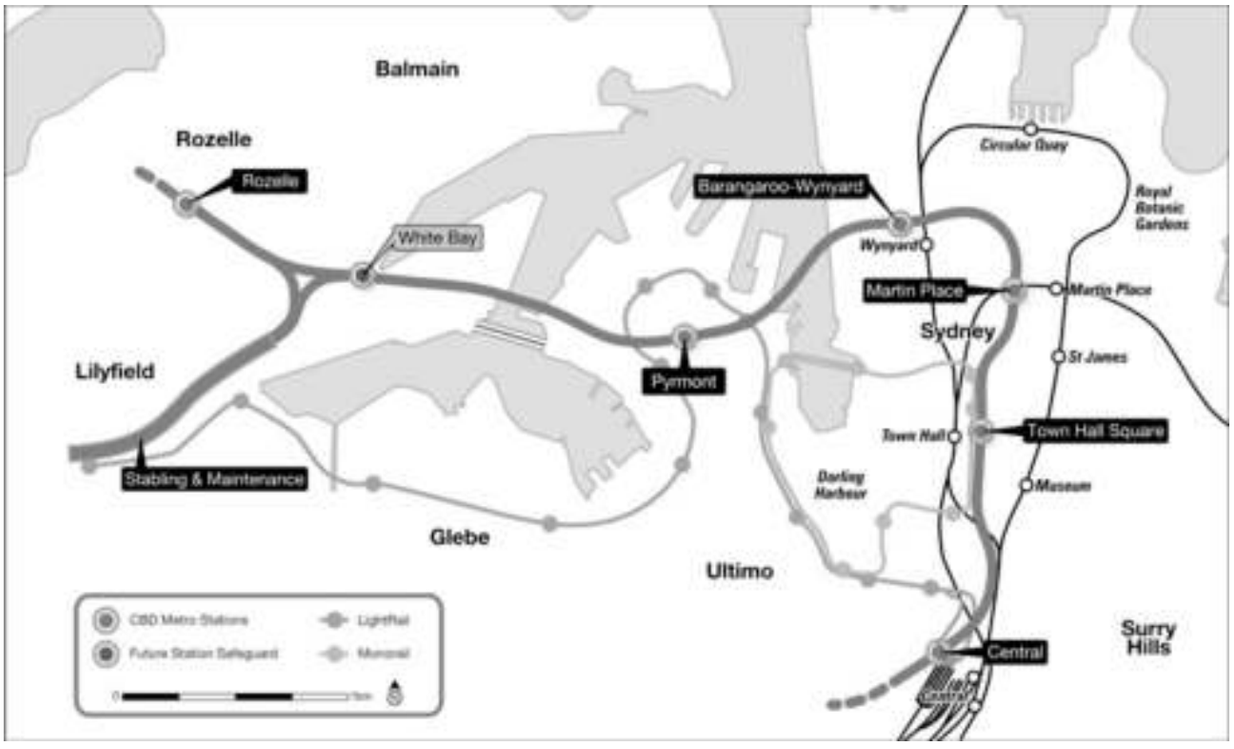
"We believe there is a very strong commercial prospect of private investors investing in the development of the rail stations themselves if there is a commercial development at those stations," Ms Bligh told reporters. "So just as you see in other cities of the world, underground stations can be great underground shopping areas and that could see some commercial investment help government get this project up and running."

While funding details and station locations were yet to be finalised, Ms Bligh said the cross-river rail project should be completed by 2016.



Cross-River Rail Project

- potential underground rail stations at Park Road, Woolloongabba, Central, Roma Street, a third CBD stop which could beneath QUT's Gardens Point campus, or under Albert or Edward Street;
- an $8 billion, phase one approximate cost — a link from Brisbane's Beenleigh line to the Caboolture line — by 2016;
- possible underground tunnel from near Fairfield to near Campbell Street at Bowen Hills;
- Exhibition and Bowen Hill stations upgraded;
- new tracks, or upgrades of existing services needed south of Yeerongpilly and between Albion and Wooloowin;
- an investigation team is checking basements on inner city buildings for "ground anchors";
- Top of the list for Queensland Government push for Infrastructure Australia funding.
- Approximately $8 billion to be found from state, federal and private investment.



$93M payout for Sydney CBD Metro

Major contractors shortlisted for the axed Sydney CBD Metro project will receive a total of $93 million in compensation payments for tendering costs.

The contractors, including McConnell Dowell, Abigroup, Leighton Contractors, Downer EDI, Laing O'Rourke, Thiess and John Holland, were part of five consortiums shortlisted for the construction and operations contracts for the $5 billion underground light rail project axed in February.

New South Wales transport minister John Robertson told the *Australian Financial Review* the compensation payments were calculated in an independent report by accountants Deloitte.

Responding to accusations of a cover-up by the NSW Greens, Robertson said his government had nothing to hide and its preferred option was to release the report.

"[If] the advice is that this report can be released without negatively impacting on those companies then I will release that report," he told ABC News.

In February, Australian Constructors Association president and Leighton Holdings chief executive Wal King called for full reimbursement of Metro tender costs, while Premier Kristina Keneally promised reimbursement for "reasonable costs incurred".

The *AFR* quoted an industry source saying the consortiums spent about $200 million bidding for the project. The three consortiums shortlisted for the construction contract were Line 1 (McConnell Dowell-Abigroup-Obayashi), MetroPrimo (Leighton Contractors-SELI Spa) and Thiess-John Holland JV.

Two consortiums had been shortlisted for the operations contract: Kujika (Keolis-Downer EDI Rail-McConnell Dowell-Bovis Lend Lease-Thales) and Met One (Serco-Bombardier-Laing O'Rourke-Hastings Management).

No M4 East without Federal money

A tunnel connecting the M4 motorway and the CBD will not go ahead without Federal money, according to the NSW Government.

Roads Minister David Borger admitted that state funding had been allocated to build the M4 East extension after revelations that the Government set out its determination to pursue the project in a submission to an Infrastructure Australia report in 2008. Funding has been committed to the project for planning and future work as part of the Nation Building Program 2009-2014.

However, in the short term, a project of this size is well above the funding capability of the NSW Government. Mr Borger said a "detailed preferred route" of the tunnel had not yet been decided, despite reports of the submission claiming there would be an exit in Rozelle.

Western Express/ City Relief Line

The NSW Government is working to deliver faster and more frequent rail services to Western Sydney and increase the overall capacity of the heavy rail network.

New express train services will be introduced from Penrith and Richmond and new platforms will be built at Redfern, Railway Square (near Central), City West (near Town Hall) and Wynyard.

To help achieve this, a new 5km priority tunnel, known as the City Relief Line, is proposed to be constructed from Eveleigh to Wynyard, separating western services from inner city trains.

The Western Express project will:

- Improve capacity, travel times and comfort for long distance commuters from the city's west and north west
- Add to the efficiency of the existing rail network, enabling increased train services from the north, south and south west
- Meet the demand of expected growth along the western side of the CBD (Darling Harbour and Barangaroo)
- Take pressure off existing stations in the CBD, in particular Wynyard, Town Hall and Central, and
- Make provision for future expansion of the network.

This project forms part of the NSW Government's Metropolitan Transport Plan. Funds have been allocated from the 2010-11 Budget for Transport NSW to commence the planning process and assess the design and alignment options. This project is in the early design and planning phase.

Transport NSW is starting alignment and design studies for the project and will investigate a number of alignment and construction options. A key focus of the investigations will be to make as much use as possible of land in public ownership and minimise impacts on private property along the route.

Young drillers get tunnel world record

Two teenage drillers working on Country Energy's project to place high-voltage underground cables to the South Lismore electricity substation may have broken a world record.

The 19-year-old cousins, Kane and Nathan O'Meley, from the NSW Central Coast, who carried out an 800 millimetre diameter bore through 220 metres of solid basalt at South Lismore, may be the youngest drillers to complete such a job.

Their boss and uncle, Tony O'Meley, co-owner and operator of Hunter Valley-based specialist drilling company Arogen, said, "Other companies are bringing in guys from overseas for this type of work, but we're committed to training young blokes with a passion for this."

Nathan said it was 'a bit of a shock' when they heard about the potential world record, but they were taking it in their stride. "We've been doing it for about three years. Kane and I love it — it's heaps better than school," he said. "The job took about nine to 10 weeks, but we were flat out most of the time because we had to deal with heaps of problems. This was the biggest drill we've done. We've only done little ones by ourselves before.

The $2 million project will connect two high-voltage underground cables from Three Chain Road to Country Energy's South Lismore zone substation.

Brisbane's CBD to get new underground rail station

Premier Anna Bligh says a new underground railway station will be built in Brisbane's CBD, it will be the first new city station in 100 years.

Albert Street has been chosen as the best site for a new underground railway station in Brisbane's CBD. It will service a proposed new rail tunnel under the Brisbane River, linking Salisbury in the south to Wooloowin in the north.

A feasibility study is continuing on the cross-river rail project.

BURROWS ROAD EA TUNNEL

Abergeldie Complex Infrastructure™ has just completed pipe jacking a purpose designed Transmission cable housing tunnel for Energy Australia. The tunnel will house up to 6 x132kV cable circuits which will form a part of the reconfigured Energy Australia Network from TransGrid's Beaconsfield South substation.

The 87m long and 2800mm diameter tunnel is approximately 5m below Burrows Road in Alexandria, Sydney. At that depth the top of tunnel is located 4m below the watertable and is within 100m of the nearby Alexandra Canal.

"The project required an Earth Pressure Balance Machine (EPBM) due to the difficult water charged ground conditions. Abergeldie had a suitable machine, and that was a major factor in it being awarded the job" says company director Mick Boyle.

Abergeldie has successfully provided Energy Australia with similar pipe jacked, cable housing tunnels over the past 4 years: a tunnel at Artarmon, 111m long and 1650mm diameter excavated in sandstone; another at Pymble, 97m long and 1650mm diameter bored through shale; and most recently at Carlton, a 120m long and 2400mm diameter tunnel through sandstone. All of the projects included the construction of permanent access structures that were used as send and receive pits. The projects also included fit out of the tunnels with the necessary cable support brackets so that the cables could be installed later by others.

In the previous projects Abergeldie teamed up with Tunnel Boring Australia and utilized their tunnel boring and pipe jacking equipment. This time they again teamed with Tunnel Boring Australia but utilized Abergeldie's own Herrenknecht Earth Pressure Balance (EPB2000) pipe jacking machine.

Abergeldie designs, builds and operates a fleet of the largest blind bore drilling rigs in the world. Abergeldie blind boring rigs are capable of vertically drilling and hydrostatically lining shafts up to 600m deep and 7m in diameter. Using a combination of Abergeldie's expertise in this related field and the experience of Tunnel Boring Australia, Abergeldie 'upskinned' their EPB2000 to enable it to drill the required diameter for the tunnel.

The scope of work for this tunnel also included an 8m deep launching shaft and an 8m deep receiving shaft. These will become permanent access structures. The design of the launching and receiving shafts adopted contiguous pile walls with fibreglass reinforcement positioned with exact precision for the tunnelling machine to drill through.

Leakage at the entry shaft was prevented with the use of a seal ring combined with the injection of expanding hydrophilic crystals at the entry point, and the pre-treatment of the ground by injection at the cutting

head. When the machine broke through at the receiving shaft it was completely dry.

"Due to the poor quality water charged ground we had to be careful the tunnel boring machine didn't sink when it first left the send pit. Careful steering was required to keep it on target" said Jonathan Sisovic, Abergeldie's engineer on the project. "When we broke through at the receive pit we were out by only 7mm in both line and level which is a great result. We only had a 20mm tolerance on line and level in our seal ring."

Abergeldie specialises in complex civil infrastructure projects and has been able to use its experience and resources to overcome difficult ground conditions to construct this pipe jacked tunnel within tight timeframes set out by the client.

The tunnel is due for completion late October 2010.

GFWAust stops the leaks

The underground cable tunnel beginning in Campbell Road, running below Burrows Road, and finishing at the Energy Australia/Transgrid Substation in Alexandria was constructed by Abergeldie.

The project features an launching shaft, an 87m long pipe-jacked tunnel and a receiving pit. The tunnel was constructed by an EPB TBM through waterlogged sand. The shafts were constructed by secant piling.

On completion of the shaft and tunnel construction GFWAust were appointed to stop the water ingress.

The secant piles were leaking at the intersection between soft and hard piles and at the intersection with the shaft floor slab. Water ingress was at a rate of about 20 litres/minute. GFWAust sealed the leaks with water stopping mortar and injection of polyurethane.

Ground water in the tunnel was ingressing at the tunnel eye where the tunnel entered the shaft through the secant piled wall. GFWAust injected polyurethane near the portal to stop the leak before injecting a precision non-shrink grout to form a permanent seal.

Water ingress was stopped allowing Abergeldie to complete the concreting works.

Mardi-Mangrove Pipeline

Construction of the Mardi-Mangrove Pipeline, located in New South Wales, has commenced with the first sod being turned and microtunnelling to follow shortly.

The pipeline will help secure the New South Wales central coast's long-term water supply and is expected to be completed by 30 June 2011.

Contractor John Holland will build two pipelines, including a 19 kilometre section from Mardi Dam to Mangrove Creek, and a 1.9 kilometre section from Wyong River to Mardi Dam, which will be microtunnelled in June.

Federal Member for Dobell Craig Thomson said that the project will "help to boost dam storage levels, speed up drought recovery and help protect the region against future extended periods of below average rainfall."

The Mardi-Mangrove Link is a joint initiative of Gosford City and Wyong Shire Councils. The two councils will jointly fund costs totalling more than $A80.3 million. The Australian Government is providing $A80.3 million in funding to the project, which is the largest water infrastructure project on the central coast since the Mangrove Creek Dam was built and commissioned in 1982.

Sugarloaf boosts Melbourne's water

Melbourne's water supplies will be significantly boosted with Victorian Premier John Brumby and state Water Minister Tim Holding officially opening the Sugarloaf Pipeline, located in Victoria.

Also known as the North-South Pipeline, the $A750 million Sugarloaf Pipeline runs from the Goulburn River near Yea to the Sugarloaf Reservoir in Melbourne's northeast to allow the transfer of 75 billion litres of water to Melbourne as part of the Food Bowl Modernisation Project.

The construction of the pipeline involved microtunnelling under the Toolangi State Forrest in order to protect the natural environment.

Mr Brumby said "Our major water projects, including this pipeline and the desalination plant are the roadmap back from severe water restrictions.

"The pipeline is an integral part of the biggest investment in irrigation upgrades in 100 years with water savings in northern Victoria's irrigation region to be shared with Melbourne to secure its water supplies."

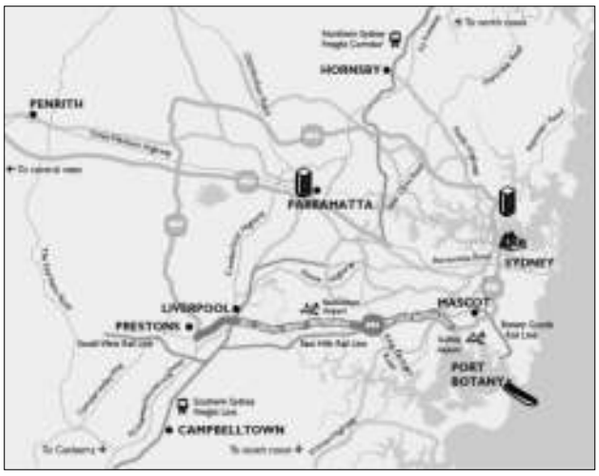
M5 corridor expansion

The NSW Government proposes to expand the 32km M5 corridor at some point in the future. This proposal involves about a quarter of the Sydney Orbital network, currently used by around 95,000 vehicles per day. The proposal includes a five kilometre link road from the eastern M5 tunnel exit point to the airport and industrial areas close to the airport.

The NSW Government has asked the RTA to look at all options in partnership with the community. Several meetings have already been held with the community and these will continue for at least 18 months during the environmental assessment stage.

In November 2009, the NSW Government announced a proposal to expand the M5 corridor. The proposal includes:

- Widening the M5 South West Motorway from two to three lanes in each direction.
- Widening the M5 East Freeway east of King Georges Road to four lanes in each direction.



- Providing four new lanes in a tunnel(s) next to the existing the M5 East tunnel.
- Providing a new four lane arterial road from the M5 East tunnels to Sydney Airport and the industrial areas of inner southern Sydney.

The M5 corridor is the main road freight, commercial and passenger route between Port Botany and Sydney Airport and south west Sydney. It is part of the National Highway Network connecting Sydney, Canberra and Melbourne. Improving the M5 corridor is a major focus for the NSW Government due to the motorway's function as a critical economic driver for NSW and Australia.

In recent years traffic levels and the high number of heavy vehicles on this route mean the corridor is operating at or near capacity in peak hours. This impacts on Sydney's economic productivity and competitiveness. The situation will be further compounded by planned commercial and industrial growth at Port Botany and Sydney Airport as well as planned population and employment growth along the corridor.

Project information is available on the website www.m5corridorexpansion.com.au

M5 Tunnel filtration suffers setback

All proposals for the construction of an eastbound filter for Sydney's M5 Tunnel have been rejected by the Road and Traffic Authority (RTA). The westbound filtration system is almost complete but is not working at this stage.

A spokesman from the office of the Transport Minister, David Campbell, says the proposals were rejected because they failed to meet the standards of the residents' group and the RTA.

TBM "Victoria" breaks through at Carr St

Northern Sewerage Project

On Friday 26 February 2010, TBM "Victoria" completed excavation of the final 700 metres of the tunnel from Newlands Road, Coburg North to Carr Street, Coburg North.

"Victoria's" breakthrough at Carr Street, Coburg North signified the completion of tunnel excavation activities on Stage 2. With tunnel excavation now complete, the Stage 2 project team's focus now turns toward completion of the remaining tunnel and shaft lining activities throughout the remainder of 2010 and early 2011.

Works on the Elizabeth Street, Coburg connection to the NSP are nearing completion. This final phase of works — which includes commissioning of the new sewer connections — was initially scheduled to occur towards the end of project completion in 2012. The commissioning works were brought forward with Elizabeth Street reopening to two way traffic in the last week of March 2010.

On 12 February 2010, the pipe jacking machine successfully broke through into the Bell Street West shaft. This completed the excavation of a 150 metre connection tunnel from the sewer located at the intersection of Bell Street and Nicholson Streets, Coburg, to the new NSP works located in De Chene Reserve. The Bell Street West connection works were scheduled for completion in April 2010.

Pipe installation has begun on the tunnel drive from Brearley Reserve, Pascoe Vale South to Bass Street, Pascoe Vale. These works commenced with the first pipe being installed in the week beginning 15 February 2010, and will continue through until late 2010.

Pipe installation on the Brearley Reserve, Pascoe Vale South, to Vanberg Road, Essendon tunnel alignment was scheduled to commence in April. Pipe installation is continuing on NSP Stage 2, with works on the Jukes Road, Fawkner to L.E. Cotchin Reserve, Reservoir and the Jukes Road, Fawkner to Newlands Road, Coburg tunnels timed for completion in late 2010.

Construction of the final tunnel on the project is still progressing well with a breakthrough of the tunnel boring machine 'Gemma' planned for late September/early October at Carr Street.

Shaft lining and pipelining are also progressing well along the other tunnel reaches with Stage Two recently installing the last of the Glassfibre Reinforced Plastic (GRP) pipes. The Stage Two team is now focusing on the completion of shaft lining activities at each of the three shaft sites.

Overall the project is tracking extremely well, and is currently ahead of its mid 2012 deadline.

Community Open Day

On 24 July the Northern Sewerage Project (NSP) opened the doors of one of the most complex shaft sites on the project to local community members. Eighty five pre registered members of the community attended the day and were given the opportunity to be briefed on the entire project by one of the Project Directors. Following the briefing attendees were provided with a surface tour of the Brearley Reserve construction site prior to taking a trip down the 64 metre vertical access shaft for a tour of the tunnel currently under construction. Attendees were then provided with a BBQ and the opportunity to discuss different aspects of the project with members of staff. Overall the feedback received on the day from attendees and project staff alike was that the day was a resounding success.

Melbourne Main Sewer Breakthrough

The first tunnel breakthrough has been achieved for the Melbourne Main Sewer Replacement project under Melbourne's inner suburbs.

The 100 metre long tunnel boring machine "Lucy Loo" has been tunnelling under Port Melbourne for the past ten months and has completed her journey, breaking through into the access shaft at Swallow Street.

Project Director Phil Corluka, said Lucy had created a tunnel almost 1.2 kilometres long, which is about half of the project to replace a 2.3 km stretch of Melbourne's sewer network from Port Melbourne to Docklands.

"The tunnel boring machine had navigated its way through challenging geological conditions, ranging from strong Basalt Rock to Coode Island Silt which is a soft clay material that made steering the machine difficult," Mr Corluka said.

"The Melbourne Main Sewer Replacement is a critical piece of infrastructure that will meet the demands of the city's growing population for the next century.

"The original Melbourne Main Sewer was built in the 1890s and while it has served the CBD and inner suburbs well, it needs to be replaced due to its age and capacity to keep up with urban development."

Lucy will now be taken out of the shaft at Swallow Street and begin her second tunnel drive from Fennell Reserve, Port Melbourne, and tunnel north towards the Yarra River.

Another recent significant milestone achieved on this technically challenging project was that the laying of pipe under the Yarra River reached the halfway point.

The Yarra River crossing is taking place upstream of the Charles Grimes Bridge.

Frankston Drainage Improvement Project

As a low lying area, Frankston on Melbourne's Peninsula is subject to serious flooding during severe wet weather. Tunnelling works are currently underway as part of the $A41 million Frankston Drainage Improvement Project, which is one of Melbourne Water's biggest projects and will provide increased protection from flooding and improve drainage in the area.

The Frankston Drainage Improvement Project involves the construction of a 1.5 kilometre stormwater drainage pipeline from Monash University Peninsula Campus car park to Kananook Creek.

The project is being constructed by the Pipelines Alliance, a joint venture between Fulton Hogan, Jaydo, GHD and Melbourne Water. The tunnelling works of the project have been contracted to Winslow Infrastructure.

The Frankston Drainage Improvement Project began construction in September 2009 and saw the construction of a twelve metre deep shaft at Monash University Peninsula Campus.

Tunnel to free up Hoddle Street

A $1.5 billion plan to ease Hoddle Street's traffic gridlock with a new underground road was raised at a recent meeting of transport, government and business groups as they consider options to fix the notorious traffic snarl.

The proposal to duplicate the street underground, possibly by tunnelling beneath the existing road, is one of several options examined by a VicRoads-commissioned report by consultants GHD.

A state government-appointed advisory group examining the Hoddle Street gridlock — part of a two-year government consultation process — are now considering the report. Group members include the RACV, public transport groups, the Victorian Employers Chamber of Commerce and Industry, and Yarra Council.

GHD reported that up to 79,000 vehicles used the intersection at Swan Street each day, and 68,000 used Victoria Parade, with forecasts for traffic from the Eastern Freeway to rise from 64,000 vehicles to 114,000 by 2031.

The report flags various options for solving Hoddle Street's traffic problems, including underpasses at Victoria and Wellington parades and at Johnston Street at a cost of $160 million to $600 million each.

Road tunnelling or overpass measures are largely supported by the RACV and VECCI, but public transport groups have raised concerns that increasing traffic flow will only increase car use and congestion.

Southbank 'deck' over CityLink tunnel

The entrance of the CityLink tunnel at Southbank would be built over to make way for new residential and community developments under a proposed 30-year-plan for Southbank announced by the City of Melbourne.

Under the Draft Southbank Structure Plan, three new precincts would be developed to provide an "urban heart" for the area. Work is expected to begin soon to build community facilities, including a library and maternal and child health services on the site of the former JH Boyd Girls' School.

The draft structure plan will be introduced to council where it will be subject to a six-week public consultation process.

Laser boring Bendigo sewer main

Laser boring will be used to install sections of the new 1.15 kilometre sewer trunk main in Bendigo, Victoria.

The 300 — 375 mm diameter sewer main will be constructed by Coliban Water and will cost $A650,000. Trenchless Technology will be used to install sections of the main including one road crossing, one rail crossing and a 130 metre section which crosses through the backyards of residential properties.

Coliban Water's General Manager Operations and Headworks Neville Pearce said "With a number of streets potentially impacted by the works, laser guided and directional boring will minimise the impacts on properties and traffic flow."

Contractor Austin Earthmoving has subcontracted Pezzementi Laser Boring to complete the trenchless sections of the project.

The project forms part of Coliban Water's $214 million capital works program in its 2008-2013 Water Plan. Works on the project were completed in April this year.

Adelaide Desal Tunnelling Commences

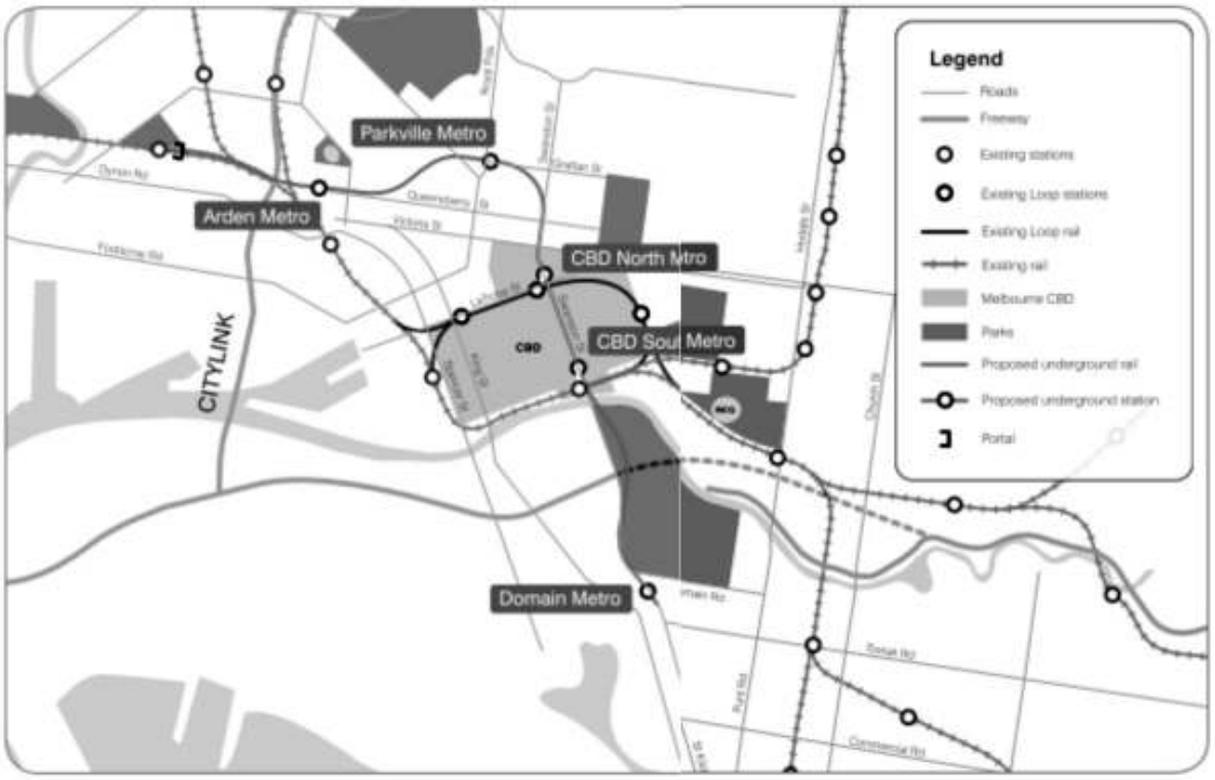
Nessie the tunnel boring machine has commenced tunnelling for marine works as part of the Adelaide Desalination Project.

The second tunnel boring machine (TBM) to work on the project, Cora, has been lowered to the bottom of the working shaft and is being assembled into the launch chamber.

The tunnelling works are part of the plant's outfall and intake pipeline construction. Marine excexcavation works began in November 2009 with the arrival of the 2,400 tonne jack up barge, the Santa Fe, off the coast of Port Stanvac.

The Santa Fe completed the installation of the intake and outfall risers in mid-April 2010 before being removed from the site.

Upon completion, the 11.5 kilometre pipeline will deliver desalinated water from Port Stanvac to the Happy Valley water treatment storage area. The Adelaide Desalination Project will deliver up to 100 billion litres of water annually, which is approximately half of Adelaide's water supply.



Melbourne Metro Rail Tunnel Route

Key details have been released for the preferred route and station locations for $4.5 billion Melbourne Metro Rail Tunnel. The proposed new major rail tunnel will run between Dynon in the west, through the CBD and out to St Kilda Road near Domain.

The proposed new stations are; Arden Metro Station in North Melbourne, Parkville Metro Station, CBD North Metro Station, CBD South Metro Station and Domain Metro Station on St Kilda Road.

The extra rail track provided by the Melbourne Metro Rail Tunnel will allow an extra 14 services and 12,000 passengers to travel into the city each hour.

Subject to funding Melbourne Metro Rail Tunnel is expected to start construction in 2012 and be completed by 2018.

The Victorian Government is seeking public comment on the preferred station locations before submitting its final proposal to the Federal Government for consideration

Melbourne Metro — New Rail Tunnel (Stage 1)

Melbourne Metro Rail Tunnel is a major new rail tunnel between Dynon in the west and St Kilda Road near Domain. This new underground link will benefit the entire metropolitan rail network by creating more rail capacity in the inner-city with five new stations including a new underground Arden Station in North Melbourne.

With proposed underground stops connecting to Melbourne Central and Flinders Street, it will give people from all lines an easy interchange point to access new stations in North Melbourne, Parkville, and St Kilda Road. This will help relieve pressure on trams in Swanston Street and St Kilda Road.

Stage 2

Stage 2 linking Domain to the Caulfield corridor has been identified as a longer term initiative.

Melbourne east-west tunnel back on agenda

A Brumby Government is actively pursuing a road tunnel from Kensington to Clifton Hill. The project was first mooted in the 2008 Eddington report, but community backlash forced the government to back away from any immediate plans when it released its $38 billion Victorian Transport Plan later that year.

The submission to the Federal Department of the Environment indicates the tunnel would follow the completion of the $3.5 billion Westlink project, which is expected to begin in 2013, and is seeking the department's permission to proceed with the project linking Western Ring Rd with Kensington via Sunshine Rd and a new tunnel under Footscray.

The document refers to Westlink as the "immediate priority" in a "three-stage" proposal to build an 18km link between Melbourne's western suburbs and the Eastern Freeway in accordance with the Eddington Report.

A tunnel from Footscray to the Port of Melbourne is the State Government's answer to the West Gate Bridge girdlock that snares thousands of Geelong commuters every day. The $2.8 billion WestLink tunnel would start nearby Dynon Rd and finish either on Geelong Rd near Footscray West train station or an industrial area on Paramount Rd. The new route will funnel a portion of the 160,000 vehicles that travel the bridge each day. Trucks are expected to take advantage of the direct access to the port from the Princes Highway, leaving a clearer run from Geelong along one of the fastest-growing corridors in the state. Community consultation and design work will take until at least 2011 which will determine the design of the tunnel access on the Maribyrnong River crossing.

The Victorian Transport Plan also includes routes to remove truck traffic from residential streets, and a $4.5 billion rail tunnel from Footscray to St Kilda Rd.

Binningup Desalination Project

The approx $1bn Southern Seawater Desalination Plant is under construction near Binningup, about 150 km south of Perth. It will supply water to Perth, as well as the nearby regional city of Bunbury. It is designed to initially deliver 50 gigalitres of potable water per year or 20% of Perth's requirements. Capacity may be increased to 100 gigalitres/year at a future date.

The project will deliver potable water into the South West Integrated System via a 30 km 1.3m diameter pipeline to a storage facility near Harvey. It is expected to be operational in 2011.

The site is located at Taranto Road, Binningup, about 1.2km from the coast with most of the plant situated in a now disused limestone quarry. The intake and outlet pipelines from the plant to the beach and under the ocean are being constructed using two tunnel boring machines and using both tunnelling and pipejacking technology to cover a distance of about 900m.

The specialised tunnelling subcontractor, Zueblin Australia and the Southern Seawater Joint Venture have kindly offered to conduct a tour of the tunnelling and pipejacking operations and the Desalination Project plant site area to members of the Australasian Tunnelling Society on Friday 10th September.

Wonthaggi Desalination Project

AquaSure will finance, design, build, operate and maintain Australia's largest desalination plant on the South Gippsland coast.

AquaSure brings together three companies, all leaders in their fields:

- Degrémont — a SUEZ ENVIRONNEMENT company and world leader in reverse-osmosis desalination technology
- Thiess — one of Australia's largest and most trusted construction and services companies, and
- Macquarie Capital — the world's strongest and most experienced infrastructure advisor.

Thiess Degrémont will design and construct the reverse osmosis desalination process plant, marine tunnels and structures, 84km water transfer pipeline and 87km underground powerline to supply power to the plant.

The Victorian Desalination Project is a key part of the State Government's Water Plan to save, recycle, distribute and create water.

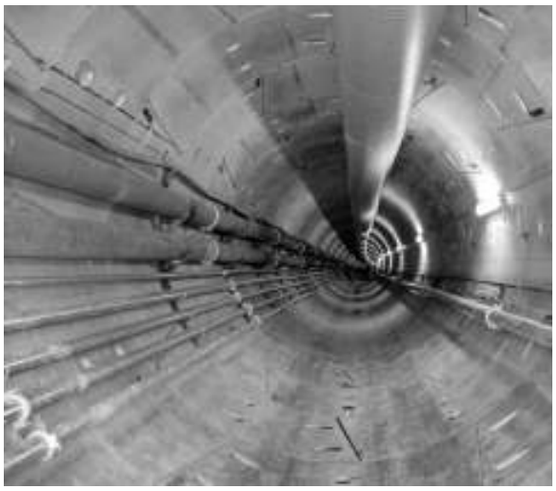
It will deliver the largest desalination plant in Australia, capable of supplying up to 150 billion litres of water a year — a third of Melbourne's annual water needs — with capability to expand to 200 billion litres a year in the future.

Significant progress has been made on the desalination plant site since Thiess Degrémont, the design and construction contractor for AquaSure, began work in September 2009. Bulk earthworks are now complete, with more than 1.3 million cubic meters of earth removed to create new dunes, and more than 15,000m3 of structural concrete poured. The reverse osmosis building has begun to take shape, with more than 1000 tonnes (more than 30 per cent) of structural steel now erected, and more than a third of the 84 km Victorian manufactured pipeline that will carry desalinated water to Melbourne has been laid. Around 24km of power supply conduit has been laid, with 24.7km of the Victorian manufactured cable pulled through.

Construction has also started on the 1.2 km long intake tunnel with over 130 meters bored and work is about to start on the 1.5 km long outlet tunnel. The tunneling is a major milestone for Victoria's desalination plant which remains on time and on budget. Unlike most desalination plants around the world, Victoria's intake and outlet tunnels are being built 15 to 20 meters underneath sand dunes and the seabed to ensure the marine environment is protected.

The custom-built tunnel boring machines are 4.8 metres wide, 91 meters long and weigh more than 500 tonnes each. Two local school students won a competition to name the tunnel boring machines. Jakob Moon, 6, from Traralgon, the son of a project worker, named the intake machine 'Wonthaggi Maggie' and Mycalie James, 18, from Bass Coast Specialist School named the outlet machine 'Rocking Ruby'.

The intake tunnel will draw seawater into the plant where it will be desalinated. The drinking water will be pumped to Melbourne, and the seawater concentrate will be discharged back into Bass Strait via the outlet tunnel where it will be easily dispersed.



Sydney Desal wins Excellence Award

Sydney's Desalination Project, which relied on tunnel boring machines to install the necessary pipeline, has received the Government Partnership Excellence Award at Infrastructure Partnerships Australia's 2010 National Infrastructure Awards.

The plant is the biggest water infrastructure project completed in New South Wales since Warragamba Dam and is Australia's largest desalination plant. The project used three tunnel boring machines (TBM) to minimise the disturbance to residents and also to protect unique tracts of seagrass along the Botany Bay floor.

Production of water commenced in January 2010 and the plant will have a final capacity of 250 million litres per day.

The Sydney Desalination Plant was designed and constructed by John Holland in a joint venture with Veolia Water for Sydney Water.

"The award builds on our reputation for project delivery excellence in New South Wales and our partnership approach to major infrastructure projects, particularly the water sector," said Glenn Palin, John Holland's Group Managing Director.

Sydney's Desalination Plant can supply up to 15 per cent of Sydney's water needs. A feature of the project are the two 2.5 kilometre long inlet and outlet tunnels that carry seawater to the plant for desalination and then disperse refined water back into the sea. John Holland completed the tunnels one month ahead of schedule.

The awards recognise engineering excellence across eight categories and were held in Sydney on 11 March.

Perth sewer construction

Water Corporation has started work on a new sewer pipeline in the northern suburbs of Perth, Western Australia that will use microtunnelling.

Water Corporation and its contractor DM Civil will construct a 4.4 km section of sewer pipe through the suburbs of Woodvale, Kingsley, Madeley and Wanneroo, which will form part of the Gnangara Branch Sewer Section 1 and Collection Sewer.

Microtunnelling will be used to build the section of sewer from Whitfords Avenue to Susan Road to reduce community disturbance.

Most sections of the pipeline will run through Yellagonga Regional Park, and Water Corporation is working closely with the Department of Environment and Conservation, and the Friends of Yellagonga to ensure that environmental sensitivities are well managed.

Sewer construction is expected to be completed by 2011.

Victoria Park Tunnel on track

Work is on schedule for the $340 million Victoria Park Tunnel project. The 440m long cut-and-cover tunnel project is one part of a series of projects collectively known as the Central Motorway Improvements (CMI). Once finished, the tunnel will take about 100,000 vehicles in its three northbound lanes from early 2012.

The tunnel will take the pressure off the St Marys Bay section of State Highway 1, which is currently used by about 200,000 vehicles a day.

Work is being directed under the Victoria Park Alliance that includes Fletcher Construction and the New Zealand Transport Agency. Project liaison manager Darren Utting said work was taking place at five different locations and the work had progressed well thanks to the ground excavations being easier than expected. By the end of the tunnel project about 150,000m3 of dirt would have been moved from the site.

About 280m of the tunnel walls have been completed, 80m of which are in the Victoria Park section of Beaumont St, parallel with the motorway flyover.

A total of 439 of the required 1039 concrete piles have also been inserted at the base of the tunnel and stand as much as 18m in the ground. The walls were each about 1m thick, about 20m apart and stand between 14-25m deep into the ground.

Historic Culvert Removal

Before tunnelling began, workers had to relocate 2km of water mains and 500m of stormwater culvert. Workers removed the historic brick-lined Freemans Bay Culvert, built around 1900 to channel a stream from Western Park.

Tunnel dig diverts traffic through park

As part of the preliminary work traffic will be looped through part of central Auckland's Victoria Park from as contractors get closer to digging a 440m motorway tunnel under the existing flyover.

Transport Agency contractors closed the busy intersection of Victoria St West and Franklin Rd to allow the northbound tunnel to be dug through the park as the main part of a $406 million project. Drivers will now use a sealed diversion of Victoria St into the southern edge of the park.

A similar operation is planned at its northern end, where traffic has been diverted for several weeks near the intersection of Beaumont St and Fanshawe St.

Historic hotel on the move

Adding to complications at the southern end is a plan to move the historic Birdcage Tavern temporarily out of the way of the tunnel builders. This operation, which will be undertaken on a set of four skids.

The Birdcage, built in 1885 as The Rob Roy Hotel, will be jacked up, put on concrete beams at the end of the month and moved 40 metres up Franklin Rd in the city suburb of Freeman's Bay.

When the work is finished in about six months, the 125-year-old hotel will be moved back onto its original site on top of the new tunnel and be part of a new plaza. The future use of the old pub has yet to be decided.

When The Rob Roy was built it was sited on Auckland's waterfront but since then reclamation had moved the brick and concrete building several hundred metres from the seafront.

The category one classified Historic Place Trust building is very fragile and had been extensively strengthened on the inside and outside for the move. The move is a very delicate operation and will take between six and 10 hours.

New Zealand's biggest crane hits Auckland

The biggest crane New Zealand has ever seen is swinging into action over Auckland city to help build one of the country's most significant road projects.

Just six months into construction, workers had already used enough concrete to fill 100 Olympic-sized swimming pools. It was hoped the above-ground work would be completed by next year's Rugby World Cup, but the entire project will not be completed until mid-2012.

Trench excavation commenced

Excavators have started the massive task of removing 16,000 cubic metres of rock and earth to form the trench for the Victoria Park Tunnel. The trench will be 700 metres long and will include a 450m cut and cover tunnel running

underneath Victoria Park. The construction sequence is being varied where the tunnel will run under local roads, Beaumont Street and Victoria Street West. Here, the tunnel will be built by "top-down" techniques.

The depth of the excavation will be 13 metres at the tunnel's lowest point. The material being removed will be mainly natural marine sediment, the fill used to reclaim Freemans Bay in the early 1900s, and the underlying East Coast Bays sandstone. Procedures are in place for recovering anything of historic significance found during the operation, and for the possibility of contaminated materials.

Wellington Northern Corridor

The NZ Transport Agency Board has announced key decisions on the route for the Wellington Northern Corridor, marking a major milestone in the strategic development of this section of State Highway 1. This includes duplication of Mt Victoria and Terrace tunnels included in northern corridor plans.

The corridor, identified by Government earlier this year as one of seven roads of national significance, will be developed as a four lane expressway from Levin to Wellington Airport. The corridor will be built in sections with the overall route substantially completed within the next ten years.

The announcement includes the decision to progress Transmission Gully rather than the Coastal Highway Upgrade as part of the Wellington Northern Corridor.

NZTA Board Chair Brian Roche said this question was considered very carefully before a final decision was made. "Our task was to choose the route which would deliver the best result for the region and New Zealand, while also bearing in mind the potential impact on the environment and surrounding communities. In the end it was clear that Transmission Gully was the better choice. It is less expensive, it will provide a safer four-lane route, it's better for local communities and better for the environment, and it will reduce travel times between Kapiti and Wellington."

Mr Roche said the Board had also chosen a preferred option for the Kapiti expressway route, another key part of the Wellington Northern Corridor. After careful consideration the Board had selected the Sandhills (Western Link) route as the preferred option. "After carefully considering all three options and the feedback from the community on each we came to the conclusion that this route best balances the needs of the Kapiti community with those of the Wellington region and the country as a whole. This new route will help ensure that Kapiti continues to contribute to and benefit from economic growth in the Wellington region." Mr Roche thanked the Kapiti community for ensuring that the Board were well informed of their views on the options, with more than 4,500 submissions provided.

Developing the Wellington Northern Corridor will reduce congestion, improve safety and support economic growth by allowing people and freight to move more efficiently through the region.

He said the NZTA would focus on significantly completing the entire Wellington Northern Corridor, from the Airport to Levin, within ten years.

Priority would be given to projects which address key bottlenecks first, easing congestion and creating capacity where it is most needed while other projects in the corridor are prepared for construction.

Auckland CBD rail tunnel project

The Auckland rail system is currently approaching capacity due to the limit on the number of trains that can fit through the twin-track approach to Britomart station. A CBD tunnel project is being investigated to connect Britomart with the Western Line at Mt Eden via the central city. This will provide two more tracks accessing Britomart allowing an increase in system capacity as well as shortening the route of the western line while providing greater accessibility to the rail system via three new stations under the CBD. The project represents the most significant investment in the history of Auckland passenger rail and will form the centre piece of the network for generations to come.

However, it is identified that the proposal connection to Britomart has some unnecessary drawbacks despite the substantial capital investment, namely that the expansion in capacity will be less than double the current limited capacity, and that the central capacity would still be only two-thirds of the capacity of the existing suburban system. Furthermore conflict between through-running and terminating trains for slots in the existing Britomart approach tunnel would greatly limit the peak capacity of the Auckland rail network, as terminating trains must necessarily occupy two slots on existing approach tunnel as they enter and exit via the same route.

Other drawbacks include the inter-mixing of operationally different 'rapid transit' and locomotive hauled trains at Britomart, the reduction in the potential for Britomart to function as a regional terminus, and the need to retrofit Britomart to support rapid transit style services on platforms 1 and 5 at great expense. There is also a strategic drawback of the proposal. While the system is approaching capacity now, no new capacity would be available until the entirety of the project was complete at a lead time of 7 to 10 years and a cost of approximately $1.5 billion dollars. This represents a significant period of unrealisable potential patronage growth on the network.

A modification to the CBD tunnel concept is proposed to address these drawbacks. It is proposed that the CBD tunnel be extended a further 900m eastward connect directly to Quay Park junction via a cut-and-cover tunnel under Quay Street. The existing Britomart station and approach tracks would be bypassed, while a new pair of tunnel platforms would be built adjacent to Britomart and connected to the existing station concourses via short underpasses.

The existing Britomart station and its approach tunnel would be untouched and continue to operate in their current capacity as terminal station for diesel and electric powered services, while all services using the CBD tunnel would use the new purpose-built 'rapid transit' platforms adjacent. Connecting the eastern end of the tunnel to Quay Park junction via a new pair of tracks (rather than the existing Britomart approach tracks) would provide triple the current system capacity (rather than double), and would therefore match the capacity at the core of the system to that at the periphery. This would allow the CBD tunnel to be utilised to its fullest capacity for electric suburban rapid transit services while allowing the existing station to accommodate various diesel or electric express, regional and intercity services.

The modified proposal also allows for capital expenditure and capacity increases to be introduced in stages. As a first stage the initial 900m cut-and-cover tunnel and new platforms adjacent to Britomart could be constructed and opened first, allowing a doubling of system capacity with a 3-4 year lead time and a cost of approximately $250 million dollars. This would allow rail patronage to continue to grow while the second stage extension through the CBD to Mt Eden was being constructed.

The modification represents the addition of 900m of new tunnel and an fourth pair of underground platforms to the existing proposal at an estimated increase in total project cost of 15–20%.

However, the modification would provide 100% more capacity over the existing proposal plus considerable benefits in terms of in operational flexibility and project staging. Therefore the relatively minor additional expenditure of the modified proposal may result in greatly improved outcomes in cost-benefit analysis, particularly if long term growth over the lifetime of the infrastructure is taken into account.

Green & Yellow Lines — existing tracks into Britomart
Blue Line — track from Newmarket & Orakei heading into CBD rail tunnel
Red Line — track from CBD rail tunnel heading to Newmarket & Orakei
Black lines — indications of pedestrian access points to new station & station outline.

Station Locations

Underground station sites being considered for a $1 billion-$1.5 billion central Auckland rail tunnel have been extended to upper Symonds St.

Consultants conducting a $5 million investigation study for KiwiRail and the Auckland Regional Transport Authority for a 3.5km tunnel between Britomart and Mt Eden believe three new stations should be built to maximise patronage and rail access to the inner city. Albert St-Mayoral Drive and Karangahape Rd have been proposed locations for some time for the other two stations, but Symonds St is identified in a progress report as a major catchment for rail passengers.

The consultants have shortlisted two almost identical sites, both reaching between the intersections of Symonds St with Khyber Pass Rd and Mt Eden Rd but at slightly different angles, depending on the eventual tunnel alignment. They are also considering a pair of options for each of the other two train stops along the tunnel, which would also turn Britomart into a through station on an inner-city rail loop.

That would almost double Britomart's capacity, which is expected otherwise to become constrained by 2020, and give western line passengers a more direct link to downtown Auckland than through Newmarket.

A new Aotea Station, either under the southern end of Albert St or across the Wellesley St intersection under Mayoral Drive, would potentially be busier than Britomart — putting passengers within easy walking range of more shops, offices and classes.

The two options for Karangahape Rd are either beneath its intersection with Pitt St or near the top of Queen St.

But the allure of Queen St may be offset by a need for a shallower site there, and its proximity to potentially unstable land at the top of Myers Park.

The consultants say more investigation would be needed to predict the impact of a station at that site, particularly on the park and St Kevins Arcade.

At first 14 tunnel alignment options were considered, most following a route from Britomart to upper Vincent St before taking varying courses under Spaghetti Junction and Newton on their way to the western line.

One major variation, which did not make a shortlist of three, was for a tunnel swerving beneath Fanshawe St and Nelson St before running under Wellesley St to Symonds St.

Although that would have taken trains close to Auckland University, it would have made the tunnel far more circuitous than the other options.

Auckland Regional Council chairman Mike Lee, whose organisation has been briefed on the progress report, said last night that building a station at the top end of Symonds St was an excellent idea which would boost urban renewal in what was already "a wonderful funky area of the city that has a lot of atmosphere".

The latest report has refrained from narrowing down the cost estimate for a project expected to exceed that of the $1 billion rail electrification project.

A KiwiRail spokeswoman said that was unlikely before the preferred line was chosen by the end of the year, when her organisation intends seeking a land designation to protect the route.

The tunnel is expected to take seven to 10 years to design and build.

It has strong support from Auckland City Mayor John Banks and Manukau Mayor Len Brown, rivals for the Super City leadership who were annoyed when Transport Minister Stephen Joyce said in October that he remained far from convinced about the need for the tunnel.

Although a cost-benefit analysis has yet to be undertaken, the regional transport authority predicts an inner-city rail loop would make downtown Auckland accessible to 370,000 people on train trips of 30 minutes or under.

The latest report from the consultants — a consortium of AECOM, Parsons Brinckerhoff and Beca — expects the tunnel will make "a critical contribution in lifting the entire region's and country's economic performance".

Wellington pursue underground option

The Wellington Regional Chamber of Commerce will be urging the government to consider the underground option for the Basin Reserve as well as the Buckle Street sections of State Highway One.

"If Buckle Street is to be trenched under the new Memorial Park, as was reported in March, it makes sense to investigate the possibilities of continuing the tunnel past the Basin rather than building a flyover between two tunnels," said Chamber CEO Charles Finny. "While the tunnel option may cost more, it is likely to be the best solution in the longer term. It is also the quickest and easiest in terms of consent as it would impact on fewer people and be least disruptive visually. We have learned from the Karo Drive Bypass mistake the costs of taking shortcuts. The decision not to trench that section of State Highway One is one that road users and pedestrians are already regretting due to ongoing traffic delays and environmental costs. The Wellington economy relies on an efficient transport system to improve the flow of goods and services and people. This is also a crucial part of the Road of National Significance connecting the airport to the lower North Island.

Train specs mindful of tunnel plans

Auckland's new electric trains must be capable of running through future tunnels beneath Waitemata Harbour, KiwiRail is telling international suppliers.

In a document seeking expressions of interest in supplying a fleet of 38 electric multiple units (EMU) by 2014, the Government-owned rail company says they must be designed to allow operations through tunnels under both central Auckland and the harbour. These would involve "significant underground running" and operations through underground stations, it says.

In the case of the proposed 3km inner-city tunnel between Britomart and Mt Eden, the trains would have to run up a steep 1-in-26 grade, including curves with a radius as tight as 100m.

Although a study team commissioned by the former Transit NZ and Auckland councils favour road and rail tunnels for the next harbour crossing, Transport Minister Steven Joyce is not ruling out a new bridge for a project he hopes will be ready by 2025.

The number of railcars making up each EMU is not stipulated, but the KiwiRail document says they will be about 70m long, meaning a likelihood of three-car trains capable of seating 240 passengers. They will be built of stainless steel and have a maximum speed of 110km/h, with better acceleration and braking power than Auckland's existing diesel fleet.

The document is the second in preparation for a supply and maintenance contract to be signed early next year, and will be used to compile a short-list of contenders by July.

Although KiwiRail has decided against bidding for its own contract, and building the trains in New Zealand as sought by the Rail and Maritime Transport Union, that organisation is welcoming what it calls "strong local content provisions".

Overseas firms are encouraged to ally themselves with New Zealand contractors or suppliers for the purpose of responding to the document, which says local content could provide them with an option to secure a local base from which to provide a cost-efficient maintenance service. But no requirement for local content is included in a list of "non-price" attributes on which contenders will be scored for KiwiRail's shortlist.

Christchurch Ocean outfall

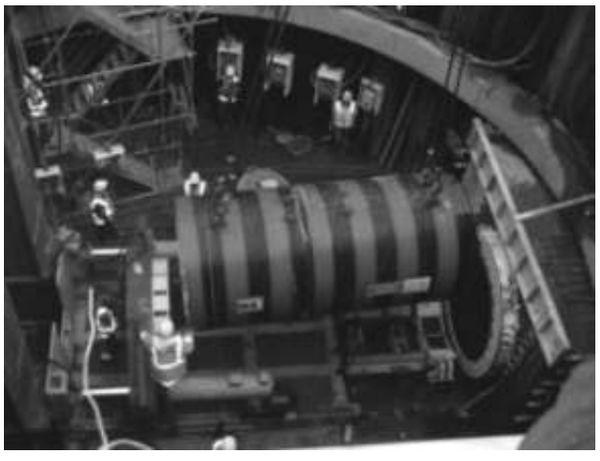
The last section of the Christchurch Ocean Outfall project, located in the South Island of New Zealand, has been completed for Christchurch City Council.

The overall aim of the Christchurch Ocean Outfall project is to permanently avoid discharging the city's treated wastewater into the Avon-Heathcote Estuary. The new outfall transports the waste underground from the Christchurch Wastewater Treatment Plant and discharges it three kilometres offshore into Pegasus Bay.

The microtunnel machine, nicknamed 'Dora the Bora', bored 2.3 kilometers of concrete pipeline onshore, which was part of the 1.8 metre diameter, 4.8 kilometres long outfall pipeline.

For the $NZ87.2 million project, microtunnelling proved to be the most economical option for the project, as well as the option with the least environmental and community impact. The project was the first time microtunnelling has been used on this scale and over this length of drive in New Zealand.

Mark Christison Manager of City Water and Waste for the Christchurch City Council said that the council was "very proud of this project and pass on their sincere thanks to the construction and design teams that have made it happen".



The microtunnel machine, nicknamed 'Dora the Bora', bored 2.3 kilometers of concrete pipeline onshore, which was part of the 1.8 metre diameter, 4.8 kilometres long outfall pipeline.

Milford Sound tunnel considered

Otago and Southland conservation boards will consider in confidence a 135-page draft "determination report on Milford Dart Ltd's proposal to build a $160 million tunnel linking Queenstown to Milford Sound.

Southland conservancy community relations manager Martin Kessick suggested to the Otago Conservation Board that it follow the Southland board's lead in agreeing to accept the draft report in confidence, consider it, and at its next meeting put together some advice to pass on to the conservancy.

Milford Dart applied to the Southland Conservancy for a concession to build and operate the "dart passage", a 10.2km long, 5m diameter, single-lane bus road in December. The original application was lodged in 2005, revised in 2007 and further amended last year.

Southland Conservancy's Chris Visser, who put together the draft report, said it included draft recommendations. Once the conservancy had feedback from Milford Dart, the two conservation boards and Ngai Tahu, it would complete a draft report to go to the "decision maker". Its recommendations would then be put to the minister.

Otago board chairman Hoani Langsbury said the board had not looked at the previous applications for the tunnel as it considered a clause in the Mt Aspiring National Park management plan opposing any new roads in the park meant it could not consider it.

Board member Abby Smith said there were other issues to consider such as walking access and the appropriateness of a road in a national park being restricted to certain users.

Contract award for Central Interceptor Project

Watercare Services has recently awarded the contract for the Central Interceptor Project in Auckland, New Zealand, to engineering consultants AECOM.

The first stage of the project involves the construction of a new sewer tunnel approximately 14 kilometres in length and will be completed by 2025. This new sewer will collect wastewater flows from parts of central Auckland and Waitakere City and transfer them to the existing Mangere Wastewater Treatment Plant (WWTP). Stages two and three of the project will be completed by 2040.

As part of the principal engineer adviser team led by AECOM, Jacobs Associates will lead the tunnel and shaft conceptual design efforts for the initial phase of the work. Jacobs Associates has identified challenges to the design, including

- Challenging tunnelling conditions within a region of basalt-filled valleys and volcanic vents;
- The siting of facilities within heavily urbanised areas with tight space constraints; and
- Defining appropriate excavation methods for an underwater crossing of the Manukau Harbour.

The new system will address future dry weather capacity needs as well as mitigation of wet weather overflows. The project will also be designed in accordance with provisions for projected population growth in the Auckland region.

Rosedale Tunnel and Outfall Complete

History was made on Monday, 16 August when a short ceremony was held by North shore City Council to officially open the Rosedale Tunnel and Outfall.

The $116million development, North Shore's largest ever capital project, replaces a pipeline built in 1958 which carries treated effluent from the Rosedale Wastewater Treatment Plant to a discharge point 600m offshore from Castor Bay.

The new tunnel and outfall carries the highly treated effluent much further out to sea — from the treatment plant to Mairangi Bay along a 3km underground tunnel, and then a further 2.1km offshore through an outfall pipeline where it is dispersed deep in the Rangitoto Channel.

The completed project is part of North Shore City Council's ongoing commitment to protect and improve the quality of our beaches. The new tunnel and outfall has a life span of at least 100 years and will effectively cater for the city's continued growth. The project was completed by North Shore City Council in partnership with McConnell Dowell, AECOM, Aurecon, LOVAT and Wilson Precast Tunnelling.

North Shore City's Council General Manager Infrastructure Services, Geoff Mason says that the strong partnering relationships established between North shore City Council and its contractors have resulted in the successful completion of a world class outfall. "These strong partnerships have allowed all parties to play a proactive role in achieving innovative and effective solutions throughout the project."

Mr Mason says that a significant achievement of this project was the mitigation of disruption for local residents. "There were times when residents were aware of the project, but on the whole, the underground tunnelling, from Atlas Place to Mairangi Bay, was a minimum of 25 metres below the surface, resulting in minimum disruptions for the community. He says that the council would like to thank local residents, and the citizens of the wider North Shore, for their patience, and for their ongoing interest and support.

Memorial seats will be installed in Mairangi Bay to mark the route of the tunnel. These seats were designed by North Shore artist Phil Bonham, and constructed using concrete segments similar to those used to line the tunnel.

Rosedale Tunnel and Outfall Project General specifications:

Maximum flow capacity: 6 cubic metres per second

Total project cost: $116million

Total length of tunnel and outfall: 5.1km

Designed life expectancy: 100 years

Tunnelling method: Tunnel boring machine

Dredging method: Barge-mounted digger

Construction start date: February 2008

Construction completion date: July 2010

Tunnel specifications:

Tunnel length: 3km

Tunnel length under sea: 600m

Tunnel diameter (internal): 2.8m

Minimum depth underground: 25m

Maximum depth underground: 75m

Liner segments: 18,000

Downhill gradient: 1:90

Marine specifications:

Marine outfall length: 2.1km in seabed

Marine outfall diameter (internal): 1.47m

Depth under sea: 14m–17m (dependent on tides)

Depth under seabed: 1m

Construction timeline:

In February 2008 construction began on the first stages of the project with the digging of a 45m drop shaft. Room

was created at the base of the shaft to allow the tunnel boring machine, Amelia Rose, to be assembled underground.

In December 2008 an offshore riser, which would later connect the completed tunnel to the outfall pipeline, was installed 600m offshore from Mairangi Bay. The riser is needed to carry the treated effluent from the tunnel to the outfall pipe.

Amelia Rose was specifically designed and imported for this project. She began boring the tunnel in February 2009, working 24 hours a day, seven days a week, in order to complete the 3km tunnel by December 2009.

In preparation for the installation of the outfall pipe, a 3m-deep trench was dredged into the seabed. The dredger operated 24 hours a day, seven days a week, and completed its work in February 2009.

The 2.1km outfall pipeline, constructed by joining together 12m lengths of pipe, was fabricated in Kaiaua on the Firth of Thames. Each section, between 400 to 500m long, was individually towed by tug boats approximately 100km to Mairangi Bay.

The high-density polyethylene outfall pipe was placed into a 3m-deep trench dug in the seabed with concrete ballast blocks attached to hold it in place. The pipeline was then covered with a 1m depth of seabed material.

Once the pipeline was installed, divers attached 58 diffuser nozzles to the last 350m of the pipeline. These 'duck bill' diffusers disperse the treated effluent into the sea across a greater area in smaller volumes than the previous systems.

The final stage of the project, in May 2010, saw the completion of the cascade drop-shaft structure connecting the treatment plant to the tunnel entrance. Twenty four concrete segments, each weighing 56 tonnes, were installed in the shaft to form the cascade.

Cyclists prefer tunnel

A plan by the New Zealand Transport Agency to create a cycleway over the Caversham Hill is not the best option for cyclists, according to the group pushing to be able to use a former rail tunnel through the hill.

Dunedin Tunnels Trail Trust spokesman Gerard Hyland said it was good to see the $30 million Caversham highway upgrade going ahead, but it was "disappointing" the agency was "unable to see the advantages of using the old Caversham tunnel as a cycleway".

The upgrade from Andersons Bay Rd to Lookout Point includes a cycleway up the northern side of the Caversham hill.

Mr Hyland said using the tunnel alternative would remove a "large amount of non-vehicular traffic from a busy and potentially dangerous section of State Highway 1.In addition to creating a safer route for cyclists travelling between Caversham and Green Island ... it shortens the trip and changes it from a vertical climb of 120m — close to a 1 in 10 gradient — to a gentle rail-trail gradient. A cycleway over the Caversham hill would be suitable for regular cyclists, "however, a cycleway through the tunnel could be used by a far larger group of people".

Mr Hyland said the agency had agreed to leave the Caversham tunnel mouth unblocked when it upgraded the highway. He considered developing a cycleway through the Caversham tunnel and through a second tunnel at Wingatui fitted into the agency's safer journeys strategy, announced last year, to lift bicycle use and cut cycling fatalities.

The Dunedin City Council is planning a feasibility study into using the tunnels, but will also look at other options for a cycleway south of the city. Acting general manager strategy and development Nicola Johnston said the terms of reference for the study had been prepared. They noted the "necessity of connecting to the cycleway plans for Caversham highway improvements".

Homer Tunnel may be widened

The New Zealand Transport Agency is considering widening the Homer Tunnel on the Milford road (State Highway 94) between Te Anau and Milford Sound. Meeting the Queenstown Lakes District Council's utilities committee recently, NZTA regional director Bruce Richards said the agency was investigating options for improving safety at the Homer Tunnel.

"I would like to see the tunnel widened. It is important to tourism in the area, but it is also a matter of safety. One day there could be another bus fire in there, and a wider tunnel would allow for a pedestrian walkway along the side, to be used in case of an emergency," Mr Richards said. The work is still at the planning stage, with the initial investigation scheduled to be completed in October.

After the meeting, he told the Otago Daily Times the NZTA had been presented with various options for improving safety in the tunnel, but said widening it appeared to be the "preferred option so far", although no final decision has been made yet.

After October, a tender process for the design of any chosen upgrade will be carried out, and funding would have to be allocated. Mr Richards indicated work on the tunnel could start within the next financial year.

The Homer Tunnel runs beneath the Homer Saddle within Fiordland National Park. Construction began in 1934 and, following delays during World War 2 and for avalanche damage, it opened in 1953. The 1.27km long tunnel has a 10% gradient and varies in width from 6.5m to 7.5m. At the height of the summer tourism season it is used by more than 100 tour buses a day.

Nevis tunnel option

The NZ Transport Agency will explore the idea of a tunnel to replace a rockfall-prone stretch of highway at the Nevis Bluff, midway between Cromwell and Queenstown.

Blasting and drilling work to remove loose rock from the bluff is expected to delay motorists using State Highway 6 until mid-March.

The $240,000 job started this month. Agency Central Otago area manager John Jarvis said the bluff was inspected every month and, as part of reviews this year, the option of building a tunnel would be explored. If a tunnel were built it would cost tens of millions of dollars but it would largely remove the need for monitoring, expensive blasting and sluicing of the face.

Two blasting jobs had been completed and contractor Fulton Hogan's 10-strong team was doing physically demanding and dangerous work, Mr Jarvis said.

Meridian approval for Waitaki water

Meridian Energy has taken a major step towards construction of a massive hydro-electric tunnel along the Waitaki River in South Canterbury.

The state-owned power company has gained final approval to take Waitaki water for its proposed $900 million North Bank Tunnel project — a planned 12-metre-wide, 36km-long underground tunnel carrying up to 280 cubic metres of water per second, producing 1400 GWh of electricity annually for 175,000 homes in Otago and Canterbury, the Timaru Herald reported.

The Environment Court gave the company consent to take and use water from Lake Waitaki and to discharge water into the lower Waitaki River for 35 years after Meridian and the Lower Waitaki River Management Society reached agreement on Meridian's consent application — which addressed environmental issues surrounding wetlands and braided-river birds.

Management society chairman Bill Penno said the group did not get everything it had been asking for but they had come to an acceptable agreement.

Meridian spokeswoman Claire Shaw said the next step was to start talking to landowners and other stakeholders about the land use consenting process.

Once complete, the tunnel scheme will feed into the Hunter Downs irrigation scheme, which could irrigate up to 40,000 of 60,000 hectares of land from the Waitaki River as far north as Otipua.

The project is expected to take seven years to complete and will employ more than 400 people.

Jakarta sewage tunnel system

The city administration says it is working with the central government to build a sewage tunnel system that will channel household liquid waste to a plant that will recycle it into raw water.

Governor Fauzi Bowo said the government would use a Rp 3.8 trillion (US$412.5 million) loan from the Japan International Cooperation Agency (JICA) for the initial construction of pipes and the plant. "We chose a foreign loan because the private sector cannot afford to fund an infrastructure project of this scale," he said after meeting with representatives from the Public Works Ministry. The city will foot Rp 700 billion of the total cost.

Susmono, the director of environmental health division at the Public Works Ministry, said the plant would turn liquid waste, including from septic tanks, kitchens and bathrooms, into raw water before flushing it away into nearby rivers or dams. "Houses that are connected to the sewage system will have dry ditches. The ditches will only channel rainwater," he said.

Fauzi said the city and the government would need to review a master plan of the first phase of the project, which is expected to start in the middle of 2011 be operational by 2020. He said in the first stage of the project, a team from the city and the government would construct the central zone project that would run from Setia Budi in Central Jakarta to a plant in North Jakarta, the team had not decided on the plant's location, saying they were still considering the options of an area near Pluit dam and Muara Angke, North Jakarta.

The central zone would use a 1.8-meter diameter pipe from Setia Budi that would be pumped to the plant, he said. The first phase of the project can only serve 700,000 people, or some 10 percent of the capacity," Fauzi said. Despite the small capacity, he said the construction of the main pipes would be the milestone of the project, as it would make construction of the rest of the system easier. The next project would be the northwest zone, running from Gunung Sahari in Central Jakarta to Sunter in North Jakarta. The southwest zone would run from Palmerah to Kebon Jeruk in West Jakarta, he said.

Fauzi added that he was optimistic that by 2030, the capacity of the sewage system would reach 25 percent after these two zones were completed. Ahmad Haryadi, the deputy governor overseeing city spatial and environment planning, said the team had not calculated the cost for the whole project, including the second phase. "The easiest calculation was the central zone," he said.

Susmono said the tunneling sewage system was a national project started in 15 cities. He said the pilot project for the system was being applied in 11 cities, including Jakarta, Bandung in West Java, Medan in North Sumatra, Yogyakarta, Surakarta in Central Java, Banjarmasin in South Kalimantan and Denpasar in Bali.

In Jakarta, a sewage processing plant, part of the project, is located in Setia Budi, covers only the neighboring area.

Rohtang tunnel finally starts

More than a decade after its strategic value was realised after Pakistan tried to cut the Srinagar-Leh road during the Kargil conflict, work on the Rohtang tunnel was finally be kicked off when UPA chairperson Sonia Gandhi layed the foundation stone of the project on June 28.

The 8.8 km tunnel cuts through the Himalayan range to make an all-weather road to Ladakh and the strategic Siachen glacier, was conceptualised 27 years ago but work was only accelerated following the Kargil conflict. The Rs 1,495-crore tunnel, which was cleared by the Cabinet Committee on Security last year, will be constructed with the help of Austrian firm Strabag and is expected to be ready by 2015.

Located 51 km from Manali, the tunnel will be constructed at the Rohtang pass, at an altitude of 13,000 feet, and will give all-year access to Ladakh and the Lahaul-Spiti valley in Himachal Pradesh. This will be a drastic improvement from the present situation as the Rohtang pass remains snowbound for more than six months.

The tunnel will be an all-weather alternative which is expected to help the armed forces maintain connectivity to the region in the face of heavy snowfall, high velocity winds and sub-zero temperatures. The tunnel will also reduce the distance between Manali and Keylong by at least 48km and will save travel time by about four hours.

The tunnel is expected to be completed by 2015. About 18 avalanche protection structures have been erected on the tunnel. The BRO is also studying the feasibility of constructing another tunnel beneath the Shinkula Pass.

India's longest tunnel

The 10.96 km long Pir Panjal Railway Tunnel at Banihal in J&K, part of the Jammu-Srinagar railway line, due to be completed next year is nearing completion.

The Banihal Tunnel is located at relatively low altitudes, — touching 2,200 m at its peak, with an average altitude of 1,750 m. As of now the longest tunnel in the country is the 6.5 km long Karbude Tunnel in Ratnagiri district of Maharashtra, part of the Konkan Railway network, but being located on the Western Ghats, this tunnel is located at almost negligible altitudes of less than 50 feet.

The longest road tunnel in India is the 2.8 km long Jawahar Tunnel, again at Banihal, with an altitude of 2,209 m, completed in 1956, and has twin tube tunnels running side by side, also making it unique. The Rohtang Tunnel is proposed to be built under the Rohtang Pass in the Leh-Manali Highway. The 9 km long tunnel will be the longest road tunnel in India and is expected to reduce the distance between Manali and Keylong by over 60 km.

Lowari Tunnel — Pakistan

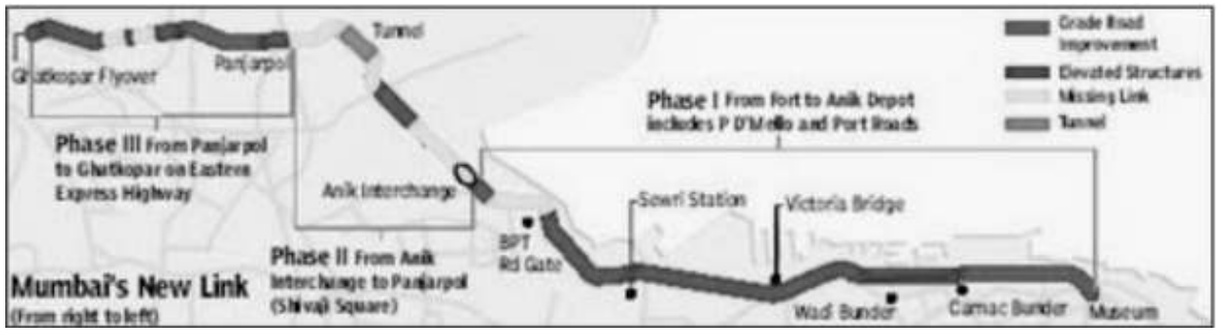
The Pakistani government has nearly completed a vehicle tunnel through the Lowari mountain pass, which has made Chitral accessible to the rest of Pakistan during the long winter months for the first time in history. Typically snowfall atop the 10,000-foot overland Lowari Pass cuts off the district from the rest of the country for half the year — making Chitral virtually impenetrable.

The Lowari Tunnel may will make Chitral open year 'round. The completion of the Lowari Tunnel was delayed by fighting that spilled over from the Swat Valley southeast of Chitral last year. Foreign construction firms refused to work on the tunnel project while Taliban extremists were roaming the Dir Valley due south of Chitral. But once the fighting in Dir subsided, Chitral was not as isolated during the past winter.

Undersea tunnel from Cebu to Lapu-Lapu City

A legislator has proposed the construction of an undersea tunnel that will connect to major cities in the province of Cebu, in the Phillipines. Cebu City 1st District Rep. Rachel Marguerite del Mar said the tunnel will link Cebu City to Lapu-Lapu City and ease traffic congestion, which has been a result of the expansion of the Mactan-Cebu International Airport.

"This project may appear ambitious but this is the solution to the traffic situation in the city," Del Mar said in a statement. Del Mar recently filed House Bill 192, which provides for the construction of the additional access routes and appropriating funds for the infrastructure project. "Because of this, necessary complementary infrastructure facilities must be in place and in top shape. And any infrastructure strategy must consider the expanded and accelerated economic growth of the area," she said. "The traffic movement across the existing Mandaue City to Lapu-Lapu City roads and bridges shall exceed its accommodation capacity in the coming days," the neophyte lawmaker added.



Mumbai's first twin road tunnel

Mumbai's first twin tunnel costing Rs 61 crore will be completed by the end of this year. The tunnel starts at the BARC Mountain and ends at Gautam Nagar near Panjarpol. The MMRDA has completed the excavation of 350 metres of the left tube of the twin tunnel starting from the Eastern Freeway towards Panjarpol, of which, a 100-metre full cross section will be concrete lined. The excavation work of the 250-metre right tube from the Eastern Freeway towards Panjarpol has also been completed.

The tunnels are about half-a-km in length each. They are 17-metre in width and 10-metre in height and will have

four carriageways in each tunnel.The twin tunnel is a part of the four-lane Eastern Freeway Project, which starts near the PD'Mello Road and joins the Eastern Express Highway via the Anik-Panjarpol link road, near Wadala, covering a distance of 12 km.

Melamchi drinking water tunnel resumes

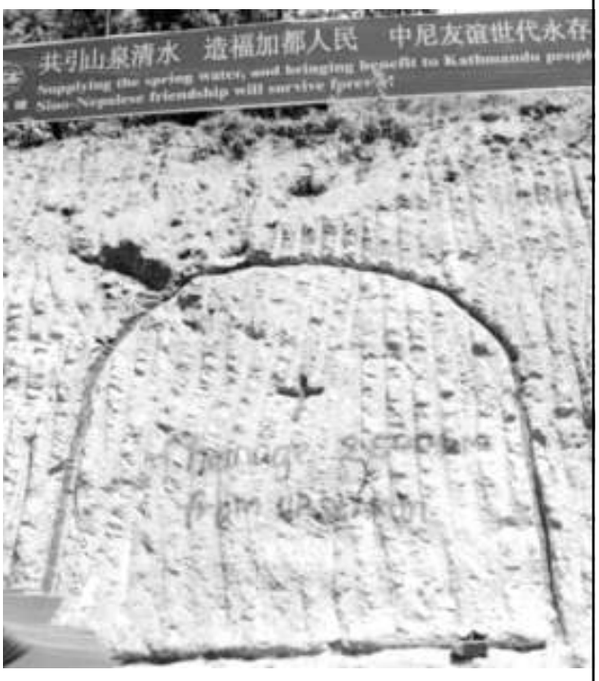
The construction of tunnel of the Melamchi Drinking Water project stalled for past six months due to obstructions by locals and lack of construction materials has resumed.

Two Chinese companies, China Railway 15 Bureau Group Corporation and China CMIIC Engineering Corporation have got the contract to construct the 26.5 km long diversion tunnel connecting Melamchi river with Sundarijal in Kathmandu.

However, the construction had stalled after digging only 3 metres of tunnel due to the obstruction by locals. They had padlocked the office of the project with various demands including their involvement in the construction, additional funds for the development of the affected VDCs and even changing the name of the project.

Assistant Executive Director of Melamchi Drinking Water Project Narendra Kumar Baral said, the work has begun as the locals opened the locks after reaching agreement. Baral also said the project had recommended to the government to change the name of the project as per the demands of the locals.

The contractors have claimed, the construction will be completed on time despite the obstruction.



Work begins on Bangalore metro

The Bangalore Metro Rail Corp (BMRC) has begun preparatory work to commence tunnelling for the underground corridor at Minsk Square.

The Minsk Square underground station is part of the UG-2 corridor running from Chinnaswamy Cricket stadium to Magadi Road. Excavation will begin by the year end after the TBMs arrive from Japan.

"We have placed barricades and other equipment at the police parade grounds, opposite BRV armoury. The underground ramp for the Minsk Square station will begin at the grounds, while entry/exit point with air ventilation points will be located on the land adjacent to the HAL corporate office," said a BMRCL engineer.

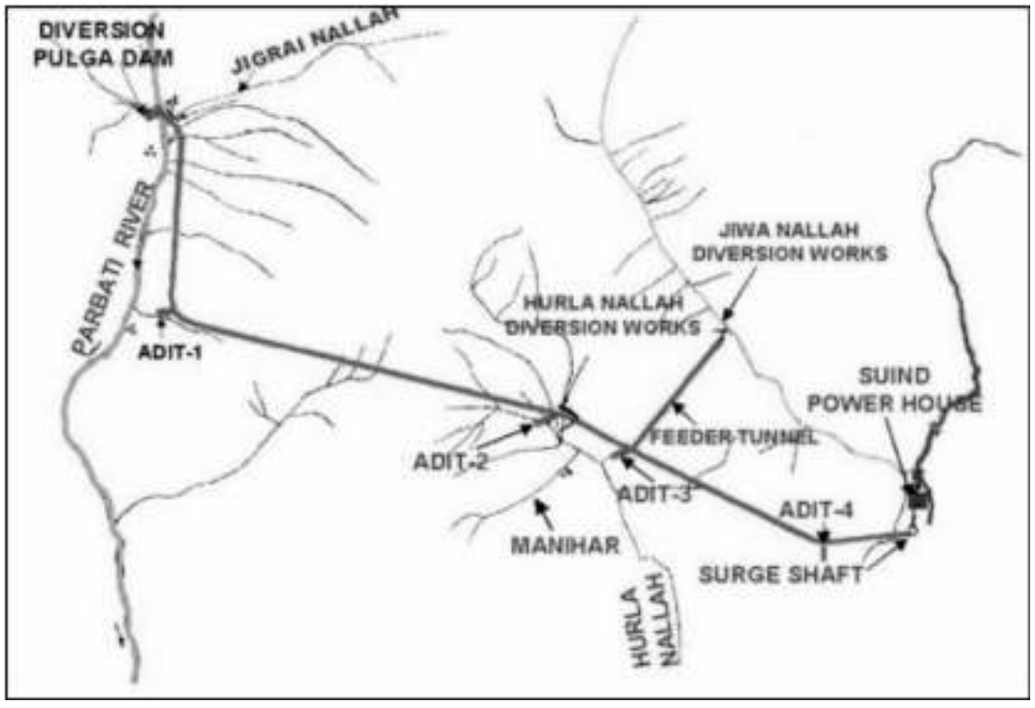
India's first underwater train tunnel

Afcons Infrastructure, the infrastructure arm of Shapoorji Pallonji group, has bagged a Rs 938-crore contract from Kolkata Metro Railway Corporation (KMRC) for a critical stretch of the Rs 4,678-crore East-West Metro that includes three underground stations and a section under the river Hooghly.

This is the first time that a transportation tunnel running 20 metre below a river will be built in India. Mumbai-based Afcons, which recently completed a job for the Delhi Metro Railway Corporation, grabbed the contract through competitive bidding. Others in the fray included Senbo-Shanghai Urban, CEC-Simplex , IVRCL and L&T. KMRC is a joint venture between West Bengal government and union urban development ministry.

Afcons Infrastructure will design and execute the project dubbed "UG 1" through a recently formed strategic JV with a Russian company Transtonnelstroy. The Transtonnelstroy Afcons JV is slated to construct a 3.89-km stretch, including 520 metres of the underwater section and three underground stations at Howrah Maidan, Howrah station and Mahakaran, within a period of 42 months. The Russian company has experience of working on similar projects in Iran to build a road under the sea. Incidentally, Afcons is also bidding for upcoming Chennai Metro projects with its Russian partner.

"For the underwater stretch, we've tied up with Atkins, a Dubai-based company which is a leading consultant for underwater tunneling," R V Ramanan director (transportation) of Afcons said. Incidentally, Atkins which has worked on the Dubai Metro will also assist Afcons to monitor and study the impact of tunnelling on the buildings and structure above ground.



Kullu Valley Hydroelectric Power Project Resumes

India's National Hydro Power Corporation has resumed work on an ambitious hydroelectric power project in India s Kullu valley.

The construction at the Parbati Hydro Electric Project was delayed due to frequent blasting at the tunnel digging site, resulting in the leakage of mountain water. The work on the head race tunnel has also been brought to a standstill after the tunnel digging machine ended up getting submerged in silt and water. But after the environmental concerns were addressed by the corporation, work has resumed on the second stage of the project in the valley. "In comparison to the earlier situation, we are in a better position to carry out the project now. Future projects will also benefit due to reduced pollution from the plant.

We are also finding solutions such as planting more trees and constructing fisheries. So we are implementing the complete environmental management plan, and the entire state supports that." Sharma added that the power plant would begin generating electricity in another two years. The National Hydro Power Corporation is a Government of India enterprise set up in 1975 to provide and develop hydroelectric power in India.

Today, it s among the top ten companies of India in terms of investment. It s also explored other sources of energy, such as geothermal, tidal and wind.

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Development of Underground Space

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Keynote Presentations

- **Professor Giovanni Barla, Turin Polytechnic University** never fails to infuse his audience with his enthusiasm and love for underground soil/rock mechanics and we look forward to his address.
- **Alan Morris, Project Manager for the XRL Tunnels , Mass Transport Railway Corporation, Hong Kong** will provide an overview of tunnelling in Asia while also outlining his views on where our industry finds itself in terms of technical developments.
- **Professor Arnold Dicks**, Chairman of the ITA Contractual Practices Group and Australian delegate to PIARC in tunnel ventilation, safety and environment will address operational issues in particular in vehicular tunnels.

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Neelam Jhelum Hydroelectric Project

Neelam Jhelum Hydroelectric Project is located near Muzaffarabad, capital of Pakistani Administered Kashmir. It aims to dig a tunnel and divert water of Neelam River from Nauseri, about 41 KM East of Muzaffarabad.

A powerhouse will be constructed at Chatter Kalas, 22 Km South of Muzaffarabad; and after passing through the turbines the water will be released in Jhelum River, about four Km South of Chatter Kalas.

Once completed, the Neelam Jhelum Hydroelectric Project will produce 969 MW of electricity annually at the cost of US 2.16 billion dollars.

This hydroelectric project was formally announced by former Minister Omar Ayub on June 10, 2007. WAPDA selected MWH, a global provider of environmental engineering, strategic consulting and construction services, to provide engineering and construction management services for the Neelam-Jhelum Hydroelectric Project.

It is a joint venture led by MWH and consisting of MWH, Pakistani firms NESPAK, ACE and NDC, and Norwegian firm NORPLAN. The MWH will provide design, make construction drawing preparation and management construction services; and the project will be completed within eight years.

A concrete gravity dam 135 m long and 47 m high will be constructed on Neelam River at Nauseri. The dam is designed for over-topping. The dam will create a head pond of eight million cubic meters, which will allow a peaking reservoir of 2.08 million cubic meters to meet daily peaking of power for more than four hours.

A six gate tunnel intake structure of 280 cumec capacity will be connected with three conventional flushing surface basins installed at their end for taking sediment back into river.

The total length of head race tunnel is 28.5 Km. A 15.1 Km stretch of the tunnel from the Nauseri will be constructed as a twin tunnel system each with cross section of 42 Sq.m. The remaining head race tunnel down to the surge chamber will be a single tunnel having cross section of 82 Sq.m. The tunnels are shotcrete lined with a concrete invert.

The tunnel crosses Jhelum River approximately 380 meters below its bed. The tunnel will be accessed by 7 Adits for removal of excavated spoil.

The surge chamber consists of 340 m high riser shaft and 820 m long surge tunnel. Four steel lined Penstock tunnels 150 m long and having 3.8 m internal diameter will also be constructed.

The under-ground power station will have four units with a total capacity of 969 MW. The power station will be connected with Rawat Grid station (in Pakistan) through 500KV double circuit transmission line.

Overall project cost is estimated at Rs. 130 billion (US 2.16 billion dollars) and Installed capacity 969 MW four units @ 242 MW each.

The concrete gravity dam is expected to take eight years for completion. The construction contact was awarded, on July 7, 2007, to M/s CGGC-CMEC consortium China for implementation of the project at a cost of Rs. 90.90 billions.

Government of Pakistan has approved financial arrangement for the project and established Neelam Jhelum Hydropower Company for project implementation.

Although the work has already started on the project, as yet there is no written agreement between WAPDA and government of Pakistani Administered Kashmir.

Meanwhile the Indian plan is to divert water through a 21 KM long tunnel before it enters Pakistani Administered Kashmir; and release the water into Bonar Madumati Nullah — a tributary of the Jhelum River. The diverted water would be used for generating electricity and feeding the Wullar Lake in the process.

In other words, after the completion of this project, the water of Neelam River or Kishen Ganga will join River Jhelum at Bandipore on the Indian side of LOC instead of its present convergence at Domel in Muzaffarabad, Pakistani Administered Kashmir.

Pakistan has serious objections to this project, as they feel this project will reduce flow of water in the Neelam River when it enters Pakistani Administered Kashmir; and it will have a severe impact on their project: Neelam-Jhelum Hydro Electric Project.

The government of Pakistan wishes to resolve this issue bilaterally, but there is also talk of invoking the arbitration process enshrined in the Indus Water Treaty of 1960.

Overall project cost is estimated at Rs. 130 billion (US 2.16 billion dollars) and Installed capacity 969 MW four units @ 242 MW each.

Xi'an Metro Line 1

Robbins has announced that the first of two 6.2m diameter EPB machines, delivered to project in China, was successfully launched on April 28.

The EPBs will excavate Lot 12 of the metro line to create two parallel 2.3km long tunnels, and will pass through four cut-and-cover stations stretching from Kangfu Road to Chang Lepo. Once complete, the 26.4km metro Line 1 will travel from north to south through downtown areas of Xi'an.

Robbins signed the contract with China Railway 11th Engineering Bureau Group Ltd in June 2009. The machines were assembled in March at a manufacturing facility in Chengdu and the second machine will be launched later in May. The TBMs are the first to start work on Line 1, and will be followed by a further eight machines.

Both TBMs have been customised with spoke-type cutterheads and 800mm diameter shaft-type screw conveyors to aid their advance through sand pebbles

and clay while maintaining a water-tight seal and balanced pressure.

Xi'an is a 3,000 year old city well known for its rich culture and artefacts such as the terracotta warriors. The new metro line will pass near a number of ancient structures and, as city regulations stipulate a maximum of ± 15 mm surface extrusion or settlement on tunnelling projects, subsidence and vibration will be carefully monitored throughout excavation.

Line 2 of the Xi'an metro is currently under construction and will be operational in 2011. Three more lines are planned for excavation in the next five to seven years.

VINCI signs MoU for Vietnam road tunnel

French construction and concession company Vinci SA has signed a memorandum of understanding with Vietnamese concession holder Deo Ca Investment JSC for the turnkey construction of the Ca Pass tunnel and road project in Vietnam.

The value of the project is estimated at $600 million. The agreement provides for a first phase of exclusive discussions with a view to signing a design-build contract.

According to the design, Deo Ca Pass Tunnel will start at KM 1353+500 on National Highway No 1A in Hoa Xuan Nam Commune, Dong Hoa Dist, Phu Yen province and end at KM 1373+500 in Van Tho Commune, Van Ninh Dist, Khanh Hoa province. The total length of the road is 11,100 metres, in which the main tunnel through Deo Ca Pass is 5,450 metres long and the other tunnel through Co Ma Pass of 350 metres long.

In the first phase, the investors plan to build the roads with Grade 3 standards for delta road with total surface width of 12 metres, for designed speed of 80 kilometres per hour. There are two tunnels in Deo Ca Pass Tunnel, 80 metres separated from each other. The tunnel's width is 11.5 metres for two lanes, one for the pedestrians.

Pahang-Selangor tunnel

The US$2.8 billion interstate raw-water transfer project from Pahang to Selangor in Malaysia officially began on April 6, with a ground-breaking ceremony attended by Sultan Ahmad Shah of Pahang.

Once completed in 2014, the project is expected to pump 1,890 million litres of untreated water each day from Sungai Semantan in Pahang to the Hulu Langat water treatment facility in Selangor, via a 44.6km tunnel bored through the Titiwangsa mountain range.

The project is essential to cope with the future demand for water from industrial, commercial and tourism sectors in Selangor, Kuala Lumpur and Putrajaya. The demand for treated water is expected to increase 4.3% yearly and will reach a higher rate in 2015.

The first phase of the project, which will be mainly financed by the Japan International Corporation Agency (JICA) at a cost of US$1.2 billion, will involve the construction of a tunnel, a dam, water intake point, pump station and dual water pipelines. The pipelines and tunnel will be the longest in South-East Asia and the sixth largest in the world.

The second phase will comprise the water treatment plant in Hulu Langat and a distribution system costing some US$1.4 billion to be funded by Perbadanan Aset Air Berhad.

Energy, green technology and water minister, Datuk Seri Peter Chin Fah Kui says: "Work on the two parts of the project will be carried out simultaneously and will take approximately 60 months to complete. Completion is expected on May 30, 2014."

The raw water supply project, which is jointly developed by Japan's Shimizu Corp and Nishimatsu Construction, along with local companies: IJM Corp and UEM Builders Bhd, is expected to earn Pahang US$22 million annually for the next five years.

Hong Kong Water caverns win environment award

A design that creatively preserved the heritage and natural environment of the campus grounds at the University of Hong Kong (HKU) won in the Design Category of the 2010 International Water Association's (IWA) Project Innovation Awards for the East Asia region presented recently at The Portman Ritz-Carlton Hotel, Shanghai, China.

Prompted by the Water Supplies Department's initiative of building a service reservoir inside a cavern, Black & Veatch's design ingeniously fashioned a cavern to house two service reservoirs as part of HKU's Centennial Campus expansion. The novel approach had never been attempted in Hong Kong before and was commended for the environmental benefits that it brought about.

There was a fresh water service reservoir inside the proposed campus expansion site supplying drinking water to local residents. The original project scope called for replacing this reservoir with two new reservoirs with a total capacity of 26,500 cubic meters on platforms cut into the Lung Fu Shan hillside located next to the site.

The innovative solution hinged on the construction of salt water service reservoirs that would be housed in a new cavern carved out from inside the hill. The new fresh water service reservoirs would then be built on the area previously occupied by the original salt water service reservoirs.

The award-winning design saved a significant number of trees and an area of 6,000 square meters from destruction. By ensuring the slopes and trees all stayed intact, the amount of generated waste was reduced by approximately 85 percent. Three graded historical buildings, as well as the habitats of a number of protected species of flora and fauna, were also preserved.

In addition, Black & Veatch was able to complete the project six months ahead of schedule and under budget.

The project, "Design and Construction of Re-Provisioning of WSD Utilities and Infrastructure Works for Proposed Centennial Campus of the University of Hong Kong," was appropriately recognized for its achievements on the eve of World Environment Day, 5 June.

Hong Kong West Drainage Tunnel

The HK$3000 million Hong Kong West drainage tunnel and lower catchment improvement project will be contributing to the general improvement in environmental quality due to the improvement of the drainage system. It is estimated that the environmental improvement will result from the reduction of flooding and hazardous flow within the urban area

The HKWDT Project aims at alleviating the flooding problems in Northern Hong Kong lsland. The scope of the project comprises the construction of a drainage tunnel deep into the ground in Mid-levels of the Northern Hong Kong Island from Tai Hang to Pokfulam to intercept and convey the stormwater from the upper catchment directly to the sea near Cyberport.

Arup

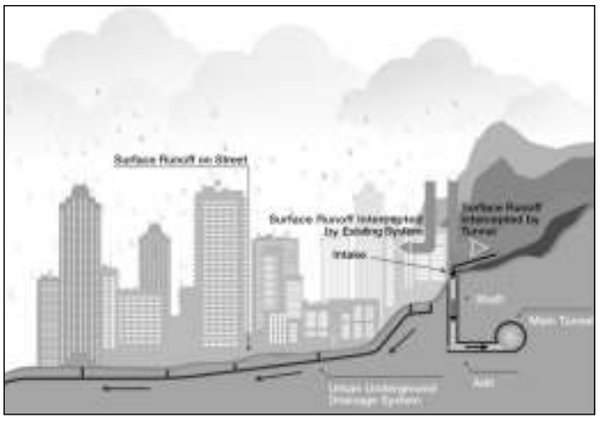
Arup was awarded the detailed design and supervision contracts for the project. The largest of the three current drainage projects in Hong Kong has as its objectives to raise the overall flood protection standard and effectively relieve the flooding risk of the low-lying urban area at northwest Hong Kong Island. Arup is providing a full range of multidisciplinary services to the project including tunnel, geotechnical, hydraulic, landscape design, environmental and traffic impact assessment. Other associated works include: slope works, hazard mitigation measures, roads and drainage works, traffic management, environmental mitigation measures, landscape and other ancillary works.

Lay-out & Construction

The Hong Kong West Drainage Tunnel runs in two sections. The first, 4.5km long and 6.25m in diameter, runs from Tai Hang to beneath Aberdeen Tunnel; the second, 6km long and 7.25m in diameter, is from Aberdeen Tunnel to Cyberport. The main tunnels will be constructed by two tunnel boring machines (TBM) starting from the eastern portal at Tai Hang and the western portal at Cyberport. Along with the main tunnel there will be 35 intake shafts up to 180m deep, many to be constructed in very constrained sites. To connect the shafts to the main tunnel there will be 7.5km of connection adits.

Major Improvements and Benefits

As per the Hong Kong Drainage Services Department (HKDSD), “After completion of the works, rainwater above Mid-levels will be intercepted by the drainage tunnel and hence the capacity of the existing stormwater drainage system will be improved. Together with the lower catchment works to be implemented, a reasonable flood protection level can be achieved.” The Hong Kong West Drainage Tunnel Project will raise the overall flood protection standard and effectively relieve the flooding problem in Northern Hong Kong Island.



Environmental Benefit of the Project

The drainage tunnel project will be improving the flood protection level for the low lying areas on Northern Hong Kong Island without any significant additional improvement works to the existing drainage system in highly busy districts like Sai Ying Pun, Sheung Wan, Central, Admirty, Wanchai and Causeway Bay.

The drainage tunnel will also be conveying the uphill runoff via its intake structures and adit systems for disposal into the sea off the western cost of Hong Kong Island, alleviating the flooding problems on Northern Hong Kong Island. A report from HKDSD further notes, that with the proposed system, the flood protection level of trunk drains will be improved to a 50-year return period and will minimise the requirement of extensive pipe laying works in the highly congested urban areas with congested underground utilities, and hence would prevent associated environmental impacts arising from those works.

The Project is expected to be completed by end of 2011.

Halcrow wins Hong Kong MTR tunnel

Halcrow has been awarded the detailed design of the two sections of tunnel which form part of the Hong Kong's MTR Corporation's new £10 billion Shatin to Central link (SCL).

The SCL is a strategic railway line that runs through multiple districts in Hong Kong. It comprises two sections. The first section will extend the existing Ma On Shan Line from Tai Wai to the West Rail Line through East Kowloon. The second section will bring East Rail Line across the harbour to Hong Kong Island. The SCL will strengthen the current railway networks by connecting several railway lines through a number of interchange stations. It will save travelling time and provide the community with faster and more convenient railway services.

The present design focuses on the line to the existing station at Hung Hom. The section of the route Halcrow is to design — known as Lion Rock and Diamond Hill approach tunnels — comprises 4.7km of twin tunnels, to be formed in two sections by drill and blast and tunnel boring machine. The commission also incorporates the design of associated ventilation structures.

Particular design challenges include accommodating the twin tunnel boring machine tunnels within a narrow road corridor that is confined by high-rise building foundations and seeking to raise the currently proposed alignment to reduce the pressures on the tunnel during construction.

The win re-establishes Halcrow's reputation as a major tunnelling consultant in Hong Kong, having previously designed tunnels for MTR on their Airport Railway and Tsueng Kwan O Extension.

Halcrow's Hong Kong-based managing director and the project director Gerry Daughton said: "Within our technical proposal, we focused on providing innovative ideas to solve some of the difficult construction aspects of the design, and it is particularly pleasing that the MTR has complimented us on this aspect of our submission. This win has put Halcrow back on the map in Hong Kong as a major infrastructure designer and is an important milestone as we seek to expand our business in East Asia."

Taiwan unenthusiastic about cross-strait undersea tunnel plan

The Mainland Affairs Council (MAC) , Taiwan's top China policy coordinating body, has responded coolly to a Chinese engineer's proposal that a tunnel be built under the Taiwan Strait as part of a high-speed railway line linking Taipei and Beijing.

An MAC official, who spoke on condition of anonymity, described it as a unilateral declaration by China and said Taiwan has never had such a plan. "Besides, it is improper now for the two sides to talk about such a huge project, given the current political situation across the Taiwan Strait," the official said.

Wang Mengshu, a member of the Chinese Academy of Engineering and deputy chief of the China Railway Tunnel Group (CTG), told the China News Service recently that CTG executives would meet with officials from Taiwan in May to discuss the high-speed rail tunnel project. "If everything goes smoothly, the undersea tunnel could be built in 10 years," Wang said. He added that Beijing has also completed plans to build three long high-speed rail lines that would cut across Central Asia, Russia and Southeast Asia.

Negotiations have been underway for the development of these three mammoth projects, which are expected to be completed by 2030 at the earliest, he added. China has also proposed building a tunnel for vehicle traffic under the Taiwan Strait as part of a freeway connecting Beijing and Taipei.

Hong Kong Express Rail Link

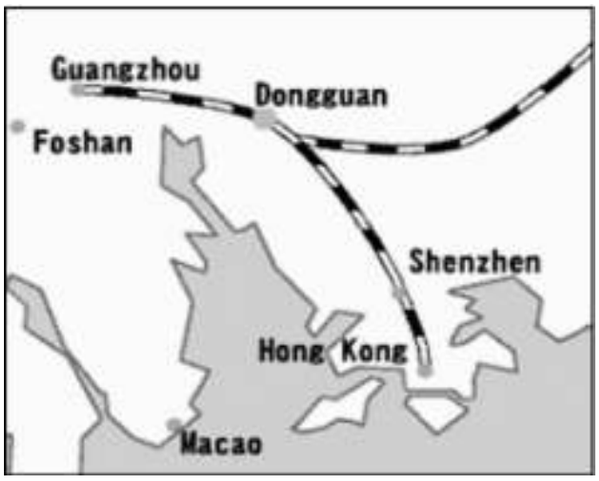
Scheduled for completion in 2014-2015, Hong Kong SAR's Executive Council has given the go ahead for a HK$39.5 billion 26 km underground high-speed railway link. It will fully connect with mainland China's rail network. Travel between Hong Kong and Guangzhou, on the mainland, will be halved to just under 50 minutes. In essence, Guangzhou will become a regional railway hub, linking the express rail network, and billed as a gateway into mainland China.

The Hong Kong government will pay for the initial construction cost, but the Mass Transit Railway Corporation Limited (MTRCL) will operate the line for 50 years with annual concession fees under a build-operate-transfer arrangement.

Bouygues Construction's Hong Kong subsidiary Dragages Hong Kong won a $445.8 million contract to build of part of the new high speed rail link between Hong Kong and Guangzhou. Work is expected to last five years.

A Gammon Leighton Asia joint venture has been awarded the HK$2.9 billion contract by MTR Corporation to construct the West Kowloon Terminus Approach Tunnel and Track Fan Tunnel section.

The project, which provides the transition from the approach tunnel to the terminus at West Kowloon district, involves the construction of 300m of a 'fan' shaped reinforced concrete structure complete with landscaped deck. The construction will utilise a cut-and-cover method



with foundations formed on piles and diaphragm walls. Extensive temporary utility and traffic arrangements will be necessary.

Scheduled to be completed in 2015, the contract also includes construction of associated plant and support buildings and non-rail related work to enhance connectivity with the local community, such as a public transport interchange and an extensive footbridge network.

Yamate tunnel extension

The Yamate tunnel extension is one of the biggest construction projects underway in Tokyo at the moment. The original Yamate Tunnel opened to traffic in December 2007. It carries the Central Circular Route of the Shuto Expressway from the Takamatsu on-ramp in Toshima to the Ohashi Junction in Meguro, Tokyo, Japan. The overall length is 11 km..

The new extension connects underground with the Yamate Tunnel, extending it to the Oi Junction in Shinagawa. Nearly all of the tunnel lies beneath Yamate Street. When complete in 2013, the Yamate Tunnel, together with this extension, will surpass the Kan'etsu Tunnel on the Kan-Etsu Expressway, becoming the longest roadway tunnel in Japan.

Shanghai longest river tunnel

The first phase of Shanghai's longest river tunnel has been completed and started operation, two weeks before the Shanghai Expo opened on May 1.

The Longyao Road river tunnel, 4.04 km long, starts from the intersection between Shilong road and Longwu road in Xuhui district, goes under the Huangpu River and ends at Chengshan road in Pudong district.

The first phase of the tunnel — the section between the intersection in Xuhui district and Jiyang road in Pudong district — took 25 months for construction, said a spokesman with Shanghai Construction Group, builder of the tunnel.

The Expo site, covering 5.28 square kilometers, spans across the Huangpu River and the tunnel would be a major channel for passengers getting from one side of the river to the other, said the spokesman.

Shanghai Expo 2010, with the theme "Better City, Better Life", runs from May 1 to Oct. 31 and is expected to attract 70 million visitors.

Tunnel collapse cover-up

Two managers of a construction group have been detained for "attempting to cover up" a railway tunnel collapse that left five people dead and one missing in Yun'an county of Yunfu, Guangdong province.

Feng Liangmao and Li Gang, the chief managers of the No 8 section project of the China Railway Tunnel Group were detained for submitting a false report 23 hours after the accident occurred, a press release from the Yun'an county government said.

The accident, which left four other workers injured, occurred on 16th January, when dozens of laborers were toiling to build the Baiyun tunnel on the Guangzhou-Nanning high-speed railway line in Qiling village.

"Being the managers responsible for the construction of the tunnel, they (Feng and Li) were too busy rescuing workers buried under the debris. They were not prompt in reporting the accident to local authorities," the release said. The tunnel collapse was only reported to the local government the next morning.

"It was an error of judgment on part of the two managers. Due to the delay, it was difficult for us to organize a prompt rescue operation," said Yang Yuejun, Party secretary of the No 8 section project. Yang said Feng and Li "might lose their jobs", and if they were found guilty of making a false report of the accident, "they would be punished in accordance with the criminal law".

According to the Guangzhou-based Southern Metropolis Daily, Feng had initially said that only four workers were injured and two missing in the accident.

The local government has set up a special task force to investigate, Yang said.

Wang Qiang, mayor of Yunfu, said an "overall safety inspection of the Yunfu section of the Guangzhou-Nanning railway and other construction projects will be conducted soon" to prevent similar disasters.

Construction of the 30-billion-yuan railway, which connects the southern city of Guangzhou and Nanning, capital of the Guangxi Zhuang autonomous region, started in 2008 and is due to be completed by 2012.

LED Tunnel Lighting for Chinese Highway Project

LED-based tunnel lighting for two new highway tunnels in central China is saving up to 60% in energy consumption and related costs over fixtures built with traditional light sources. Utilizing LUXEON Rebel LEDs from Philips Lumileds, the 3,900 fixtures involved in the project were developed by Xi'an Liming Electronic Technology Co., Ltd., with engineering assistance and LED inventory management supplied by Future Lighting Solutions.

Xi'an Liming, China's leading LED tunnel lighting manufacturer as well as one of the country's largest suppliers of outdoor LED lighting, worked with the engineering team at Future Lighting Solutions to ensure that the fixtures would meet national tunnel lighting standards as well as have a sustainable LED supply. Future's services included LED part and color bin selection, optical simulations, lens testing, advanced CCT binning to provide the desired 5000K color temperature, and bonded inventory for LED availability.

"Future's help in designing and optimizing these tunnel fixtures was instrumental in our ability to both meet and exceed the national standards for this kind of lamp, and thereby win the lighting contract for these two tunnels," said Yijing Mu, General Manager of Xi'an Liming. "More tunnel construction projects are on the drawing board, and we are now well-positioned to bid on those additional projects."

The fixtures are providing illumination for the Xinkailing and Wangzhuyuan No. 2 tunnels of the Liu'an-to-Wuhan highway, a north-south extension of the Shanghai-to-Wuwei mainline that is one of the country's key east-west arteries. The lighting — running the entire 4.7 km (2.9 mile) combined length of the two tunnels — was a joint project of Xi'an Liming and the Anhui Province Huanyu Highway Construction Development Co., Ltd.

Each 50W and 100W tunnel lamp contains 42 and 72 LUXEON Rebel LEDs, respectively. In addition to energy savings, advantages over conventional light sources such as fluorescent, metal halide and low and high pressure sodium include a 60,000-hour+ life and ability to withstand the shock and vibration of the tunnel environment, which in turn will reduce replacement, servicing and labor costs as well as lane closures.

Other benefits of using LED technology for this project include better color rendering for improved driving visibility and safety, less yellowing of the lamp fixture from baked-on dust and pollution because of LEDs' low heat production, and 'green' features such as ROHS compliance and mercury- and lead-free construction.

China's first undersea tunnel

China's first undersea tunnel connecting the southeastern Fujian province with Xiamen island was opened to traffic at the end of April 2010.

The Xiamen island is one of the special economic zones launched by the government in the 1980s.

The 8.7-km tunnel, built at a cost of 3.2 billion yuan ($468 million), was designed for driving speed of about 80 km per hour and is expected to cut travel time between the two areas from an hour to just nine minutes.

It took four years and eight months to complete the tunnel. Six kilometres of the tunnel is under the sea with a maximum depth of 70 meters. It boasts the world's largest tunnel with a maximum area of 170 sq. meters.

'The tunnel was designed and constructed by Chinese experts and is a result of extremely tough work caused by loosening soil and a permeable sand layer under the water, said Zeng Chao, vice director of the tunnel project. 'The project garnered valuable experience for building more undersea tunnels in the future,' he added. Two more tunnels will be built in Fujian province, and another tunnel is under construction in Jiaozhou Bay in eastern Shandong province, said Zeng.

It took four years and eight months to complete the tunnel.

Underwater tunnel for Russian oil

China has finished the construction of a tunnel under the Amur River to accommodate an extension of a pipeline intended to pump millions of tons of Russian oil to the energy-hungry country every year, the Xinhua news agency reported recently.

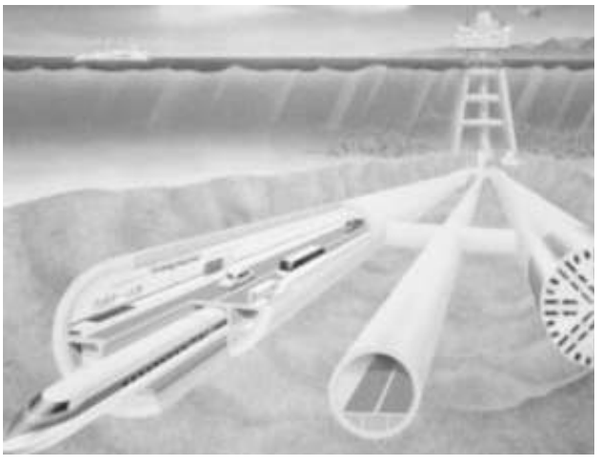
More than 80 Chinese workers have been involved in the drilling of a 1,900-meter tunnel on the Russian-Chinese border since September last year, Xinhua said.

Russia and China signed cooperation deals on the construction of a branch of the Eastern Siberia-Pacific Ocean pipeline (ESPO) toward China and long-term Russian oil supplies to China in February 2009.

The branch, which runs from Skovorodino in Russia's Far East to China's northeastern city of Daqing, is expected to become operational in 2011.

Russian officials earlier said the construction cost of the branch had been estimated at 11-12 billion rubles ($377 mln — $410 mln), while the annual revenues from oil sales to China could reach 57 billion rubles ($1.9 bln).

Russia is scheduled to export annually 15 million tons of crude oil to China over the next 20 years.



Korea-Japan Tunnel Faces Hurdles

Discussions for a Korea-Japan undersea tunnel have been gaining momentum among researchers, politicians and entrepreneurs, but the project faces many hurdles before it can become a reality. If realized, the two countries would be linked by a 200-kilometer undersea tunnel from Busan to the Japanese Island of Kyushu.

A high-speed rail would connect the two countries in 50 minutes. The Korea Japan Tunnel Project Association in Busan and the Japan-Korea Tunnel Research Institute, a non-profit foundation in Tokyo, have been leading the research.

Studies on the tunnel have been initiated mostly by the private sector, but government support is likely to gain pace, particularly in light of the role it is expected to play in accelerating travel and business exchanges.

Busan Mayor Hur Nam-sik has already launched a related task force.

The tunnel would also facilitate bilateral trade, which rose from approximately $40 billion in 1999 to more than $89 billion in 2008. About 20,000 people traveled daily between the countries in 2009.

The project would be profitable, according to a study from Prof. Park Jin-hee, a professor at Korea Maritime University. It currently costs $665 to ship a container (20 cubic feet) from Osaka to Busan. The price would drop to $472 through the undersea transportation system.

The project will also promote balanced regional development. Some see it as a catalyst for the breaking down of psychological barriers and hostility stemming from centuries of conflict between the two neighbors. However, opponents said engineering and cost concerns are major hindrances to the project. Construction costs are projected at around 60 trillion won to 100 trillion won and the project would take seven to 10 years to construct.

If completed today, it would be the longest undersea tunnel in the world.

Phuket tunnels

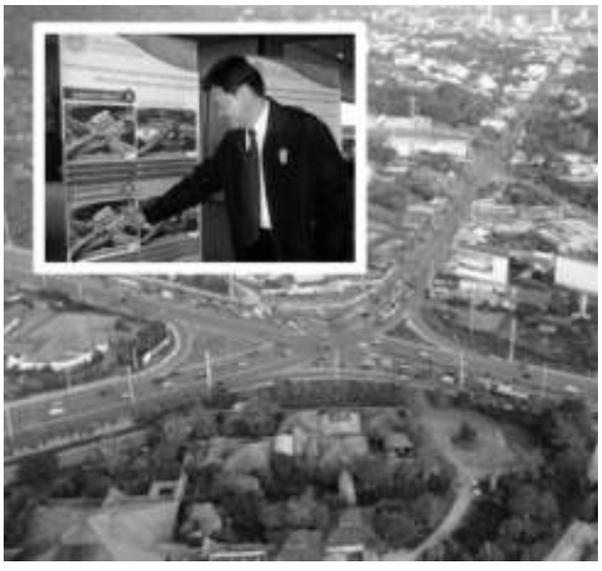
On May 26th 2010, a Vice Governor of Phuket, presided over the 2nd presentation about flyover or tunnel traffic solutions, result of a survey and design detail of flyovers or tunnels to solve traffic problems at the Thai Nan Intersection near Central Festival, presented by Thai Engineering Consultant Co. Ltd and T.E.C. International Co. Ltd.

Due to serious traffic jams at the intersections on road no.402 in front of Tesco Lotus Department Store, and the intersection on road no.402 with road no.4020 in front of Thai Nan restaurant Phuket Provincial Government had requested a budget from the Ministry of Transportation to construct flyover or tunnels at the mentioned points since they led to Phuket's famous tourist attractions.

Kasem Sriwaranan, the Director of Survey and Design Office, Department of Highways, said that after surveying the area and studying about engineering, economic and environment aspects, the appropriate solution for the Tesco Lotus Intersection was a tunnel constructed on road no.402 and a flyover bridge constructed on Yaowaraj road crossing the tunnel.

Meanwhile at Thai Nan intersection, there should be a tunnel on road no.402 only (not flyover). The constructing budget was 400 million baht per intersection, but it might be up to 500 — 600 million baht for a longer tunnel at Tesco Lotus intersection.

At the end of the meeting, those present agreed with the presentation and mentioned that there should be studies about possibilities to build flyovers or tunnels at other intersections including Bang Koo (near Toyota showroom), Naka Temple (near Weekend Market) and Chalong Circle as well.



Extreme Engineering — Transatlantic Tunnel

Introducing a 300-mph, magnetically levitated train that could travel between Canada and Scotland, submerged in the depths of the Atlantic Ocean.

Three interconnected, deep floating tunnels carry 300-mph, Mag-lev (magnetically levitated) trains between Newfoundland, Canada and Scotland would make the 2,100-mile run in less than 7 hours, breaking into daylight only for brief periods near Greenland and Iceland. Floating 600 feet beneath the North Atlantic's surface, the tunnels would be held fast in place by steel rods, piers and cables tethered to the ocean floor. The concept developed by Norwegian and Japanese engineers has passengers dining and sleeping in climate-controlled cars, while whales and nuclear subs glide soundlessly around them.

Reclaim land or dig tunnel under sea

In a move that could have major environmental repercussions for the city, the Maharashtra state government in India is contemplating to reclaim land from the sea and build a 10-km road connecting Haji Ali to Nariman Point as a part-sea link and part-underground tunnel in Mumbai at a cost of Rs 6,000 crore.

The plan was to build a sea link from Haji to Priyadarshini Park, followed by a deep (drill and blast) tunnel via Malabar Hill to Tambe Chowk and then a cut-and-cover tunnel from Tambe Chowk to Nariman Point. The Haji Ali-Nariman Point sea link is the third part of the Western Freeway Sea Link Project, which will link Versova to Nariman Point.

But the government now wants MSRDC to look into two options: Reclaim land from the sea and build a road or dig an underground tunnel under the sea from Haji Ali to Nariman Point. But both options have their drawbacks. While the tunnel under the sea would turn out to be very expensive, getting regulatory and environmental clearances to reclaim land would be difficult though project cost would be reduced by 1/3rd.

Robbins TBM launches in Laos

In February 2010, contractor CMC Di Ravenna oversaw the launch of the first TBM to excavate in Laos. The 7.6m diameter Robbins Single Shield TBM is digging a new hydroelectric tunnel for the Theun Hinboun expansion project, which will provide power to neighbouring Thailand.

CMC Di Ravenna is constructing a 5.5km long tunnel for project owner Theun Hinboun Power Co- a joint venture of the Laos government, Norwegian contractor Statkraft, and GMS Power of Thailand. Once complete, it will double the generating capacity of the current scheme from 220- 440MW.

The Robbins TBM has been designed to accommodate moderate squeezing ground conditions. An articulating cutterhead with overcutters allows the machine to excavate 100mm beyond the nominal tunnel diameter. To support the ground and provide final lining, 280mm thick, pre-cast concrete segments are being used in a 5+1 arrangement, making a finished tunnel diameter of 6.9m.

The TBM was assembled at Robbins' Solon manufacturing facility in Ohio and shipped to the jobsite along the Nam Theun River. Machine start-up went smoothly and the TBM is currently excavating around 20m/d, with rates of 30m/d expected as tunnelling progresses.

Solutions for HCM City's Thu Thiem tunnel

Thu Thiem tunnel in Ho Chi Minh City is the longest river tunnel in Southeast Asia. It has four segments, 93m long, 33m wide, 9m high each, nearly 27,000 tons in weight.

From March 7-10, the first segment was in place. The second segment was connected on April 5-6 and by April 28. On May 5-6, the third segment was set in place and connected to the other segments. The last segment will be joined to the third on June 4-5. The tunnel is scheduled for completion this August and the entire East-West avenue will open for traffic at the 2011 Tet festival.

Oriental Consultants will present its detailed repair plan in July and will begin working in the same month once all segments of the tunnel are joined. According to Oriental Consultants' Director R. MaNai, the three solutions consist of: making the best of self-healing mechanisms of concrete, relying on ventilation or using specialized glues like polyurethane or epoxy. He explained that the first method is very useful for cracks of less than 0.2mm wide. The second solution can alleviate moisture up to the designed level. The last measure is effective for larger cracks.

"The repair will be completed before the tunnel is handed over to the equipment contractor," R. MaNai predicted. He added that repairs can't be carried out immediately because of the water tanks used to hold segments from rising to the surface. Once these tanks are dismantled, the repairs will be performed.

East-West Avenue Project Management Unit Director Luong Minh Phuc explained that the two first solutions are auxiliary measures. The major one is using specialized glue to fill the cracks. "Many underwater works in the world have used this method, such as the tunnel at Australia's Sydney Port. It has been used for 20 years," Phuc noted.

According to Oriental Consultants, there are three levels of leakage. The first is called moistness if the surface of concrete is discoloured. The second is soaking if someone touches concrete and feels water on the surface. The third is leaking if concrete changing its color and water is dripping along the wall. The 130 spots in Thu Thiem tunnel belong to the first and second levels.

MaNai confirmed that the standard of leakage applied for Thu Thiem tunnel (less than 5cc/hour/one square meter or 0.12l/day/one square meter) is applied for many other submerged works in the world. The consultants agree that the leaks are not serious and that they don't affect the tunnel's structure.

Brighton and Hove wastewater

The two refurbished tunnel boring machines for the Brighton and Hove wastewater treatment scheme are both Lovat EPBs. The first TBM was previously used on the Abbey sewer, in Folkestone and in Belfast and the second one was used on Ipswich's project Orwell.

The two machines have now arrived on site. They will dig from two launch shafts two drives each. Project completion is due for 2013.

Sofia Metro line

Two Bulgarian companies, Consortium BKS Centre — Balkanstroi and Metro Build 2010, have been selected for the construction of the north line of the Sofia Metro, a process which has to be completed inside 24 months.

The excavation of the tunnel for the new Sofia Metro line commenced on April 6. A 15 million euro Herrenknecht TBM will have to excavate a total of 3.8km of tunnel, at a rate of 9.4 metres a day at an average depth of 15 metres..

BKS Centre — Balkanstroi and Metro Build 2010 are entrusted with the metro section spanning from Obelya borough until Beli Dunav Boulevard. Balkanstroi tabled a 21.356 million leva offer including value added tax, for a section which is predominantly overground, while Metro Build's offer was 25.754 million leva for the part of the north line that will be subterranean. The new metro line tunnel must be excavated in full by July 2011.

Greenwich Foot Tunnel revamp

A major redevelopment project to improve the Grade II listed pedestrian tunnel connecting the Isle of Dogs to Greenwich under the Thames was given the green light by Tower Hamlets council's Development Committee.

Greenwich council, which partly owns the tunnel with Tower Hamlets council, applied to the Town Hall for permission to give its original Edwardian features a re-vamp, repair the glass domes on the rotunda entrances, add new lifts, repair the cast iron staircases and install CCTV and lighting.

The plans are part of an £11 million project to refurbish both the Greenwich and the Woolwich foot tunnels which together are used by around 1,500,000 pedestrians and cyclists every year. The cash is coming from the Government's Community Fund and work is expected to be complete in March 2011.

The Greenwich tunnel between Millwall's Island Gardens and the Cutty Sark was the first to open by the London County Council in 1902, giving dockers from south London a short route to work at the Millwall Docks on the Isle of Dogs. It is more than 1,100ft long and 50ft deep.

TYNE TUNNEL COMPLETED

The mile-long new tunnel has been built in an effort to combat the congestion which plagues the existing north-south route.

Work began early in 2008 on a £260m project to build a second tunnel between East Howdon and Jarrow.

The existing tunnel, which opened in 1967, is running massively over-capacity and is in need of refurbishment.

So once the second tunnel is finished, in February next year, the original will close for an overhaul before reopening in December 2011.

Each of the tunnels will then become one-way dual carriageways under the Tyne, splitting the 38,000 vehicles which currently use the single tunnel between them.

The final section

The 295ft (90m) pre-fabricated section of the new tunnel was floated down the river using ballast tanks to join the others already in place. The huge concrete tube had to be lowered into a trench which was dredged into the riverbed.

Breakthrough

The final section of the new vehicle tunnel on the south bank of the River Tyne was excavated when workers broke through the remaining concrete wall at the end of the final section of the sprayed concrete lining tunnel in Jarrow. Removal of this underground wall completes the excavations for the land tunnel, making it possible to walk from the south junction to the river section.

Representatives from the New Tyne Crossing's project promoter, the Tyne and Wear Integrated Transport Authority, Concessionaire TT2 and Bouygues Travaux Publics watched the final diaphragm wall being demolished. David Wood, chairman of the transport

authority, said: "It is incredible to think that the first dig to create the tunnel trench happened around a year and a half ago, and we are already refilling the trench above the new tunnel with the soil we removed." Trevor Jackson, managing director of TT2, said: "This is a tremendous moment for everyone involved in the project.

The new vehicle tunnel remains on target to open to traffic early next year, at which point the existing tunnel will close for major refurbishment. Both tunnels will be operational by the beginning of 2012.

Fabrice Cao, section manager for Bouygues Travaux Publics, said: "The SCL sections have brought particular challenges and have required some sophisticated measures to enable us to complete them. It has been hard work to build this part of the tunnel, but it has undeniably been worth the effort as it has prevented major utility diversions."

At its deepest, the tunnel will be around 13m below the low tide level. The river section of the tunnel was built using immersed tube technology. The bulkhead walls separating the four river tunnel units are currently being demolished. Once these have been fully removed there will be uninterrupted passage from one end of the tunnel to the other.

DART Underground rail project

In Ireland CIÉ took a significant step towards delivery of the DART Underground rail project on June 30, when the group lodged a formal application with An Bord Pleanála for railway order planning approval.

If granted, the railway order will authorise CIÉ to construct, maintain, improve and operate DART Underground. Construction will commence in 2012 and the system will be operational in 2018. The project will be managed on behalf of CIÉ by Iarnród Éireann.

The group plans to deliver a second high capacity train line which will run through Dublin city centre. The twin bore tunnels will be approximately 7.6km in length and will connect the Northern and Kildare rail lines, with underground stations strategically located at Spencer Dock, Pearse, St Stephen's Green, Christchurch and Heuston Station, as well as a new surface DART station at Inchicore.

It will link the DART, Commuter, InterCity, Luas and Metro rail lines to form an integrated transport network that will treble the numbers travelling on the Greater Dublin rail system. DART Underground will have the capacity to run up to 20 trains in each direction per hour, carrying up to 64,000 commuters.

Noel Dempsey, minister for transport, welcomed the news, stating: "Today marks an important stepping stone in our efforts to increase and improve public transport in Ireland. The submission of the railway order for the DART Underground brings closer the vision of a mass transit system outlined in Transport 21, and in tandem with Metro North will transform public transportation in the Greater Dublin Area."

The project will involve the construction and operation of approximately 8.6km of new rail line (7.6km of which will be in tunnels) from the CIÉ Inchicore works to the northern mainline just south of East Wall Road. The tunnels will be constructed using two TBMs launched from the Docklands, at an average depth of 24m below ground level. There is potential for more than 75% of the spoil to be removed by rail.

Sea tunnel proposed for Corrib pipeline

The bitter battle over the 3bn euro Corrib gas discovery now hinges on a new plan to build a giant underwater tunnel to bring the fuel ashore. The alternative route for the pipeline will be outlined at an An Bord Pleanala oral hearing, 10 years after the planning battle began.

The planning authority ordered Shell E&P Ltd to redesign the pipeline for a third time and move it away from homes, ruling that it posed an "unacceptable risk". Shell wanted to bring the pipeline from the sea and make landfall at Rossport before tunnelling underneath Sruwaddacon Bay and terminating at the Bellanaboy refinery. But An Bord Pleanala upheld concerns by Rossport residents and found that up to half of the route was "unacceptable" on safety grounds because of its proximity to housing.

Now, Shell has come up with another route involving a bigger 4.9km tunnel under the bay, which is a protected habitat, bringing it further away from homes. The company has also agreed to reduce the pressure in the onshore part of the pipeline. The nearest occupied house would be 234 metres from the pipeline — three times the originally proposed distance.

Shell insists that the the modified route will not present an unacceptable risk to the public and will minimise potential disturbances to environmentally sensitive habitats.

Prague tunnel crumbles

A part of the tunnel Blanka, now under construction, crumbled in two places in Prague in July burying an excavator driver along with his machine, fortunately rescue workers managed to extricate him early in the morning, and the man had no obvious injuries.

The cave-in caused a 15-meter crater. Local residents have complained about the construction for a long time. In 2008, the ground fell through in the Stromovka public park, creating a 20-metre crater, during the construction.

The Blanka tunnel is to be a part of the Prague northwest ring road system. It will be over 6300 meters long.

The tunnels themselves are to be about 6000 meters long with construction costs of 20billion crowns ($1 billion).

Limerick Tunnel opens

The construction of the Limerick tunnel was one of the biggest engineering projects ever undertaken in Ireland. It connects the N7 with the N18 and incorporates access points from the N20, N24 and the N69. The road network which facilitates access to the tunnel on each side of the Shannon includes 11 new access bridges, six underpasses and four interchanges.

The tunnel itself, which is 900 metres long, consists of five precast concrete tubes which were made by Austrian specialists, Strabag. They were floated on to the river late last year before they were lowered onto foundations which were set on the river bed.

The public-private-partnership (PPP) Limerick Tunnel, which cost over 600 million to construct, will be operated by Direct Route until 2041 when it will revert into state ownership. Motorists who use the tunnel will have pay at one of two toll-plazas, which are located on the Coonagh side of the Shannon. However, motorists can also buy electronic toll-tags which will allow them to pass through the toll-plaza without having to stop.

Head of the coalition government, Brian Cowen described the tunnel under the Shannon as "an historic crossing" and said: "It is is a key element in our national road infrastructure and is vitally important to the people of the Mid-West.

Transport Minister Noel Dempsey said the Limerick Tunnel is the outcome of many years of vision and effort. "It is one of the largest infrastructural projects ever undertaken in the Mid-West region. It will provide a fourth crossing of the river Shannon in Limerick and improve access times for commuters to the city, as well as access to Shannon Airport, Galway, Cork, Kerry and Dublin.

Mayor of Limerick Cllr Maria Byrne said the opening of the tunnel was a "good news day" for Limerick and Minister of State Peter Power said the benefits of the tunnel will be wide-reaching: "Having world infrastructure of this nature will add significantly to Limerick's attraction as a place for foreign direct investment," he said.

NRA chairman Peter Malone Chairman, National Roads Authority, said "The Limerick Tunnel will contribute positively to growth in tourism, high end manufacturing and growing business services sector throughout the entire Mid-West."

It is expected that up to 20,000 cars will use the tunnel every day easing the pressure city centre streets and traffic blackspots such as the Condell Road, Ennis Road and the Dock Road.

New tunnel fire-fighter system

Experts are set to test a system that picks out cars and trucks at risk of catching fire before they enter a tunnel. Engineers at Siemens in Germany recently installed their experimental system at Aubinger road tunnel near Munich.

The new system will look for hotspots on each vehicle by pointing infrared cameras at them 1 kilometre before the tunnel's entrance. The resulting images will be automatically compared with reference images for each vehicle type to identify signs of overheating in the brakes, tyres, engine or other components. Warned by an audible alarm, staff closer to the tunnel will then be able to pull over suspect vehicles for inspection.

Some of the loads carried by commercial vehicles can feed a fire once it starts. A truck fire in the Mont Blanc road tunnel in the French Alps that killed 39 people in 1999 was made worse by the vehicle's cargo of margarine also catching fire. To deal with such situation in the future, Siemens is developing long-range battery-powered radio-frequency identification (RFID) tags that transmit details of what trucks are carrying to readers at the tunnel entrance. It will help firefighters know precisely what hazards they are faced with, when fire breaks out.

London's Crossrail

Costain and joint venture partner Skanska has won a £15m contract to build the Royal Oak Portal, the first tunnel-related construction contract for London's Crossrail project.

Work on the tunnel, near to Paddington main line station, will start straight away. It will act as the transition ramp for Crossrail trains when they enter and exit central London tunnels. The job is expected to finish in March next year.

The scale of Crossrail is breathtaking. Stretching from Maidenhead and Heathrow in the west through central London and across to Shenfield and Abbey Wood in the east, the new railway covers 118 km of track. Crossrail includes 37 stations, with eight brand new central London stations and 28 upgrades of others, 11 of these major reconstructions. With a total budget of £15.9 billion, Crossrail will see a transformation in the way people travel into, out of and through London. At its heart will be 42km of new tunnels underneath central London. Trains will be able to travel into London from stations in Berkshire, Essex and the borders of Kent into central London — without the need for people to get off and catch the Tube or bus.

Crossrail has also announced the shortlist for the refurbishment of the Connaught Tunnel, a major part of the Abbey Wood branch, and the Pudding Mill Lane Tunnel Portal.

Contract 315 — Connaught Tunnel

- Vinci Construction UK Ltd;
- Hochtief Murphy Joint Venture;
- BAM Nuttall Ltd; and
- VolkerFitzpatrick Barhale Joint Venture.

Contract 350 Pudding Mill Lane Tunnel Portal

- Vinci Construction UK Ltd;
- Carillion Construction Ltd;
- Dragados-Sisk Joint Venture; and
- Morgan Sindall plc.

The Invitation to Tender for both contracts will be issued next month. Crossrail intends to award the contracts in 2011. To deliver the Crossrail branch to Abbey Wood, a major proportion of the construction work involves reusing disused rail infrastructure including the Connaught Tunnel on the former North London Line branch to North Woolwich and disused National Rail tracks to Custom House — which both closed to passenger traffic in December 2006.

The Connaught Tunnel is around 550 metres long and runs between Royal Victoria Dock and Royal Albert Dock close to London City Airport. The tunnel dates back to 1850. Crossrail will be enlarging the existing tunnel so that it can accommodate Crossrail trains and overhead line equipment. Sections of the existing tunnel are in a poor structural condition. Around 100 metres of tunnel wall will be removed and will be replaced with a new tunnel lining. The existing brick arches, part of the tunnel approaches, will be retained and repaired.

Over at Pudding Mill Lane, the second tunnel portal for the main running tunnels will be constructed. The other tunnel portal will be located at Royal Oak. Preparatory work at the Royal Oak tunnel portal site got underway in January 2010.

Work on the Royal Oak tunnel portal involves construction of a 190 metre diaphragm walled box to form the foundation for a tunnel boring machine launch. Construction of the actual tunnel portal got underway last week with the first section of the diaphragm wall installed.

Crossrail tunnelling activity will get underway in 2011. Good progress continues to be made with the procurement of the three main running tunnel contracts. Tenders have been received for C300 (Royal Oak to Farringdon) and C305 (Limmo to Farringdon) and are currently being evaluated. Bids for C310 (Plumstead to North Woolwich) are due to be received this month. Tenders for the four station tunnel contracts at Bond Street, Liverpool Street, Tottenham Court Road and Whitechapel will all have been submitted by the end of September.

Work on the Royal Oak tunnel portal involves construction of a 190 metre diaphragm walled box to form the foundation for a tunnel boring machine launch.

Crossrail Tunnel Academy

The Learning and Skills Council (LSC) has given approval to £5 million funding for a Tunnelling and Underground Construction Academy at Aldersbrook Sidings, Ilford, in the London Boroughs of Redbridge and Newham.

The facility is being developed by Crossrail, Europe's largest transport infrastructure project.

The estimated benefit of Crossrail to the UK economy is at least £36 billion. It will employ over 14,000 people of which 3,500 will be directly linked to the tunnelling and underground construction environment. This employer-led project is fully supported by the industry through Construction Skills, the British Tunnelling Society and Tunnel Skills who recognise that the Academy will provide the right environment to deliver skills essential to the sector.

The Academy will raise standards within the industry and lead to the development of innovative courses and new frameworks for Apprenticeships and other qualifications to address the skills shortage faced by the sector. It will provide training for up to 1,000 learners a year catering for all types of tunnelling, and will be part of the broader economic legacy and regeneration of east London, as it sits alongside the Olympic Village and Park. The facility will meet the skills needs not only of Crossrail but also National Grid, London Underground, Thames Water, and EDF, among others. It will be able to address the needs of major developments in the UK and across Europe, thus securing the longer term sustainability of the Academy and enabling the UK to become a world leader in a modernising industry.

Terry Morgan, Chairman of Crossrail said: "We are delighted to receive £5 million in funding from the LSC. This is great news for the project and great news for the tunnelling and underground construction industry. This decision means we can now progress our plans to build this fantastic training facility, which the industry so urgently needs."

Oslo considering major tunnel project

The Oslo City Council will now consider building a major joint tunnel which will lead all railway and subway lines under the centre of the capital. This was decided at a recent Council's meeting.

Both services are in need of more tunnel capacity, and earlier this year Communications Minister Magnhild Meltveit Kleppa announced that a new railway tunnel would be planned.

The City's subway also needs more capacity, and it was therefore natural to decide to look into a joint project, rather than having to build two tunnels, says the City Council's communications councillor, Jøran Kallmyr.

Start of tunnel construction for largest high-speed camera for the nanoworld

More than 500 guests attended the ceremony on the building site in Schenefeld (Pinneberg district, Schleswig-Holstein), the future research campus of the X-ray laser facility. The first of the two tunnel boring machines — TULA ("TUnnel for LAser"), 6.17 metres in diameter, 71 metres long, weighing 550 tonnes and costing 18 million Euros — will start in the direction of DESY-Bahrenfeld (Hamburg), where it will arrive in summer 2011. Godmother for the tunnels excavated by TULA and by the same token "earthly patron saint" for the tunnel builders is Dr. Herlind Gundelach.

Fehmarn Belt crossing between Denmark and Germany

The tunnel option has been shunted into second place by the cheaper bridge concept but has remained in the running until about 2011 as the developer, Femern A/S, is awaiting data from further survey work. The tunnel alternative has been kept alive as environmental pros and cons of the rival options have been analysed.

A tunnel under the Fehmarn belt might be more cost effective than predicted. This seems to be the result of 12-month work on a range of possible scenarios. Femern A/S is now in the process of analysing the proposals put forward by the two consortiums of consultants working on the project. One group, led by Ramboll, Arup and Tunnel Engineering Consultants (TEC), is working on an immersed tunnel solution, whilst the other, led by Cowi and Obermeyer, is working on a bridge solution. Femern A/S received the initial results of the two consortiums' work in the spring of 2010 in the form of conceptual designs. So far, both are neck and neck in terms of technology, safety and finances.

When it comes to the environment, ongoing studies are to identify every possible effect of both proposals, both during the construction period and as a result of the completed traffic infrastructure.

The consortium with the winning proposal will be given the job of producing the final proposals to be used by Femern A/S for its applications to the authorities to go ahead with construction.

The treaty signed by Denmark and Germany calls for a cable-stayed bridge over the 19 km wide Fehmarn belt as the preferred solution, whilst a tunnel is the preferred alternative. A recommendation will be made in September 2010 and a final decision will be made in December 2010.

European XFEL

The new X-ray laser research facility is 3.4 kilometres long and located in the German federal states of Hamburg and Schleswig-Holstein. Its tunnel system comprises a 2.1-kilometre-long section for the electron accelerator and a "fan" of five tunnel sections in which the X-ray flashes used for research will be generated. These tunnels end in an underground experiment hall. In total, 5777 meters of tunnel will be constructed in the next two years using two boring machines, the larger of which now starts excavating the tunnel sections underneath the city of Hamburg.

The two federal states of Hamburg and Schleswig-Holstein contribute a total of 90 million Euro to Germany's share of the costs for the X-ray laser facility. For Hamburg's State Minister for Science, Dr. Herlind Gundelach, this is a good investment: "The European XFEL is one of the largest construction projects for science and a research instrument that will be unique in its kind in the world. We expect it to generate important impetus for research for the whole area. Scientists from all over the world are already preparing themselves intensively to make use of the X-ray laser, and they look forward to many new insights in their disciplines."

For the Chairman of the Management Board of the European XFEL GmbH, Professor Massimo Altarelli, today's tunnel celebration has a special significance: "For us, this tunnel celebration is a twofold milestone on the hopefully not too stony path of the European XFEL project. First of all, it marks of course the beginning of the tunnel construction. But it also centres on the new international research institution, which is currently establishing itself in Northern Germany and which will construct and operate the European XFEL. For the very first time, such a celebration is sailing under the flag of the European XFEL GmbH."

Professor Helmut Dosch, the Chairman of the Board of Directors of the Deutsches Elektronen-Synchrotron DESY, compared the new X-ray laser to a "high-speed camera for the nanoworld" and emphasized DESY's achievements: "At DESY we are feverishly awaiting the completion of the tunnels, because this will give the starting signal for the construction of the superconducting electron accelerator under the direction of the DESY accelerator experts. The accelerator relies on a technology promoted by DESY, which has passed its baptism by fire with flying colours at our free-electron laser FLASH and will give this European research project an invaluable advantage in the international competition."

Dr. Georg Schütte, State Secretary at the Federal Ministry of Education and Research, declared on the occasion: "Using the European XFEL, scientists will soon be able to better understand how the nanoworld is working. In addition, today's basic research allows us to pave the way for tomorrow's innovations, like the materials and medicines of the future. To make this possible, the German federal government is increasingly investing in education

and research, especially in times of economic crisis. In this legislative period, we are spending an additional 12 billion Euro for education and research, 6 billion of which are intended for research. This of course also strongly benefits basic research."

The main item on the agenda for the tunnel celebration was therefore the christening of the tunnel and tunnel boring machine, which traditionally takes place in an oecumenical service before the beginning of construction. The ceremony was accompanied in proper style by the miners' choir "Ruhrkohle-Chor" from Herne. It also featured the blessing of a wooden statue of Saint Barbara, which was then put up in a shrine on the tunnel wall.

The godparenthood for the first tunnels was assumed by Dr. Herlind Gundelach, State Minister for Science and Research of the Free and Hanseatic City of Hamburg. As tunnel godmother, she is regarded by the workers as the earthly representative of Saint Barbara for the duration of the tunnel construction, and the tunnel traditionally bears her first name (Herlind tunnel). The tunnel boring machine was also christened before its first assignment. Its name — TULA, TUnnel for LAser — was determined in a public contest by a large Hamburg local paper and announced at the christening ceremony. Godmother of the machine is Imke Gembalies, staff member of the European XFEL GmbH.

The tunnels of the European X-ray laser have different diameters. Whereas the inner diameter of the accelerator tunnel is 5.30 metres, most of the sections of the tunnel fan have an inner diameter of 4.60 metres. They will therefore be constructed in sections by two tunnel boring machines of different size. Tunnel construction will last from July 2010 to summer 2012.

With the X-ray laser European XFEL (X stand for X-ray, FEL for free-electron laser), Hamburg and Schleswig-Holstein will boast a unique research facility that will open up novel research opportunities for the natural sciences and industrial users starting in 2015. The main part of the 3.4-kilometre-long facility is located up to 38

metres deep in underground tunnels. The facility requires a total of 5.8 kilometres of tunnel, which can be accessed on three sites. The main tunnel for the superconducting particle accelerator, which brings electrons to the required energy, runs absolutely straight between the sites DESY-Bahrenfeld and Osdorfer Born.

The particles are then distributed into a fan-shaped tunnel system located beneath the research campus Schenefeld, in which they generate intense X-ray flashes by flying through special arrangements of magnets. These are then led into an experiment hall, where international teams of scientists use the brilliant X-ray light for research.

As the only research facility of this kind in the world, the European XFEL will produce high-intensity ultra-short X-ray flashes with the properties of laser light 27 000 times per second. This new light source will open up a whole range of new research perspectives for the natural sciences. The results will benefit a wide range of disciplines as well as industrial users — for instance for the development of new materials in the nanoworld or more effective medicines.

As an international project, the European XFEL is operated by an independent research organisation, the non-profit European XFEL GmbH. This limited liability company was founded under German law in November 2009 and already employs a staff of almost 60 people. A total of 12 countries are currently participating in the project (Denmark, France, Germany, Greece, Hungary, Italy, Poland, Russia, Slovakia, Spain, Sweden and Switzerland). China is planning to participate.

The present shareholders of the European XFEL GmbH are Denmark, Germany, Hungary, Russia, Slovakia, Sweden and Switzerland; China, France, Greece, Italy, Poland and Spain are planning to join the company. The construction costs for the facility including the commissioning amount to 1082 million Euro (price levels of 2005). As the host country, Germany (Federal government, Hamburg and Schleswig-Holstein) covers 54 percent of the construction costs. Russia takes over 23 percent and the other international partners between 1 and 3.5 percent each.

Representative of Germany and main shareholder of the company with a share of more than 50 percent is the research centre DESY, where the concept of the X-ray laser facility was initiated and developed. DESY is the awarding authority for the civil and underground engineering work that started in January 2009. The European XFEL GmbH und DESY cooperate closely on the construction, commissioning and operation of the X-ray laser facility. Together with international partners, DESY is constructing the heart of the facility — the 1.7-kilometre-long superconducting accelerator including the electron source. After its completion, DESY will take over the operation of the accelerator on behalf of the European XFEL GmbH.

Biggest EPB TBM

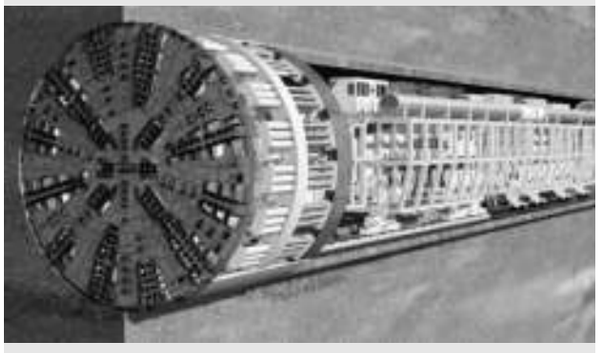
Herrenknecht is developing and building an Earth Pressure Balance (EPB) Shield with a diameter of 15.5m which will be ready to start work on the A1 highway extension between Bologna and Florence in 2011. Weighing in at 4,300t with a cutterhead power of 12,000kW and an overall length of 120m, the machine will be the largest TBM ever built.

The EPB shield will be used to bore the Sparvo tunnel, as part of the Variante di Valico extension project in Italy. It will create two parallel tunnels, each 2.5km in length, which will accommodate three-lane roads. Due to the required size of the tunnel and the geological conditions, this is considered to be the most challenging part of the overall project. The contract was awarded by Autostrade per l'Italia to a joint venture of Italian contractors comprising: Vianini Lavori, Toto Costruzioni Generali and Profacta.

Preparations for the assembly of the record-breaking TBM have already begun at Herrenknecht's facility in Schwanau, Germany. In line with current planning, the machine is expected to start tunnelling to the north of Florence in the first half of 2011.

Lot 6–7 is the last section of the Variante di Valico project to be constructed. It will considerably reduce the travelling time between Bologna and Florence for up to 90,000 vehicles per day after the route is opened at the end of 2013.

Weighing in at 4,300t with a cutterhead power of 12,000kW and an overall length of 120m, the machine will be the largest TBM ever built.



Tunnel under Sacramento River

A tunnel — not a canal — has emerged as the leading option to ship Sacramento River water across the Delta to from the Silicon Valley to San Diego.

Officials guiding the Bay Delta Conservation Plan chose the tunnel for more detailed study at a recent meeting in Sacramento. The plan is an effort to secure California water supplies from environmental problems, flood risk and rising sea levels in the Sacramento-San Joaquin Delta.

About 25 million Californians and 2 million acres of farmland depend on the Delta today for at least some of their water supplies.

The tunnel would be 43 miles long. Over most of its length it would consist of not one, but two, parallel tunnels about 150 feet underground, each 33 feet in diameter. They would rank among the largest tunnels of their kind in the world. Multiple tunnelling machines would work simultaneously for about eight years, consuming $284 million worth of electricity to build them.

The tunnels could move water at 15,000 cubic feet per second, or 10 times the volume in the American River today with an estimated cost of up to $11.6 billion.

Ken Verosub, a UC Davis geology professor, said there is no solid material beneath the Delta. Instead, it is probably layer upon layer of loose material deposited as the Delta shrank and expanded with repeated glacial periods.

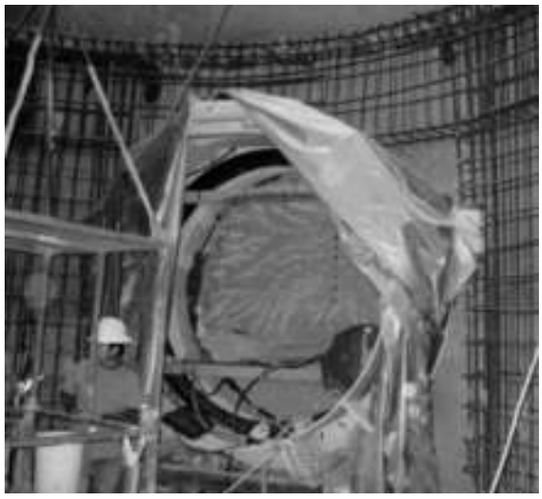
Current estimates are that construction would start in 2013 and finish in 2022.

Tunnel between Russia and the United States

Vladimir Putin, the Russian president, raised plans for a tunnel to link his country with America when he met his US counterpart last year. The 64-mile tunnel would run under the Bering Strait between Chukotka, in the Russian far east, and Alaska; the cost is estimated at £33 billion.

Roman Abramovich, the owner of Chelsea football club and governor of Chukotka, has invested £80m in the world's largest drill but has denied that it is linked with the development.

Proposals for such a tunnel were approved by Tsar Nicholas II in the early 20th century but were abandoned during the Soviet era. If finally built, the tunnel would allow rail connections between London and New York.



CSM shaft construction

Cutter soil mixing technology has been developed to construct shafts for microtunnelling projects. Norman Joyal told delegates at Trenchless Australasia 2009 about one of the first projects in the United States using this technology to build microtunnelling shafts.

The cutter soil mixing (CSM) method excavates rectangular panels while simultaneously adding water to the soil to fluidise it in place to a prescribed depth. Upon retraction, the cement grout is added and mixed with the fluidised soil to form a soil-cement mixture. To construct the shaft, the panels are interlocked to form a contiguous ring of panels.CSM was first introduced in Europe by BAUER Maschinen GmbH and has been used in Europe, Asia, and Canada. It was recently used in the US to construct trench walls in Seattle, Washington, and 11 and 16 metre deep shafts near Sacramento, California.

The CSM is being used on a Contra Costa Water District (CCWD) project in northern California to construct 20 and 32 metre deep watertight shafts in difficult ground conditions. The shafts will be used for a 275 metre long microtunnel crossing of Old River. This is the second known application of this technology in the US for the construction of microtunnel shafts and the first known application using shotcrete-reinforced walls. The shafts penetrate soft saturated silts and clays, loose-to-dense sands, and a confined aquifer presenting over two bars of pressure opposite the jacking shaft tunnel eye. Existing construction techniques, such as secant piles and slurry walls, were not considered feasible for the deeper shaft because of concerns over pile drift during installation, which can result in 'windows' between the panels.

Golden Gate Bridge Tunnel

Construction is under way on a tunnel that's expected to provide a safer way for Marin County drivers to get into San Francisco from the Golden Gate Bridge. The $116 million Battery Tunnel began construction 21st July along with an elevated 1,340-foot-long viaduct to take drivers into city.

One tunnel is slated to open on Labor Day 2011 with five lanes that will handle both northbound and southbound traffic, until a second tunnel is built.

The current route between the bridge and downtown San Francisco, Doyle Drive, has been found to be seismically unsafe. The 1.5-mile southern approach to bridge was built in 1936.

The state Department of Transportation has since spent $35 million to strengthen Doyle Drive. But bridge officials say it still could be vulnerable in a large earthquake.

East Side Access project

On June 2, a Robbins main beam TBM, built for the Dragados/ Judlau joint venture, was the first of two machines to finish a series of short rail tunnels below Manhattan's Grand Central Station.

The completion is an important milestone for the East Side Access project, which was stalled in the 1970's due to lack of funding. In total, the TBM has excavated 5.2km of tunnel since its 2007 launch, averaging 16m/d in the last month of boring.

A second double shield TBM is preparing to embark on the third of four tunnels. The short tunnels, four to each TBM, will ultimately create the upper and lower departure and arrival platforms of two stations currently under construction.

The machine was retracted at the end of each tunnel heading using specially designed, hydraulic side and roof supports to move past installed ring beams and rock bolts. These, combined with a bolted cutterhead made in five removable sections, allowed the entire machine diameter to be reduced from 6.7m to just 6m for easy removal.

The Metropolitan Transportation Authority's East Side Access project will connect the boroughs of Manhattan and Queens below the East River, providing rail service to 160,000 daily customers. Tunnelling in soft ground on the Queens side of the project is expected to start later this year. The completed East Side Access line is scheduled to begin service in 2016.

Colorado Hydroelectric Tunnel Fire Report

The fiery deaths of five workers at a Colorado hydroelectric plant in 2007 might easily have been prevented had Xcel Energy Inc. and one of its contractors followed basic safety rules, federal safety officials say.

In a scalding report on the tragedy, the U.S. Chemical Safety Board said Xcel and RPI Coating Inc. didn't take precautions before using flammable cleaning chemicals in a confined space, and failed to have rescuers standing by in case of emergency as required by law. The board also blamed Xcel for choosing RPI as its painting contractor in light of the company's poor safety record, The Wall Street Journal reports.

The board, which investigates serious chemical accidents and makes safety recommendations, also released a video of events leading up to the fire.

In the report the board called on the Occupational Safety and Health Administration to strengthen rules on use of flammable substances in tight spaces, and recommended that Colorado train firefighters for tunnel rescues, The Associated Press reports.

The deadly inferno erupted as 10 workers painting a 1,500-foot stretch of a tunnel were cleaning equipment with methyl ethyl ketone, a flammable solvent.

The fire, probably ignited by a static spark, blocked the only exit and trapped five workers, who died of carbon monoxide poisoning.

The companies face criminal charges stemming from the fire, according to the Denver Post, but the case may not go to trial until next year.

Second Avenue subway New York

The MTA has launched a tunnel boring machine to dig a tunnel from East 92nd Street to East 63rd Street.

The TBM launched May 28th will dig from East 92nd Street to East 63rd Street in the first phase of Second Avenue subway construction. "There have been skeptics who saw construction start and stop in the 1970s and said the Second Avenue subway would never be built," said Jay Walder, MTA Chairman as he stood before the machine's 250-Ton head. "This powerful machine is a tangible reminder of the important role that today's MTA capital program will play for generations of New Yorkers to come," Walder said.

Engineers expect crews to dig through to the existing East 63rd Street F-train station by November 2011, said Michael Horodniceanu, president of MTA Capital Construction. Then the machine will be taken apart and reassembled at the East 92nd Street launch box so that it can dig through the eastern side of the tunnel. Horodniceanu named the behemoth machine "Adi," after his two-year-old granddaughter.

The route carved by Adi will serve the Q-train and a new T-train. The MTA will build new stations at 96th, 86th and 72nd streets to accommodate the line. The Q-T line is on schedule for completion in December 2016, Walder said.

This phase of subway construction, which includes drilling seven-stories underground, will not disturb residents, Horodniceanu said. "The northern end, because this is the starting point, has probably been impacted the most," he said of the recent construction and blasting in the neighborhood.

The "Sand Hogs," as the workers who are building the Second Avenue line are known, were thrilled to finally see Adi in action. "It's exciting to finally get rolling," said Joseph Sammarco, a mechanic on the project. "It's been a long wait for this," his collegaue Kevin Brennan, an electrician, added.

The TBM dates from the late 1970s. It has been reconditioned and is now on the way from Newark. The TBM was tested in New Jersey. This is the same TBM that dug out the 63rd St. tunnel a few decades ago. Most recently, this machine dug out the Fall River CSO in Massachusetts

The Tbm is 450-foot-long and the machine's 200-ton cutter head uses 44 rotating discs.

The four-block-long launch box, which forms the shell of the future 96th Street Station, was excavated last year by removing 117,000 cubic yards of rock and soil.

Phase I of the Second Avenue subway line, from 96th to 63rd streets, is expected to be completed in late 2016, according to the MTA.

The Tbm is 450-foot-long and the machine's 200-ton cutter head uses 44 rotating discs.

Jersey-to-Manhattan tunnel project

Construction of the ARC Trans-Hudson Express Tunnel will accelerate this summer as contractors begin the project's first major underground segment through the Palisades in Hudson County.

The gathering pace of construction — workers already have been busy building an underpass for new tracks nearby — is another milestone for the $8.7 billion initiative that will double commuter rail capacity and improve ride quality for thousands between New Jersey and New York. It also provides an appropriate point to consider how far the ARC project has come.

The digging that begins in earnest this summer is the result of years of rigorous planning, robust public outreach and careful environmental reviews. Construction will continue to ramp up in the months ahead. Work is about to begin on a tunnel under the Palisades. By next year, tunnel segments beneath Manhattan and the Hudson River also will be underway.

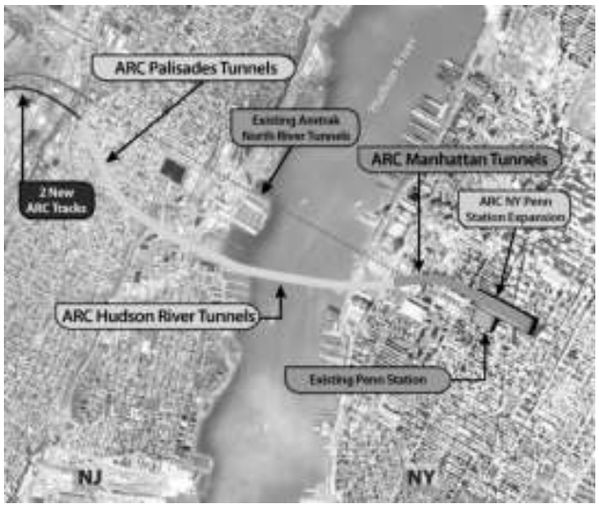
That process has created a project that will not only meet the needs of New Jersey's rail riders for decades and strengthen the state and regional economy, but will surmount the engineering, environmental and other hurdles that made other ideas to increase trans-Hudson capacity unbuildable.

ARC's route beneath Manhattan to a new, modern station under 34th Street meets future ridership demand and provides one-seat rides to and from Manhattan for the greatest number of New Jerseyans. Pedestrian connections between the new station, existing Penn Station and numbers of subway lines ensure customer convenience and travel flexibility.

ARC's planning was completed and approved by the Federal Transit Administration in early 2009. Project funding, largely from the federal government and the Port Authority of New York and New Jersey, is settled. As the work expands, so will the benefit to the economy, with as many as 6,000 new jobs created during peak construction years. Meanwhile, ARC's lasting mobility improvements will lead to some 44,000 new, permanent business, professional and service jobs after the project is complete.

The long planning and review process proved that the new tunnel's route also avoids a host of problematic environmental impacts that undermined other proposals, including disturbing the ecology of the Hudson River and disrupting a wide swath of Manhattan's West Side. Moreover, ARC planners were careful to design the new station so future service can be extended eastward when the region determines it is appropriate. Meanwhile, riders will enjoy direct, underground connections to 14 subway lines and PATH including, for the first time in two generations, the Broadway/Sixth Avenue lines used by one-quarter of all NJ Transit customers each work day.

It has been some 15 years since transportation planners first sat down to determine how best to break the trans-Hudson congestion bottleneck. It took herculean efforts by many professionals to move ARC forward, overcoming the political paralysis and occasional insistence upon unachievable perfection that have stalled many other worthy projects around the nation.



Today, we begin to reap the result of those long efforts: We are underway with an ARC project that offers tremendous benefits to riders and the economy while respecting and preserving the environment. In short, the ARC Trans-Hudson Express Tunnel project, while not perfect, is a win-win, providing impressive short- and long-term benefits for the state and region.

Don River and Central Waterfront project

Sewage, rain tunnel study for Don River and Lake Ontario In Toronto, MMM Group consultants handed out an 85-page report of graphs, charts and maps at a Metro Hall meeting on 31 May explaining methods including tunnels, shafts, underground storage tanks and chemicals that could be used to battle the problem of raw sewage flowing straight from residential and business toilets into storm sewers that then flow into the Don River and Lake Ontario, Toronto's drinking water.

It's a problem called combined sewer overflow (CSO) and it happens when a heavy rainfall pours down sewer grates, raises the level of lesser-contaminated rainwater in the storm sewer, and causes the rainwater to overflow and mix with human waste in the sanitary sewer.

The end result is sewage doesn't get a chance to get to a treatment plant; it pours untreated into the Don and Lake Ontario through sewers meant to handle only rainwater.

The city launched the Don River and Central Waterfront project in early 2008 aimed at cleaning up the Don River and the harbour. A huge chunk of central Toronto has been cited as the study area for the cleanup project. It extends from Steeles Avenue to Toronto Island and from roughly Dufferin Street to Victoria Park Avenue.

New Crystal Springs complete

Jacobs Associates has reported that on March 24, the TBM for the New Crystal Springs Bypass Tunnel reached its termination of excavation at the base of the completed North Shaft, after travelling 1.3km from the South Shaft, where it was launched on November 10, 2009.

Shank/Balfour Beatty JV is the general contractor for the project which will provide redundancy for the existing Cystal Springs Bypass water pipeline, supplying drinking water to the San Francisco peninsula. Jacobs Associates is providing construction management services for the project owner, the San Francisco Public Utilities Commission.

The planned construction approach was to complete the North Shaft, including the steel pipe installation by mid-2009, and to leave the shield in place when TBM excavation was completed. The TBM will then be 'gutted' and salvageable parts backed out of the tunnel and retrieved from the South Shaft.

The best day of progress saw 25.3m of excavation, and the overall average since the start of excavation was 12.2m/d. The TBM was designed by M.L. Shank Co, the shield was manufactured by Hitachi Zosen, and the cutters were provided by Herrenknecht. Most other components were fabricated and assembled on-site between July and October of 2009.

The next phase of work includes installation of welded steel pipes in the tunnel and backfill with cellular grout, as well as installation of near-surface pipelines, valves, and vaults at the South Shaft. Shutdown #1, which involved near-surface piping at the North Shaft being tied into the Sunset Supply Pipeline during a limited system-wide outage, was completed ahead of schedule on March 2.

Brightwater tunnels

Machines excavating a tunnel that will carry treated sewage from the Brightwater plant to Puget Sound have completed work on two of four tunnel segments A tunnel-boring machine that started from Point Wells on Puget Sound broke through the concrete wall of a portal on Ballinger Way in Shoreline June 18, completing its four-mile task.

Another machine finished a 2.2-mile tunnel segment from Kenmore to Bothell, after it was idled for nearly nine months while workers made repairs deep underground.

The tunnel segment between Bothell and the treatment plant in Snohomish County north of Woodinville was completed earlier.

When the $1.8 billion project finishes now depends on how quickly the segment between Shoreline and Kenmore can be completed. A damaged boring machine in that segment will be removed, and excavation will be completed by the machine that reached the Shoreline portal.

Boring the 13-mile tunnel is difficult because of high pressures and varying soil conditions.

Training Drill Brings Terror to New Jersey "Tunnel"

Terrorists have blown up a New Jersey tunnel with a bomb, trapping victims under cars and overturned buses — but fortunately, this is only one of the made up scenarios in a disaster drill in Newark.

The exercise prepares the Metro Urban Search And Rescue (USAR) Strike Team — firefighters from nine different New Jersey municipalities — to work together in case of catastrophic events like terrorist attacks and natural disasters.

"No one knows where or when natural disasters, fires, accidents, or terrorists may strike," said Newark Mayor Cory Booker. "I am proud of how our Fire Department has pro-actively partnered with other emergency response organizations for the second straight year to conduct this important drill. By coming together to share services we will define excellence in time of crisis by responding as a unified team."

The scenario presented to the firefighters is that terrorists have detonated an improvised explosive device (IED) in a mock "Metro Tunnel" during rush hour. During the drill, firefighters cleared debris to locate victims, and then drilled through obstructions to perform rescue operations.

"Fifteen years ago, in Oklahoma City, a lone terrorist showed the amount of death, damage, and devastation that can be achieved with a small amount of explosives, carried out with minimal thought, planning, and money," Fire Chief Michael Lalor said. "We cannot forget that tragedy, and the finest honor we, as emergency responders, can render to the victims of that horror is to unite, plan, and drill, so that we can be prepared to address any potential future acts of terrorism."

For each of the last five years, the Metro USAR Strike Team has held an annual mandatory drill to sharpen the agencies rescue skills. It was created in response to 9/11 in order to unite emergency response agencies by region.

Arica tunnel

Three Chilean architects have proposed a plan to expand sea access for Bolivia, which has been landlocked for more than a century, by constructing a tunnel that will run through Chile's first region in Arica.

Sea access has been a major issue for Bolivia since the 1879-1883 War of the Pacific that allowed Chile to annex a vast northern expanse of land from both Peru and Bolivia. The proposed tunnel would stretch from the Bolivian border through Chile's Arica to an artificial island built in the Pacific Ocean.

However, Peru is disputing maritime border issues with Chile as they believe the artificial island, built in the Pacific Ocean, will be within Peruvian waters and not Chilean waters. Chile says its maritime border with Peru is a horizontal line in the Pacific that was established in agreements signed in 1952 and 1954. But Peru claims that those are not border demarcation pacts, but rather fishing agreements between both countries, and says the border should be considered as a diagonal line equidistant between both countries.

The conflict between Bolivia and Chile these days is squarely at the center of Bolivia's refusal to export any of its abundant natural gas supplies to energy-poor Chile, which last year was at the brink of an electric rationing.

Bolivian Consulate, Magali Zegarra, who is located in Arica, said Chile will obviously invest in the project as construction will be on Chilean territory and therefore under Chilean jurisdiction. But all three countries, Peru, Chile and Bolivia will need to come to a mutual agreement before construction can begin.

The conflict between Bolivia and Chile these days is squarely at the center of Bolivia's refusal to export any of its abundant natural gas supplies to energy-poor Chile…

Seattle — World's widest Tunnel

At 56 feet across, the machine needed to dig the planned Highway 99 tunnel would exceed the 50-½-foot crossing beneath the Yangtze River in Shanghai and a 50-foot tunnel in Madrid, Spain, drilled with Herrenknecht machines.

A tunneling machine for Highway 99 is thought to cost $60 million to $80 million, out of a $1.1 billion tunnel contract, according to the state Department of Transportation (DOT). With contingencies and design costs, the tunnel is $1.96 billion, of a total $3.1 billion highway-corridor price that includes surface and elevated roads and ramps.

The challenges of tunneling are spelled out in an updated geotechnical DOT report. Clays within much of the route are sticky enough to potentially clog a machine, and there are patches of gravels and quartz sand that are abrasive.

The DOT has a target date of November 2016 at the latest for the tunnel to be ready to replace the aging Alaskan Way Viaduct. Bid proposals are due in late October.

Herrenknecht's staffers say they've contacted all three contractors bidding on the Highway 99 project. "We have quite a bit of interest to build over there, in difficult ground conditions," their boss said.

Herrenknecht's enthusiasm "is good news," said Linea Laird, the DOT's tunnel-segment manager.

But that doesn't guarantee they'll win the contract to supply a Seattle contracting team with the world's largest-diameter boring machine. Mitsubishi also is capable of building such a wide machine, while Robbins Co., a competing firm based partly in Kent, could perhaps partner with another boring-machine firm, Laird said. Mitsubishi supplied a 50-foot machine in Madrid, and Robbins a 47-½-foot drill at Niagara Falls, Canada.

Herrenknecht founded his German firm in 1978 with two employees. Now aged 65, his company has more than 2,000 employees, including a regional headquarters in Sumner.

"If the ground conditions accept it, Seattle will be No. 1 in tunneling. I think we have to fight quite strongly [for the project]; I hope we will get a chance," he said at an after-hours reception for members of the Underground Construction Association, meeting in Portland.

More than Asia and Europe, North America is now in the "champions league" of taking on tunnel-engineering challenges, he said. These include a port tunnel in Miami, a drinking-water tunnel beneath 900 feet of unstable rock outside Los Angeles, and a drinking-water tunnel from a lake near Las Vegas, under 13 times atmospheric pressure. And, of course, Seattle.

Arctic tunnel a gateway to the past

Scientists hope the planned expansion of a tunnel, excavated deep into frozen Alaskan permafrost, will answer questions about melting in the arctic and reveal evidence of ancient life.

Today, the Cold Regions Research and Engineering Laboratory, or "CRREL tunnel," is run by the U.S. Army Corps of Engineers. Scientists conducting a variety of research programs use the space as an active underground laboratory.

The current tunnel was excavated just north of Fairbanks, Alaska in the early 1960's by the U.S. Bureau of Mines. The official reason for construction was to evaluate mining and construction methods in frozen soils. But the dig exposed a treasure of geological formations, animal fossils and ancient plant remains. Bones and teeth of bison, woolly mammoth and horse from 14,000 years ago protrude from the tunnel wall, literally frozen in place and time.

In 1999, NASA astrobiologist Dr. Richard Hoover discovered a new bacteria species in ice samples from the tunnel's roof. Hoover says the roughly 32,000-year-old microbes suggest similar life forms may exist in the glaciers or permafrost of Mars or in the ice oceans of Jupiter's moon Europa.

Researchers are now planning an expansion to the tunnel and the U.S. Army Corps of Engineers has received $500,000 in federal funding to begin small-scale engineering tests.

Currently, a small wooden shack juts from the base of a wooded hill. Inside a heavy door, the tunnel cuts one hundred and ten meters in and fifteen meters down through the frozen earth.

Research Physical Scientist Dr. Matthew Sturm lives above the CRREL tunnel and is the resident caretaker and tour guide. The tunnel is chilled to -4 degrees Celsius year round to prevent the permafrost from thawing, and before entering visitors are provided hard hats and parkas. The passageway descends through the permafrost made up of frozen silts, a gravel layer, and then into bedrock.

Permafrost is soil or rock that remains frozen for two or more years. But warming temperatures are causing the permafrost to melt all across the arctic causing environmental changes and engineering headaches.

As permafrost thaws, carbon that had been bound up in the frozen tundra is released into the atmosphere, intensifying climate change. More immediately, warmer temperatures are leading to buckled roads and cracked building foundations.

Sturm says an expanded tunnel will help answer important questions about thawing permafrost that can't be seen by looking at the surface. "We have massive circum-arctic lands all of which are undergoing some degradation of permafrost, but we don't know what's happening until we see it in the surface evidence." But the expanded tunnel, says Sturm, will give scientists a unique three-dimensional look at frozen arctic soil.

Excavation on the new tunnel will also focus on preserving DNA materials. "To get the paleontology story right you have to harvest the materials very carefully," says Sturm. "That was not done in the current tunnel."

The excavation will add 1000 feet of new tunnel. Sturm hopes drilling for the new tunnel will begin in December of 2011 and open by 2013.

Fighting flood crisis in Mexico City

Deep underground, tunneling crews are racing against time as they try to save the world's third-largest metropolis from catastrophe.

Above them, the Mexican capital is sinking into the earth at a record rate, tilting the city's sewage tunnels so they are actually running backward. Crews are rushing to build a 37-mile drainage tunnel to save the city from drowning.

"Imagine the Congress, the stock exchange, the country's biggest airport, everything underwater," says Ariel Flores, water reuse manager for the National Water Commission. "It would paralyze the economy of the entire country. It would be a total disaster."

Across this city of 18.7 million, workers have started a flurry of projects to shore up areas that are sinking by as much as 8 inches a year. They're renovating a key intersection, filling holes under a commuter train line, reinforcing churches in the historic center, rehabilitating another drainage tunnel and dredging above-ground sewage canals.

Flooding poses the most danger, and there are already signs of trouble. In February, the Remedios River, a sewage canal, backed up and broke through its dike, flooding 4,000 homes with raw waste. Officials evacuated swaths of eastern Mexico City, worried about an epidemic deadlier than the H1N1 flu that swept over the city last year.

After the flood, the city installed five more massive pumps to force water out of the sinking metropolis.

"The goal: to reduce the risk of flooding as much as we can," Mayor Marcelo Ebrard says. "With luck, we'll be in time."

Mexico City's sinking problem dates back centuries. The Aztecs built their capital, known as Tenochtitlan, on a flat island in the middle of a lake. The city flooded frequently.

After the Spanish defeated the Aztecs in 1521, Spanish colonizers began draining the lake to control flooding. One flood, in 1629, left the city underwater for five years.

As the water disappeared, the city settled into the mud, forcing the government to build ever-deeper drainage tunnels to carry the water to lower ground.

In recent decades, the city's population soared, forcing authorities to pump more drinking water from underground aquifers and worsening the sinking. Mexico City and its suburbs make up the world's third-most-populous urban area after Tokyo and New Delhi, according to the United Nations.

Much of the wastewater no longer flows naturally out of the city. Pumps are used to get it over a rise called the Sierra de Guadalupe.

Landmarks anchored to bedrock are thrust skyward as the rest of the city drops. Workers have had to add 14 steps to the base of the Independence Angel monument since it was built in 1910, and a water pipe installed at ground level in 1934 now juts 27 feet in the air beside the Monument to the Revolution.

The Insurgentes Traffic Circle, a main intersection built on underground piles in 1970, is now 12 feet higher than the streets feeding into it.

In the city's colonial center, the federal government is injecting columns of wet concrete 115 feet beneath the Holy Trinity Church in an attempt to shore it up. The 17th-century church is listing to the side and sinking faster than the surrounding streets. Worshipers descend a 7-foot stairway to get in the door.

The biggest project is the Eastern Drainage Tunnel, a 23-foot-wide, $1.1 billion pipeline that will run north for 37 miles from Mexico City to lower ground in the Mezquital Valley.

At its deepest point, the tunnel will be 495 feet underground. Excavation began in June 2008 and will finish in 2012, the National Water Commission says.

It will carry away wastewater and reduce the risk of flooding, but it won't stop the sinking, says Ramón Domínguez Mora, a hydraulic engineer at the National Autonomous University of Mexico. To stop the ancient lake bed from contracting further, the city either has to stop pumping from its aquifer or inject water back into the ground, he says. But first the water must be cleaned, and the city does not have enough water treatment plants. Only 6% of Mexico City's sewage and rain runoff is treated; the rest is used to irrigate fields.

Even if the water could be returned to the aquifer, it's unlikely the ground could be "re-inflated". It is considered that once the soil of the lake bed is compacted, it will not return to its original volume. The only hope is to stop it from sinking further.

US National Tunnel Inspection Standards

Moving to fulfill an NTSB recommendation stemming from the ceiling collapse in Boston's Central Artery Tunnel in July 2006 that killed a passenger in a car, DOT's Federal Highway Administration has proposed creating National Tunnel Inspection standards that would apply to about 350 tunnels in the United States located on federal-aid highways. FHWA said it would model them after the existing National Bridge Inspection Standards, but key members of Congress said they believe FHWA oversight of more than 600,000 bridges is not doing enough to ensure those bridges' safety. DOT's inspector general also called for such an inspection regime during 2007 testimony before Congress.

The standards would apply to structures including Boston's Central Artery tunnel, New York City's Lincoln Tunnel, and Baltimore's Fort McHenry and Baltimore Harbor tunnels, all of which are heavily used. The Lincoln Tunnel carries about 120,000 vehicles per day, making it the busiest vehicular tunnel in the world, FHWA said, and the Fort McHenry Tunnel handles more than 115,000 vehicles daily.

The standards would include requirements for inspecting structural elements and mechanical, electrical, hydraulic, and ventilation systems; qualifications for inspectors; inspection frequencies; and a National Tunnel Inventory.

Tunnel inspection frequency is not consistent nationwide; it ranges from daily to every 10 years, according to FHWA. The proposed standards would require state transportation departments and federal agencies owning tunnels not only to adhere to the standards but also to report inspection findings to FHWA and fix problems they find in a timely manner.

The agency's notice cited a tunnel problem that was detected in time: "The importance of tunnel inspection was demonstrated in the summer of 2007 in the I-70 Hanging Lake tunnel in Colorado when a ceiling and roof inspection uncovered a crack in the roof that was compromising the structural integrity of the tunnel. This discovery prompted the closure of the tunnel for several months for needed repairs. The repairs included removal of more than 30 feet of soil fill material from the top of the tunnel roof, temporary support of the roof from the inside of the tunnel, removal of the suspended ceiling, and the design and construction of a new slab cast on top of the existing roof to reinforce and add extra structural capacity. To accomplish the repair, the eastbound tube under the cracked roof was closed to traffic, and the adjacent westbound tube was converted to a tube with bi-directional traffic. Even though the eastbound tunnel was closed for 7 months, and the repair cost approximately $6 million, the repairs helped prevent a potential safety incident."

Egypt planning tunnel under Suez Canal

Egypt plans to build a $1 billion tunnel under the Suez Canal at Port Said and will begin seeking finance as soon as the designs are completed, Al-Akhbar newspaper recently quoted the investment minister as saying.

The tunnel, to be built 19 km (12 miles) south of the Canal's northern entrance, will have 3 passageways, one for rail and two for cars, the newspaper quoted Mahmoud Mohieldin as telling a conference in Dahab in the eastern Sinai Peninsula.

The conference was called to discuss investment in the cities along the canal and in the Sinai, which the government is keen to develop following a number of clashes between security forces and impoverished Bedouin tribes.

"There is good cooperation with international investment funds to finance the project, which will be entirely financed outside the state budget," Mohieldin said.

Egypt now has two points for cars to cross the waterway — a tunnel near the city of Suez and a bridge near Ismailia. Once the Port Said tunnel is finished, another tunnel is planned for Ismailia, Mohieldin told the conference.

ME'S LONGEST TUNNEL

Abu Dhabi is bracing to inaugurate the Middle East's longest traffic tunnel and an expanded resort beach on time towards the year end as the emirate is pushing ahead with a major development drive to cope with rapid population growth.

When the tunnel is operated, drivers heading into Abu Dhabi will be able to emerge on the southern tip of the coastal city without having to go through agonizing traffic bottlenecks that often characterize the capital's roads.

The Abu Dhabi MunicipalityAbu Dhabi Municipality said it had completed more than 75 per cent of the Dhfive-billion tunnel project which also involves long causeways linking the Capital with the nearby Reem and Saadiyat islands. "This mega infrastructure project is part of the municipality's strategic aim to meet the requirements of a developing city, as well as respond to the needs of the growing population," the MunicipalityMunicipality said.

Thousands of workers, armed with bulldozers and cranes, have been involved in the construction of one of the largest infrastructure ventures in the region.

The causeways connecting the Western flank of the Capital to Reem Island have already been completed.

They will serve the Island, once a desolate tiny isle before it is turned into a major inhabitant centre housing nearly 200,000 people.

"The project was launched more than two years ago and will be completed on time at the end of this year... it will be the first free and clear road for traffic coming from the north towards Mina Zayed and the Corniche road," said Abdulah Al Shamsi, Acting Director of the Roads Division at the MunicipalityMunicipality.

"We have completed more than 65 per cent of the project...the parts completed include the bridges linking Abu Dhabi city to Reem and Saadiyat Islands."

The project has severely disrupted traffic and caused massive road bottlenecks on Salam Street and the Tourist Club area in the Western part of the Capital but officials say such problems would be a matter of the past once the tunnel and accompanying flyovers are completed.

Once the tunnel is completed, passengers coming from Dubai and other emirates will have two optional directions — either to take the expanded surface road into the capital or plunge around 15 metres underground into the tunnel. Those heading for Reem can just turn right and drive along the causeway.

The tunnel will run underground from the capital's northeastern entrance straight to Port Zayed and other coastal areas in the southern part of the city, where the fish market and harbour, the sprawling vegetable market, the ageing Iranian free port, cooperative societies and other facilities are located.

South Korea's Samsung construction company is the main consultant for this project, part of a long-term blueprint by Abu Dhabi to expand its inhabited areas and road networks to cope with a sharp rise in the population, which officials expect to nearly triple in the next 20 years.

The tunnel will run just under Al Salam street while a causeway will connect the new junction at the entrance of the tunnel with the 900-hectare Al Reem Island, which will be inhabited by a few thousands people this year.

Al Reem, around 300 metres off the coast of Abu Dhabi, is being developed by Sorouh (Shams Abu Dhabi), Reem Investments and other property developers.

It will be one of the largest and most impressive tourist developments in the world once after the completion of those projects, which involve residential, commercial and recreational centres. It will also house hotels, restaurants, gardens, museums, an aquarium, amusement parks for children and a wildlife reserve.

Another major development project, the expansion of the famous Abu Dhabi beach, is running parallel to the tunnel construction and is scheduled to be completed towards the end of this year.

The Abu Dhabi MunicipalityAbu Dhabi Municipality is carrying out the project, which will be confined to families.

Sources at the project said it would cost over Dh30 million to bring to more than Dh200 million the total investments pumped into the Abu Dhabi beach resort.

The new project, launched early this year, involves extension of the three-km beach towards the Hilton Hotel on the Western tip of the Corniche, one of the largest and most developed seaside roads in the region.

The project was prompted by a surge in the number of visitors seeking to enjoy the warm azure water and scorching summer sun for a token fee away from costly hotel beaches and swimming pools in the capital.

The Abu Dhabi MunicipalityAbu Dhabi Municipality has set up the project to face an expected sharp increase in swimmers in the next seasons as a nearby free public beach on Ras Alakhdar has been shut to give way for the construction of a massive palace.

Located midway between the Hilton and Sheraton hotels, the beach resort has cost around Dh150 million as it includes a well-equipped clean beach, restaurants, cafes, a hotel, a mosque, parks, chalets, and other facilities.

The project is the latest in an ongoing massive development programme at Abu Dhabi's Corniche, where at least Dhtwo billion had been spent over the past eight years to develop and reshape the road and the entire area.

Abu Dhabi has been locked in a drive to expand its tourism sector as part of a long-term programme to diversify its oil-reliant economy.

The drive also includes construction of new hotels to accommodate a surge in visitors and there are plans to add nearly 17,000 hotel rooms to the existing 10,000 rooms.

Officials expect a t least three million visitors to come to Abu Dhabi in 2015 and five million in 2025.

Sources at the project said it would cost over Dh30 million to bring to more than Dh200 million the total investments pumped into the Abu Dhabi beach resort.

Abu Dhabi new tunnel boring joint venture

Abu Dhabi-based Aabar Investments has confirmed it has entered into a joint venture with a German company to engineer, design and build tunnel boring machines and related equipment.

The deal has been completed with Herrenknecht AG which will see Aabar own 51 percent of a UAE based company that will own and operate a manufacturing facility for tunnel-boring machinery and equipment.

The new company operations will include the assembly and manufacture of tunneling technology and vertical drilling rigs and will serve customers in the Middle East and North African region, Aabar said in a statement posted on the Abu Dhabi Securities Exchange.

Qatar subsea tunnel project

Jamal al-Kaabi, acting manager of the design department at Qatar's Public Works Authority, has said the country will go ahead with plans for a 12km subsea tunnel that will link the capital's new airport with the financial centre at a cost of more than $1bn, Zawya Dow Jones has reported.

'The road is under the urban planning department for the concept design and then we will be taking that project for the detailed design and construction phase,' he said. Danish engineering consultants COWI have submitted a feasibility study and a preliminary concept design, which is now awaiting approval from the Qatari government's urban planning department.

New Ethiopia dam tunnel collapses

A water passage tunnel in a recently inaugurated hydropower dam in Ethiopia has reportedly collapsed, an NGO, International Rivers has said.

In a press statement copied to ghanabusinessnews.com, the NGO said a critical water passage tunnel in the newly inaugurated Gilgel Gibe 2 hydropower project in Ethiopia collapsed.

About 10 days after the ceremony, "African Energy Intelligence" and the Italian public channel RAI 3 reported that, the project's core component, a 26-kilometer-long tunnel collapsed, shutting down operations for an extended period. The repair could take months, the reports said.

The dam which is currently Ethiopia's biggest power plant has a capacity of 420 megawatts and was built at a cost of 374 million euros. The project channels the water discharged from the Gilgel Gibe 1 Dam through a long tunnel and a steep drop directly to the valley of the Omo River.

The project, being built by Italian firm Salini, had already been delayed by more than two years, the statement said.

The NGO claims that the Gilgel Gibe contract was also awarded without a feasibility study. Adding that construction started — again in violation of Ethiopian law — without an environmental permit.

Italian law and international agreements require that development aid only fund infrastructure projects that are based on international tenders. Yet in violation of that law, and against the recommendation of its own evaluators, Italy's Ministry of Development Cooperation awarded 220 million Euros in aid money for Salini's contract on Gibe 2. The European Investment Bank contributed another 50 million Euros, and the Ethiopian government funded the remaining 104 million Euros for the project, it said.

According to the statement, the power project was supposed to be completed in December 2007, but shoddy planning took its toll. Poor geological studies overlooked sandy soils and other unexpected problems. Tunnel-boring equipment got stuck in the mud, and engineers had to redesign the tunnel's path. Usually contractors carry the risks of such cost overruns. Yet the dubiously negotiated contract for Gilgel Gibe 2 exempts Salini from geological risks, so the Ethiopian electricity consumers and taxpayers ended up with the bill.

This new accident falls under the contractual responsibilities of Salini, and the company must restore the tunnel and cover all extra costs, but it is possible that part of these costs will again be transferred to Ethiopian taxpayers, the statement said.

Work begins on Doha airport station

Mott MacDonald's design role on the New Doha International Airport Terminal metro station has come to fruition as construction started on the first underground metro station in Qatar. The station will be the terminus for the future Doha Metro line, providing the rail link between Doha City and the airport's main terminal.

Mott MacDonald was commissioned in 2008 by the government of the State of Qatar, to develop designs for the metro connection from the airport to the wider Doha network.

The project included developing a metro system based on conservative parameters and space proofing of 1.3km single track twin bored tunnels and a 305m long, 25m wide and 20m deep cut and cover underground station. During the preliminary design of the station box, Mott MacDonald's team of professionals developed plans and designs, with support from sub consultants Aedas.

Mert Yesugey, Mott MacDonald's project manager says: "Mott MacDonald developed the design for the fully space proofed structural shell of the station box to a tight schedule for the completion of the structure ahead of the airport opening, including sectional

handover of the ground level to others for completion of the above ground infrastructure in time for the airport opening in 2011.

"The provisions for the station box also included temporary electrical and mechanical systems to facilitate the maintenance, inspection and security of the station box during the interim stage until the station becomes fully operational. We are currently providing construction support services on site until the completion of the station box in 2011."

Xstrata suspends Australia investments

Xstrata has suspended AUD586 million of expenditure to develop both the Wandoan thermal coal project and a project to extend the life of the Ernest Henry copper mine.

The decisions represent the initial findings from Xstrata's ongoing review of planned investment into its Australian operations and growth projects as a result of the Australian Government's proposed Resource Super Profits Tax.

Key Queensland growth initiatives to be suspended are: * AUD400 million Ernest Henry Mining (EHM) shaft underground mine project, already approved by Xstrata for development near Cloncurry in north-west Queensland ; * AUD91 million early works and detailed design for the first stage of the 30 million tonnes per annum, AUD6 billion Wandoan Coal Project and related infrastructure; * AUD82 million of additional exploration and sampling for Wandoan and the Surat basin; and * AUD13 million of drilling on additional coal expansion projects in Queensland including Rolleston West and Sarum.

Mick Davis, Xstrata plc Chief Executive commented: "The RSPT has created significant uncertainty for the future of mining investment into Australia and would impair the value of previously approved projects and exploration to the point that continued investment can no longer be justified. Our Australian management teams' analysis demonstrates that the RSPT would significantly impact the value and cashflows of both of these projects. The impact of the tax eliminates the net present value of the Wandoan coal project almost entirely and substantially reduces the value of the Ernest Henry underground shaft project. The two projects involve significant risks and total capital investment of over AUD6.4 billion. Neither will be viable if the RSPT is imposed."

"In addition, the Government's decision to change the rules for existing investments has introduced the significant risk that any new investment in Australia may again be subject to tax regime changes without consultation. Any potential Australian mining investment now needs to show a higher rate of return to compensate for the impact of the world's highest mining taxation on cashflows. Investors will also expect higher project returns to justify the increased risk of investing in Australia. The suspension of investment into these key projects for the future of our business in Queensland makes them less likely to proceed and ultimately compromises Australia's ability to continue to benefit from future commodity price rises."

"We will continue to seek meaningful consultation with the Federal Government to engage on the industry's key concerns in respect of the RSPT. In the meantime, we have an obligation to make business decisions in response to changing circumstances and we continue to develop business opportunities and develop growth projects in countries which promote competitive and predictable fiscal regimes."

The Ernest Henry underground mine project was approved by the Xstrata plc Board in December 2009 and would have extended the life of the EHM operations from 2013 to at least 2024, with a total capital investment of AUD589 million (US$542 million). EHM's current open pit mining operations would have been progressively transformed into a major shaft underground mine through this investment.

Although the development of the smaller decline underground mine is currently planned to continue, the suspension of the majority of the underground development project will halve the mine's planned annual production rate from 2012 and reduce the planned life of the operations by at least five years, from 2024 to 2019.

Xstrata Coal has spent approximately AUD200 million over three years progressing the Wandoan Coal Project through feasibility studies. Early works scheduled to commence from July 2010 will be suspended immediately, including drilling, the construction of workers's accommodation, communications and road upgrades.

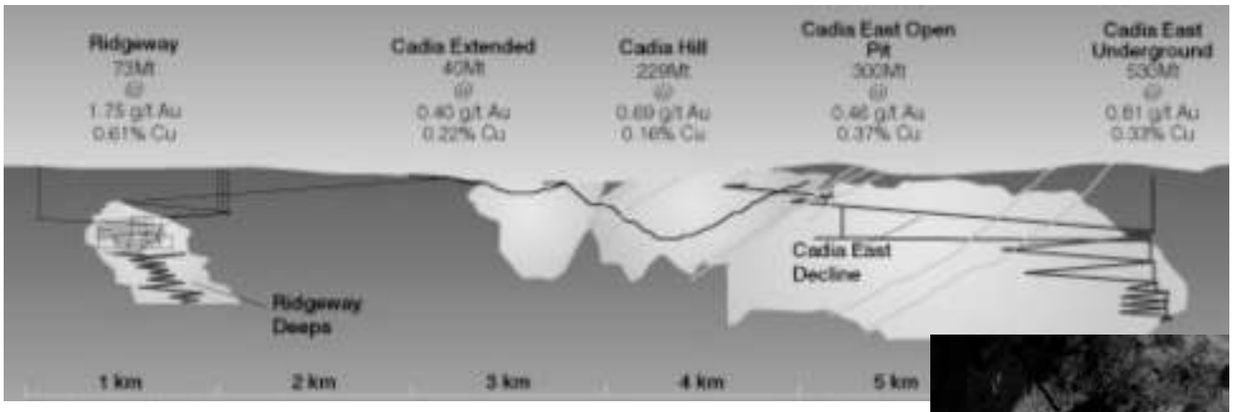
The two projects involve significant risks and total capital investment of over AUD6.4 billion. Neither will be viable if the RSPT is imposed.

Australia drops mining tax

Australia's government has dropped plans for 40 per cent tax on booming mining company profits, defusing a damaging row with big business and clearing the way for national elections to be called at any time.

Along with Australia's biggest miners, BHP Billiton and Rio Tinto, Xstrata welcomed the government's decision to replace its 40 per cent resource super profits tax with a 30 per cent minerals resource rent tax. But smaller miners, including Queensland collier Clive Palmer, say the deal comes at their expense.

In a joint statement coinciding with the government's announcement, the big three miners said they were "encouraged" by the new regime, which represented significant progress towards a regime that satisfied the industry's core principles. The miners say the changes meet a core principle that any new tax not be applied retrospectively, so existing projects where investment decisions already had been made were not adversely affected.



Biggest underground gold and copper mine plans near Orange NSW

Newcrest is set to build what it says is the largest underground mine in Australia, after approving the development of the Cadia East gold and copper deposit near Orange in central western NSW.

Newcrest said the Cadia East gold deposit was one of the world's largest, comprising a mineral resource of 2347 million tonnes, containing 33.2 million ounces of gold and 6.59 million tonnes of copper, along with a current ore reserve of 18.7 million ounces of gold and 3.16 million tonnes of copper.

Newcrest said development of the Cadia East deposit would underpin production from the Cadia Valley for at least 30 years. Development will include construction of an underground mine adjacent to the existing Cadia Hill open pit mine. Capacity at the existing Cadia Valley processing plant will be increased to 26 million tonnes per annum from 24 million tonnes per annum.

"It will be Australia's largest underground mine and one of the largest underground mines in the world," Newcrest said in a statement to the Australian Securities Exchange. The project, estimated to cost $1.91 billion, will generate 1300 jobs at the peak of construction.

The project is expected to be funded from internal cash flows, with most of the capital expenditure to be incurred by the end of the 2012 calendar year.

Construction will start immediately, with first production expected in the second half of 2012. Commissioning with appreciable production levels is expected during the 2013 calendar year.

Newcrest said the project would underpin its strategy to remain a low-cost gold producer, with production costs well within the lowest quartile of global cash costs. The Cadia East cash cost over the first 10 years of production would be below $100 per ounce, with a total production cost of less than $250 per ounce.

The project would enable production from Cadia Valley operations to increase to a range of 700,000 to 800,000 ounces of gold per year over the first 10 years, and 75,000 tonnes to more than 100,000 tonnes of copper. The expansion of the mine will extend its life by at least 20 years.

At its peak, a new Cadia East Mine will produce gold and copper with an estimated value of approximately $1 billion per annum at today's values.

Mr Kelly said planning approval had been given subject to strict conditions, which will manage the environmental impact of the mine expansion. "Planning approval will consolidate existing consents for the mining complex, which has been operating since 1998," Mr Kelly said. "That will mean the entire mining operation, including the parts currently in operation, will be required to be in line with modern, best-practice environmental standards. One of the major issues considered during the planning assessment process has been the potential impact on surface and groundwater supplies.

In order to ensure the water impacts were considered and managed, independent hydrology experts Emeritus Professor Tom McMahon and Mr Larry Cook have been engaged. They found Cadia could access enough water under existing licences to meet the project's needs, including from more efficient water use and increased capacity in the mine's existing dams.

If at any stage the mine is not able to show it has sufficient water for the expansion, it must curtail its operations. The approval also incorporates an extensive biodiversity offset strategy, including the conservation of 938 hectares of land to compensate for the clearing of 238 hectares of vegetation. The assessment found the project is unlikely to significantly impact on endangered ecological communities such as the Box-Gum Woodland.

Carrapateena for sale

One of the largest undeveloped copper and gold projects in Australia is up for sale. The project partners which own the copper and gold project in South Australia's far north have appointed Rothschilds to find a joint venture partner or buyer for the project. Carrapateena is something of a fairytale story, with RMG Services owner and metallurgist Rudy Gomez putting his own money on the line to drill two holes at the site, about 100km southeast of the Olympic Dam copper, gold and uranium mine.

The SA Government, through its PACE program, co-funded that drilling, which returned a phenomenal intersection of 70m at 3.03 per cent copper and 0.4 grams per tonne of gold. Canadian company Teck came on board in late 2005 and backed up the initial drilling with a 905m intersection at a grade of 2.17 per cent copper and 0.9 grams per tonne of gold, starting from 487m below ground surface.

The depth of the deposit could be a factor in Teck seeking a partner, as it has limited underground mining experience. The company has also had a turbulent time during the global financial crisis and could be unwilling to commit to a project needing a substantial capital investment.

It is believed Teck, via its drilling commitments and payments to RMG, has secured a one-third stake in Carrapateena, with RMG retaining the rest. The company is believed to have completed 75,000m of drilling at the site.

Mr Gomez said yesterday Carrapateena was destined to be a great project. "There's nowhere in the world that has intercepts like that. That's why it's generating a lot of interest," he said. Mr Gomez said while there had been a lot of drilling at the site, there was not enough to release a resource statement compliant with Australian reporting standards. "The ore body was quite large," he said.

"Teck Cominco had to finish up on the drilling because they have met our agreement, so they were not able to develop a JORC (Australian standards) resource, but at the same time the drilling was done very competently ... and the ore body's there. But it is quite large and needs more exploration. Now we have to look for what is the best option, whether we look for a joint venture partner or whether we sell up."

The Carrapateena project is located within the same geological structure, known as the Gawler Craton, which hosts the Olympic Dam mine and the Prominent Hill copper and gold mine.

However, it lies outside the Woomera Prohibited Area, meaning its development would not require Defence Department approval.

Merlin molybdenum and rhenium mine

Ivanhoe has awarded the construction contract for the decline access into the planned Merlin molybdenum and rhenium mine on the company's Cloncurry Project in northwestern Queensland to Byrnecut Australia Limited.

Mobilisation of equipment and personnel will commence immediately and be closely followed by the start of excavation of the box-cut on the Mount Dore Ridge. Development of the decline access is expected to be underway within eight weeks to allow construction of the Merlin decline to continue throughout the Queensland wet season (December to March).

"The discovery of the Merlin deposit, the purchase of the Osborne operating facilities and the recent equity funding all have been extremely important steps in Ivanhoe Australia's progression as a developing company," Peter Reeve, Chief Executive Officer of Ivanhoe Australia Limited said. "The commencement of this underground decline access to the Merlin deposit also is a very important step as it marks another milestone in the re-emergence of the Cloncurry mineral field as a major producing region. While Ivanhoe Australia will retain a strong focus on exploration, work on the decline marks the point at which Ivanhoe Australia starts the transition from explorer to producer."

Mining approval for Rasp mine

CBH Resources Ltd can start the first stage of operations at the Rasp zinc and lead mine in Broken Hill after getting government approvals.

In January, the Broken Hill city council approved the restart of underground operations in the Main Lode pillars, while the Department of Industry and Investment had approved the underground mining application in December.

The state and city council approvals allow the company to mine and crush 120,000 tonnes of ore a year from Rasp for two years.

Hellyer Mine update

Bass Metals has encountered water bearing structures in the Fossey decline at its Hellyer Mine Project development in NW Tasmania, bringing extra pumping capacity to manage the unexpected water flows.

The Fossey decline is at approximately 625 metres of the 911 metre total planned decline length but its advance in recent weeks has continued to encounter significant unexpected highwater bearing structures.

Difficulties associated with these water bearing structures have been exacerbated by snow storms which have restricted access to site for several shifts.

The increased water flow has made mining activities difficult and placed the interim pumping and power supply services under maximum load, with no contingency if further such structures are intersected.

In response Bass has decided to bring forward in the development schedule the installation of permanent services and upgrade of the pumping capacity to ensure sufficient contingency.

The original planned final pumping capacity was to be 80 litres per second, which is now being upgraded to 180 litres per second. The current pumping requirement is estimated to be 50 to 60 litres per second.

The water flows have caused a further delay in the decline advance and Bass now estimates that the overall mine development is four weeks behind the original schedule.

The upgrades to the dewatering circuit and modification to the schedule is likely to result in a capital cost increase of approximately $0.7 million.

The refurbishment of the Hellyer Mill is approximately 60% complete with costs to date consistent with the planned expenditure schedule.

The issues in the underground mine development have prompted a review of the overall development and production schedule. In late July 2010, it was regarded as realistic, albeit, "tight" to have the Mill commissioned and in production in December 2010.

Bass still expects ore production from the Fossey mine in November-December, but given the recent issues in the decline development, plant commissioning will be completed prior to Christmas and then after the work force has had a break over Christmas, start treating Fossey ore early in the new Year, 2011.

In dealing with the water inflow and the installation of the extra power and given the occurrence of Christmas in the middle of that schedule it was decided to plan to start processing Fossey ore in January 2011, rather than in December 2010.

The company said in the overall scheme it is regarded as a very modest and prudent revision to the schedule.

Margaret River Against Underground Mining

The Margaret River Wine Industry Association has approached the State government about the possible effects mine tunnels would have on the quality of the soil in which their vineyards thrive.

The association's chief executive Nick Power says the plan of eastern states-based company LD Operations to establish an underground coal mine would affect the agricultural area.

The 300 members of the MRWIA are concerned about the subsidence and hydrologic environmental impacts of the mine tunnels. Coal mines have been noted to cause sinking, or worse, the collapse of the top soil into underground voids. Even ground water levels change near mining sites.

The Margaret River region enjoys a Mediterranean style climate. Vineyards are not affected by extreme summer and winter temperatures and humidity levels are ideal during the growing period. For decades, the nearly 5,000 hectares under vine has consistently yielded high quality fruit of intense flavour.

Australia sells Coal to China

Australian firm, Resourcehouse, has signed a $60 Billion (AUS$69bn; £38bn) deal to supply coal to Chinese power stations. It is Australia's "biggest ever export contract". Under the deal, the firm will build a new mining complex to give China Power International Development (CPI) 30 million tons of coal a year for 20 years.

The new mining complex will be established in Queensland. The plan also requires laying 500km (311 miles) of railway line to move the coal to the coast. The complex in the Galilee basin, to be called China First, is expected to start coal production in 2013 and will churn out some 40 million tonnes a year.

Queensland state premier Anna Bligh anticipates the project will create tens of thousands of jobs and produce multi-million dollar royalty payments for the state government. But the lucrative Sino-Australian deal will almost certainly disappoint some environmental groups, who believe Australia's reliance on plentiful reserves of coal, both for domestic electricity generation and for export, should be reduced in favour of renewable sources of energy.

Analysts say the deal signals a thaw between the two nations, following a string of incidents in 2009 that strained relations, from the arrest in Shanghai of an Australian mining executive from Rio Tinto to the failed attempt by the state-owned resources company, Chinalco, to buy into the Anglo-Australia mining giant, Rio Tinto.

Murchison Bell and Big Bell

Aragon Resources diamond drilling has intersected high grade gold intercepts on the Golden Crown and Great Fingall deposits, which is part of the Central Murchison Gold Project in Western Australia.

Open pit ore from the Day Dawn Mining Centre would be combined with that from the Murchison Bell and Cuddingwarra Mining Centres providing a platform for underground development and a staged open pit / underground production scenario.

The large remaining underground resource at the Big Bell underground mine is currently undergoing a re-start study and is expected to provide a solid base for a consolidated gold mining operation targeting 100,000 ounces per annum for an initial 8 years.

The objective of the current diamond drilling at the Great Fingall and Golden Crown mines is to further evaluate the existing resources and to test for down-plunge extensions to these prolific producers.

Gold was discovered at Murchison Bell in 1904 by prospector Harry Paton. From 1910 open pit mining commenced and subsequently operated by various owners. Underground operations only commenced in the mid-1990's. The vast majority of the 2.6 Moz of gold produced came from the underground mining operations which ceased in 2003.

Heritage Mining proposals for Talisman

Mt Karangahake draped in dense bush appears indomitable, yet is honeycombed with man-made voids. A century ago, tunnels on 16 levels were chipped and blasted into it in pursuit of gold, combing 34km of the interior.

The Karangahake gorge was the centre of a gold mining industry; Waikino, where the ore was crushed, was a substantial settlement. These days the scenic gorge is conservation land, with popular walking trails passing relics of the gold rush days.

Most visitors are unaware that prospectors have returned to the mountain, following quartz veins containing minute traces of gold. Heritage Gold has a permit to prospect inside Mt Karangahake, within the conservation estate. A gate on the narrow gravel road bars access so mining can take place in the old Talisman mine, halfway up the mountain.

Between 1875 and 1929, the Talisman produced more than a million ounces (28.3 tonnes) of gold and three million ounces of silver. Since 2003, Heritage has restored the old workings and drilled core samples covering 1100m, concentrating on a rich vein called Maria. Heritage director Peter Atkinson is proud of the DoC sign on the gate: in signalling a partnership between conservation and mining, it is as symbolic as a wedding band.

Just across the gorge, Heritage has a permit to test drill beneath the Rahu block, where geologists believe the same gold-bearing veins discovered at Talisman continue. They are looking for bonanza concentrations — grades of ore where the gold is visible, containing at least an ounce to the tonne. "The history of this mine has been dominated by bonanza concentrations," says Atkinson.

Higher gold prices and more efficient extraction methods mean that grades uneconomic in the past are now worth going for. And modern equipment can get deeper than miners could a century ago.

The gorge is south of the "green line" which bars mining from most of the Coromandel Peninsula. That area, north of the Kopu-Hikuai road, is Schedule Four land — part of the conservation estate, off-limits to mining.

Heritage believes Karangahake can serve as a model for mining in conservation areas with minimal environmental effects. It's the type of mining Prime Minister John Key calls surgical: underground tunnelling using smaller drilling machines and carts than with open cast digs, with waste rock recycled to fill the cavities created. Rock cleared so far from Talisman has been donated for DoC tracks, says Atkinson.

"It's the sort of mining that can be undertaken fairly unobtrusively. There's a small footprint — a narrow entrance is pretty much all you need and you can put some of the infrastructure inside the portal. More and more people are turning to narrow vein mining because [surface deposits] have been pretty well mined out."

Heritage was granted a mining permit for Talisman last November and is seeking joint venture partners; discussions have been held with Chinese companies. Atkinson says China is looking 20 years ahead for its mineral needs.

In its heyday, the Coromandel was home to one of the most productive goldfields of its type in the world, with more than 50 deposits found. If it was again opened up for exploration, companies would return with their test drills, says Atkinson. "If you want to find gold, go to a gold deposit that's already there."

Atkinson is a down-to-earth Australian with an exploration vein stretching from Kalgoorlie. He came here in the early-1980s and is a past-president of the New Zealand Minerals Industry Association. He has an interesting take on the distinction between conservation and mining land: "Not all conservation land is created equal — some of it is mining land."

He says large tracts of mining land were put into conservation estate without much thought for their mineral wealth when the Department of Conservation was set up in 1977.

"It's not that miners want to go into conservation estate — it's just that DoC owns all the prospective mining land. Coromandel is the richest bit of goldmining country in New Zealand. There is certainly some very attractive ground but, like the rest of the DoC estate, you have to ask: 'Why should all of that land be of significant conservation value given that, outside towns, it's the most modified land?' If you value conservation estate, you should value mineral resources as well."

Ten kilometres away at Waihi, old-style open-pit mining and its cleaner, gentler modern face sit side-by-side: the Martha mine on Waihi's doorstep and the underground Favona mine, both owned by international giant Newmont. From the outside, Favona is just a 5m-wide portal in a hillside but the extent of rock being extracted, and the machinery, are much bigger than Heritage's narrow vein approach at Karangahake. The adjacent processing plant crushes thousands of tonnes of ore a day, carried 2km by conveyor belt from Martha and by truck from Favona. The chemical-laden slurry from which gold is extracted goes to one of two big tailings dams behind

the plant (one is full and being decommissioned). Waste rock is returned underground to fill the voids created by extraction.

Both mines are nearing the end of their days — Newmont has a permit to expand Martha to the east and extend its life for three years but has yet to commit, while Favona, which opened in 2006, has a limited life expectancy.

Unless new veins are found, the future of the processing plant and about 130 jobs are in doubt — but Newmont is exploring north of Whangamata, at Onemana and Opoutere, and is keenly interested in the review of schedule four land further north.

External affairs manager Kelvyn Eglinton says the processing plant could one day accept ore from other mines on the peninsula.

"This is our strategic advantage — we could bring material here and not necessarily by truck — we could pipe it and pump it with minimal environmental impact."

Eglinton laments the extremism of the debate about mining in conservation lands. He says the industry accepts that highest-value land should not be exploited.

"The issue on the Coromandel is that no one's been up there with modern drilling techniques for 30 years to really know [what's there].

"Before we do anything we would need aerial magnetic surveys to narrow down where we would drill. Then if we do find anything you have the debate about the conditions [on extraction] and whether there's a net benefit. All we're saying is, 'let's have the debate'."

Bonanza gold at Golden Crown Mine

Perth-based Aragon Resources has hit bonanza gold from drilling at the Golden Crown Mine in Western Australia.

Further high-grade gold extensions of the main quartz reef were encountered with the latest diamond hole returning a bonanza intercept of 9.3 metres @14.65g/t Au from 715.9 metres. The results from hole CMD 00021 include 3.4 metres@ 37.54g/t Au from 715.9 metres (main reef). The ore system remains open down plunge.

The intercept is considered to have intersected the down-plunge southern portion of the main reef approximately 40 metres below the current resource boundary and includes apparent quartz splays and wall-rock alteration of the main reef.

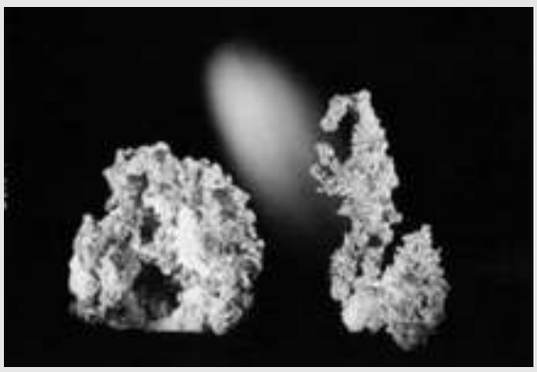
The company estimates that the true width of the intercept is approximately 7.5 metres at this location. Within this intercept, the main reef is manifested as a 3.4 metre quartz reef assaying 37.54g/t Au and which also exhibits abundant visible gold.

The Golden Crown mine is located within the Day Dawn goldfield approximately 6km south of Cue in the Murchison Goldfield of Western Australia.

The quartz reef is located just 500 metres south of the Great Fingall Mine which historicall has produced 1.9 million tonnes @ 19.5g/t Gold for approximately 1.2 million ounces. Production to date from the Golden Crown Mine was 288,000 ounces.

Aragon holds a land position in the Central Murchison of 33,400 hectares including the three historically significant goldfields of Big Bell, Cuddingwarra and Day Dawn. Historic production from the Aragon land package totals 5 million ounces. The total estimated resource inventory within Aragon's tenure is 11,490,000 tonnes @ 4.0g/t Au containing 1.5 million ounces.

Aragon refers to the total package as its Central Murchison Gold Project. The Golden Crown mine is just one of the exciting opportunities for future gold production in this impressive package. Aragon is currently evaluating the defined resources, drill testing for primary extensions and performing open-pit and underground mining studies as integral steps in fulfilling its strategic plan. The company anticipates that these works will continue through 2010 followed by the completion of a detailed feasibility study during 2011.



Oceana Gold takes over Frasers contract

Oceana Gold is taking over the Frasers underground mining contract, which was costing it about $25 million per year, and is offering the contractor's 100 staff employment with Oceana.

Australian-based Byrnecut Mining has been contracted at the East Otago Macraes site to mine Frasers — which cost $US54 million ($NZ75.8 million) to develop — since April 2006, with the tunnel fully commissioned in January 2008.

Oceana chief operating officer Mark Cadzow said the company would maintain manning levels and would offer employment to Byrnecut's 100 employees, plus Byrnecut would act in an advisory role until September. Frasers has about 125 staff.

"The main advantage is leveraging off other parts of the [open pit] operation and utilising those synergies to reduce costs," Mr Cadzow said.

Oceana recently got out of its forward contract hedging arrangements to sell all its gold on the global spot market and expects an extra $70 million-$80 million if prices remain around the $US1100 per ounce level. Prices spiked yesterday above $US1200.

About 1 million tonnes of ore is taken out of Frasers annually. It is forecast to deliver 55,000-65,000oz of gold annually for three years. However, the extent of the ore body remains undefined at depths beyond the present 580m. Test drilling in adjacent areas recently delivered "promising results" of "significant" grades.

High output from Endeavour mine

Takeover target CBH Resources has reported "continued excellence" from its Endeavour zinc/lead/silver mine, in New South Wales,.

CBH reported that activities linked with the ramp-up of production have also progressed on schedule. The ramp-up would see Endeavour produce around 850 000 t/y, from July this year.

Metal production for Endeavour during the fourth quarter was forecasted to increase by a further 25% on the third quarter production figures, while cash costs for the fourth quarter were estimated to be around $0,70/lb zinc equivalent.

These costs were expected to decrease to between $0,50/lb and $0,55/lb zinc equivalent, as the benefits of higher production and other cost efficiencies were realised, the company said.

Huntly East Mine considers contract option

Solid Energy is investigating the option of contracting out part or all or all of its operations at its Huntly East Underground Mine to increase productivity and secure the mine's long-term viability.

The move follows several months' discussion with the Engineering, Printing and Manufacturing Union (EPMU) and its East Mine workforce seeking their agreement to changes required at the mine to give confidence in further investment in the mine and to secure its long-term future. Current levels of productivity are insufficient to sustain the mine's long-term viability.

Solid Energy is continuing discussions with the EMPU while carrying out these investigations.

Solid Energy's General Manager North Operations, Craig Smith says: "Solid Energy has kept the East Mine workforce fully informed of the process to date and will continue to do so. We still hope to reach a position where the necessary changes to East Mine's productivity can be achieved within the existing workforce. We'll be discussing the results of our investigations with the union and the workforce."

Argent buys Bullant gold mine

Argent Minerals has acquired the Bullant gold mine, in Western Australia, from gold major Barrick for more than A$5.2-million in cash and 350 000 Argent shares.

Argent said in a statement that it would raise up to A$16-million by way of a share placement to fund the acquisition, development and working capital for the Bullant project.

The purchase agreement with Barrick was conditional upon the issuance of Argent shares to fund the purchase. Argent would now seek the necessary shareholder and regulatory approvals to conduct the capital raising, and consent for the proposed transaction as soon as possible.

The Bullant project includes an underground mining operation, located about 65 km from Kalgoorlie. Barrick ceased mining operations at Bullant in December 2009. Between 2002 and 2009, the underground mine had produced 1.95-million tonnes at 5.1 g/t gold, for 322 700 oz of gold. Argent said in a statement that site facilities and equipment were also included in the purchase agreement.

Argent intended to reopen the mine, extend the decline and establish development drives to support the start of stoping within about six months of completing the transaction agreement, which was scheduled for late September.

The company would then enter into a toll treatment arrangement. Argent added that this arrangement could be entered into with one of a number of possible treatment plants within a short trucking distance from the mine site.

The project is estimated to host a total Measured Resource of 5 400 oz, 47 200 oz of Indicated Resource, and a further 96 600 oz of Inferred Resource.

Avoca to develop underground mine in WA

Avoca Resources Ltd says it will develop a second underground gold mine at its Higginsville project in Western Australia, and will open its well-telegraphed takeover offer for Dioro Exploration NL.

Avoca said it had a new reserve estimate for the Chalice deposit at Higginsville of 720,000 tonnes, grading 5.1 grams per tonne (g/t) and containing 118,000 ounces of gold. "The new Chalice underground reserve will allow Avoca to develop its second underground gold mine at Higginsville and will be the third mining reserve after Trident and the Fairplay open pit reserve," Avoca said.

The miner estimates underground development will commence mid-2010 following the dewatering of the Chalice open pit. Capital costs are estimated to be $42 million although Avoca is looking into potential savings of $3 million using pit-dewatering options.

It plans to produce 57,000 ounces at 5.5 g/t in 2011/12, 44,000 ounces at 5.5 g/t the following financial year and 17,000 ounces at 3.8 g/t in 2013/14.

Avoca managing director Rohan Williams said the advancement of the Chalice deposit would help the miner to achieve its goal of a more than 10-year mine life for the Higginsville project.

McPhillamys 3M ounce Resource

Alkane Resources has inked a maiden resource estimate of 2.96 million ounces of gold for the McPhillamys gold discovery, located within the Orange District Exploration Joint Venture with Newmont.

An independent resource assessment by Richard Lewis of Lewis Mineral Resource Consulting Pty Ltd in Sydney. defined an initial Indicated and Inferred Resource at a 0.3g/t gold cut-off of 91.94 million tonnes grading 1.00g/t Au and 0.07% Cu for a cumulative total of 2.96 million ounces of gold and 60,000 tonnes of copper.

Alkane is in a joint venture with Newmont Australia Limited, a subsidiary of the US based Newmont Mining Corporation over the Orange District Exploration Joint Venture, 400km northwest of Sydney, which includes Alkane's Molong and Moorilda tenements located near the city of Orange in the Central West of New South Wales, adjacent to Newcrest Mining Ltd's Cadia Valley Operations.

The bulk of the Resource is located within an Inner Ore Zone with dimensions of 600 metres by 200 metres.Further drilling is likely to significantly expand the resource. Potential development models include open pit and block caving underground mining concepts.

Currently the JV is drilling four deep core holes to specifically test the potential for the block caving concept.

Craic goes underground

Gold producer Range River will start the changeover from openpit mining to underground mining at its Craic deposit, in Western Australia.

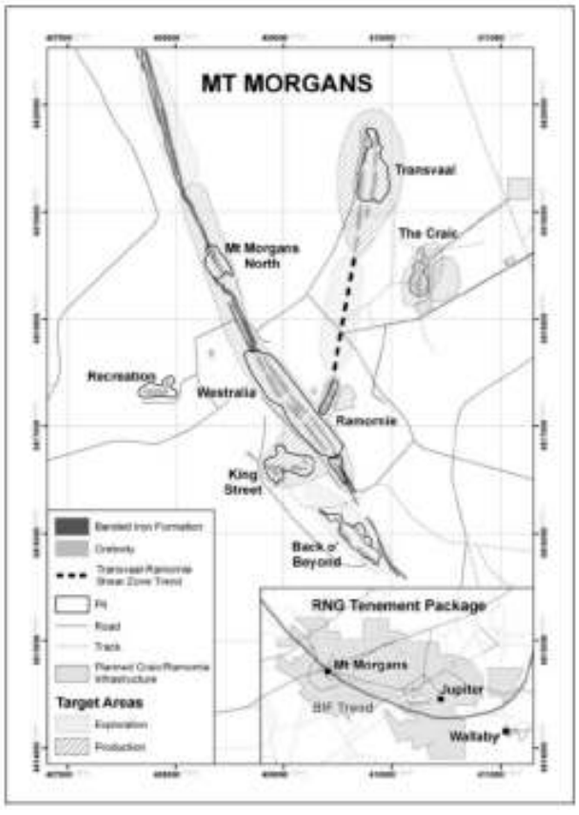
MD Rick Watsford said that the company would also shift its focus from bulk mining operations to more selective underground mining. "This will provide opportunities to drill test the depth extensions of our Craig deposit, and later the reopened Transvaal deposit."

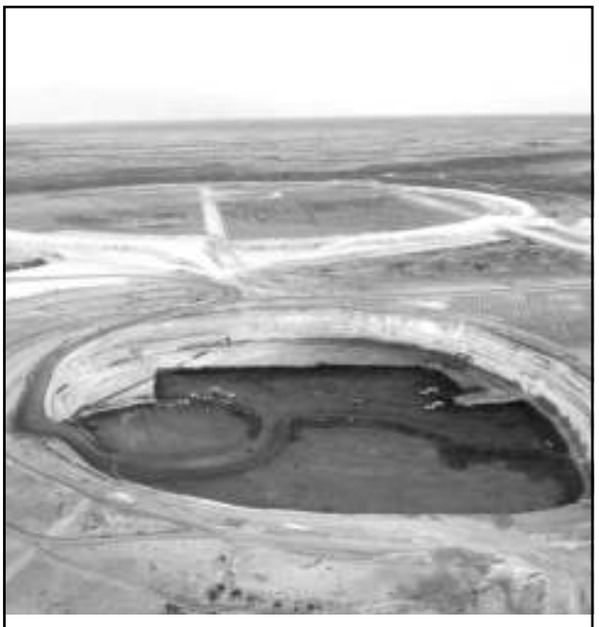
Watsford also said that the company's gold production reached record levels in July. Mount Morgans operation, which consists of the Craic, Transvaal and Westralia deposits, produced 3 298 oz of gold during July 2010, setting it up to meet production targets of between 8 000 oz and 9 000 oz for the quarter.

The Mount Morgans operation was expected to deliver a minimum of 215 000 oz over a five year period, when running at full capacity.

Range River had previously reported that opportunities existed to increase the total resources at Craig, Transvaal and Westralia through extensional exploration. Similarly, there were other opportunities to identify ore deposits close to these resources that could be mined in conjunction with these three deposits.

Higher-grade ore zones exist within the Transvaal and Westralia resources and will provide opportunities to improve the underground mining cash flow, but at the expense of the total resource mined.





Prominent Hill new underground mine

OZ Minerals says changes to the federal mining tax will allow underground mining at its Prominent Hill operation in outback South Australia and the board have approved the construction of a new underground operation. All government approvals have been granted.

Underground expansion plans were put on hold in May, but OZ Minerals managing director Terry Burgess says they are back on track because of changes to the planned mining tax

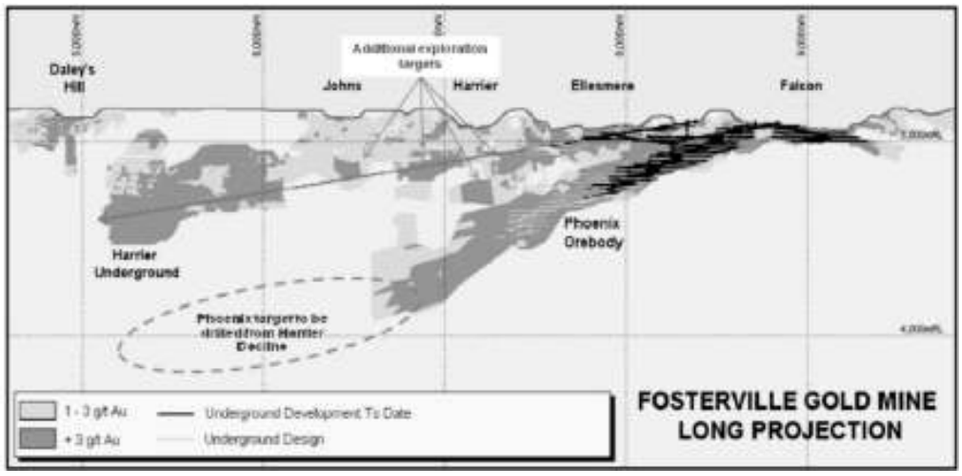
Preproduction expenditure on construction and other costs is expected to be $135 million. Construction will begin immediately with an instant need for a drilling contractor for the construction of ventilation shafts.

First production is expected to be in the last quarter of 2011, with full production achieved in the second half of 2012.

The new mine will exploit the copper deposit to the west of the main open cut mine and will contribute an average of 25,000t of copper and 12,000oz of gold each year.

The ore will be processed using the existing facilities established to process the ore from the main pit. The chalcocite-bornite deposit will be mined using sub-level open stoping techniques. The mine life of the underground western copper deposit is expected to be 5 years.

Harrier underground commenced



The Fosterville Gold mine is located 20 km east of Bendigo, a township of approximately 95,000 people. Bendigo, a historic gold mining centre located 150 km north of Melbourne, is estimated to have produced 22 million ounces of gold following the first discoveries in 1851.

Northgate completed the acquisition of Perseverance Corporation Ltd., on February 18, 2008, adding the Fosterville and Stawell Gold mines to its mining portfolio

The Harrier underground deposit is over 300 m below the surface and to the north east of Daley's Hill. In early November of 2009, Northgate commenced the development of a decline from the Ellesmere Zone towards the Harrier Underground, which will facilitate future development and production. Development of the decline is expected to take place over the next two years, with production in the Harrier Underground orebody starting in 2012. The Harrier decline ramp will also provide an ideal platform for exploration and resource definition drilling into the Phoenix orebody, which has been the most productive orebody identified on the property to date. Additional drill testing of targets in other mineralized zones will also take place along the decline. The Company will invest in the order of $30M to develop the new mine.

Gold Fields go underground at Athena

Gold Fields' Athena deposit at the Saint Ives project, in Western Australia, would go underground by December.

The company executive vice-president for exploration and business development Tommy McKeith said that moving to underground mining at Athena and ongoing exploration success could extend Saint Ives' mine life to ten years.

The new exploration at Saint Ives' Athena deposit was confirming higher and wider grade mineralisation than had previously been mined.

"This has positioned Gold Fields to have Athena in full underground gold production for the first time by mid next year after an end of year start-up this year," McKeith said. Since Gold Fields took over the management of the Saint Ives project four or five years ago, it has produced around ten-million ounces of gold. Gold Fields has further added more than 3,65-million ounces in reserves since its acquisition of the project.

The St Ives operations extend from 5 to 25 km south-southwest of the town of Kambalda in Western Australia, approximately 630 km east of Perth. Located at approximately latitude 31°12'S and longitude 121°40'E, the nearest major settlement is the town of Kalgoorlie situated 80 km north.: Ore is currently mined from three underground mines, four open-pits and 10 surface stockpile sources, and processed via both mill/CIP and heap leach plants. Structurally controlled hydrothermal gold deposits situated in the Norseman-Wiluna Greenstone Belt, which is part of the Yilgarn Craton, a 2.6 Ga granite-greenstone terrain in Western Australia.

Crocodile Gold Major Exploration Program

Ore is currently being extracted from the Howley open pit mine and the Brocks Creek underground mine and is being trucked to the Union Reefs mill for processing.

At the Tom's Gully mine, development of the access ramps is underway in order to access the higher grade ore. The mill at Tom's Gully was expected to restart during Q3 2010.

Dewatering of the former open pit is progressing well at the Cosmo underground development project. Ramp development to access the underground orebody is anticipated to commence by the start of Q3 2010 and production is forecast by the beginning of Q3 2011. It is anticipated that once the Cosmo mine is in production it will substantially reduce the Company's overall cash costs.

Capital expenditures for 2010 are forecast to be US$56 million including an expenditure of US$13.3 million for the final property payment due in June. These expenditures also include those for the 2010 exploration program, and development work at Cosmo and Tom's Gully. The Company is currently completing engineering work, and sourcing of long lead time items and site preparation with respect to locating a mill at the Cosmo site, which is also expected to substantially lower production costs. This was expected to be finalised in the second quarter of 2010. Capital costs associated with the mill are not included in the 2010 total.

Exploration

As a result of the encouraging results received to date from the ongoing exploration program, Crocodile Gold has commenced an expanded exploration program for 2010 with a budget of US$23 million. This will include 40,000 metres of diamond drilling and 90,000 metres of reverse circulation drilling.

As stated in the Crocodile Gold press release dated January 25, 2010 the Howley resource has been increased at a cost of approximately US$6 per ounce, and the Company believes the potential exists to lower this discovery cost as understanding of the mineralization improves. The long term goal is to increase Crocodile Gold's resources to 10 million ounces of gold, and the aggressiveness of the new program is intended to achieve this goal as quickly as possible. If this resource goal is achieved the potential exists for annual production to rise to substantially above 250,000 ounces per year.

More than 70% of the new budget is dedicated to exploring and upgrading the resources at Cosmo and Howley. The Cosmo/Howley area covers a 5 kilometre mineralized system which is part of a 25 kilometre mineralized trend with known resources along its entire length. The longer term goal is to investigate the potential along the full 25 kilometre length. Additional exploration targets for 2010 include Tom's Gully, Maud Creek and Iron Blow.

In providing this information, President and CEO, Mike Hoffman, stated: "We are pleased to be providing detailed guidance which is consistent with all our previous statements on expected production. We have learned a considerable amount regarding the Howley and Brocks Creek operations during the start up phase and are therefore confident in our ability to meet these targets. As the year progresses and we continue to obtain further exploration data, we will examine the potential to further optimize the operation from a cost and production point of view."

"The aggressive nature of the new exploration program is testament to our belief that we are exploring a very large mineralized system with excellent long term potential, which we want to demonstrate as quickly as possible. Exploring with the goal of substantially increasing the overall reserves and resources will allow our site team to properly sequence and optimize future production. We are continuing to add expertise at the operations and are building a strong team of professionals in the Northern Territory."

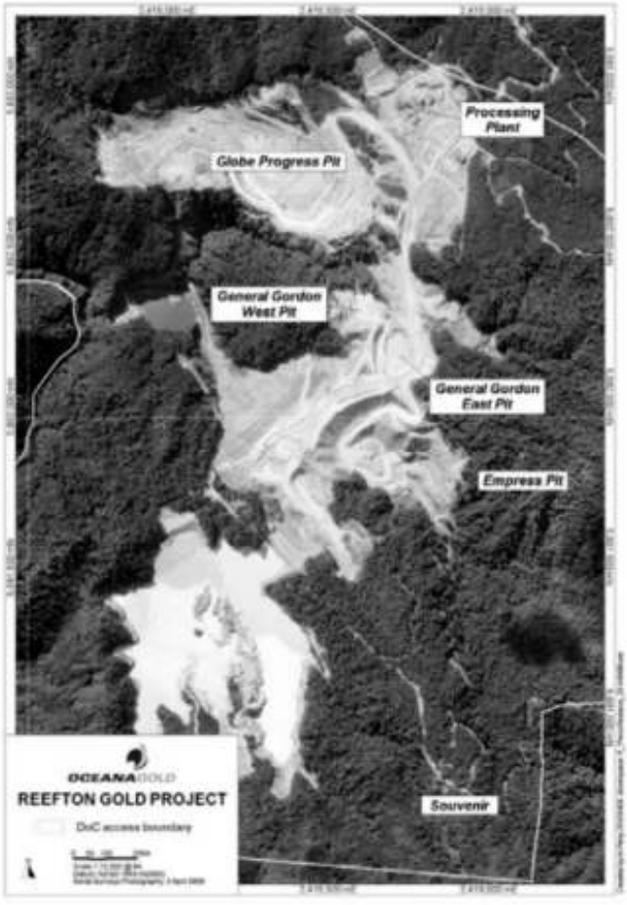
Exploring with the goal of substantially increasing the overall reserves and resources will allow our site team to properly sequence and optimize future production.

Extensions Announced at Reefton Gold Mine

OceanaGold Corporation has announced that results from the first phase of a brownfields exploration program have identified a number of extensions to the gold mineralization at the General Gordon, Souvenir and Empress deposits at the Reefton gold mine in New Zealand.

Highlights

- Drilling programs have identified mineralized extensions at Souvenir and General Gordon deposits which are likely to result in increased reserves and pit expansions. Follow up drilling at these identified areas is already underway.
- Mineralized extensions were also intersected at the Empress 1 deposit with further work planned to examine potential underground mining opportunities.
- Following intensive mapping and geochemical sampling programs, six additional highly prospective near mine targets have been identified along the mineral trend. A drilling program focused on these targets has commenced.



History

The Reefton goldfield is significant in Australasia for being a multi-million ounce producer in the late 1800's and early 1900's but with virtually no production since circa 1920 (apart from the Blackwater Mine which ceased producing in 1951) until the commissioning of OceanaGold's Reefton operation in 2007. Most historic mining in Reefton was from high grade underground operations with head grades from 15 to 34 g/t gold. These deposits were traditionally narrow veined structures that were discovered at surface and mined down dip. The immediate focus of OceanaGold's exploration program is to identify extensions within the current open pits as well as near mine satellite pits. Using modern technology and advancements in geologic understanding we aim to identify other large deposits not exposed at surface and much like those historically mined in the region.

St Ives 1Moz resource

Gold Fields has announced a substantial increase in the mineral resource of its emerging gold deposit Hamlet at the St Ives gold mine in Western Australia, to over one-million ounces of gold.

The company said that exploration drilling over the past year had led to an increase in indicated and inferred mineral resources at the Hamlet deposit, which is now reported as 6,62-million tons at 4,86 g/t for a total of 1,03-million ounces of gold. The mineral resource estimate had been independently audited by a Perth-based minerals industry consulting and advisory organisation Optiro.

After Athena, Hamlet is the company's second major discovery in the developing Argo-Athena camp in the last two years and is the result of an extensive near-mine exploration programme at St Ives.

The mineral resource is reported at a nominal 0,60 g/t gold cut-off grade, for shallow resources, constrained within an optimised pit shell and 2,4 g/t cut-off for the underground resources within conceptual stope shapes. It is expected that the majority of the resource will be mined by underground methods. The pit shell is based on price assumptions of $1 150/oz gold.

The Hamlet deposit is located about 1 km to the east of the new Athena underground mine and 12 km south of the Lefroy mill. Athena and Hamlet are part of a larger mineralised system in the Argo-Athena camp, which is being actively explored by the near mine exploration team.

Extension of rich historic orebody at Wiluna

Australian gold producer Apex Minerals has delivered immediate success from its new exploration program at the Wiluna Gold Project in Western Australia. The company announced drilling has identified the extension of the Golden Age mineralisation located to the east of the previous mining area.

The Golden Age mineralisation is free milling and is close to existing underground development, with the mineralised zone open up and down-dip and to the east.

The first six holes drilled into this target have returned extremely encouraging results with the quartz reef being intersected in all of the holes with three containing visible gold within the reef interval. The assay result from the first of these three holes returned 6.9m @ 39.4g/t gold.

Apex Managing Director Mark Ashley said the results were highly promising. "This initial drilling program, which only commenced in early January, confirms the presence of an exciting new extension of the Golden Age deposit at Wiluna," he said. "This Golden Age extension is under explored, free milling, high grade, close to existing development and has the potential to make a significant additional contribution to production and profitability.

"Exploration has effectively been on hold since development and subsequent production at Wiluna commenced in late 2008 so it is extremely encouraging to have such early success in one of many exploration targets that have been identified and assessed over the past 12 months."

He said the company's initial focus on Golden Age reflects it's near term mining potential and low cost drilling rather than it necessarily being the best exploration target identified to date. "Apex expects to expand its exploration program to test its numerous other targets once financially prudent to do so," Mr Ashley said.

The Mt Arthur underground is accessed off an existing highwall.

No progress for Mt Arthur Underground

BHP Billiton is still weighing up expansion options at its Mt Arthur mine in the Upper Hunter Valley of New South Wales with the $300 million Mt Arthur Underground project on hold.

The open cut expansion at the mine, also known as the MAC20 project, is back under assessment by the state government after being placed "on hold" for several months.

But the state government had already approved the Mt Arthur Underground project in December 2008.

This project was for a longwall operation targeting five seams over an initial mine life of 21 years.

Up to 8 million tonnes of run-of-mine production has been approved from this project.

A BHP spokesperson provided a brief update on the project's status.

"The Mt Arthur Underground project is currently on hold as we fully evaluate the expansion options proposed in the Mt Arthur Coal Consolidation Project," he told *ILN*.

Underground development started back in 2007 to help provide extra geotechnical information with help from contractor LD Operations.

ILN understands LDO has just a couple of staff still onsite — compared to 52 on the development team in December 2007.

The open cut expansion at the mine, 5 kilometres south of Muswellbrook, aims to lift saleable thermal coal production from 11.5 million tonnes per annum to 15Mtpa in the first half of 2011.

Integra Mining unveils another potential underground mine

Perth-based emerging gold producer Integra Mining is set for a significant resource upgrade after deep drilling at the Cock-Eyed Bob deposit within the Randalls Gold Project near Kalgoorlie, returned spectacular high grade intersections.

The latest results grade up to 51 grams per tonne and extend to +350m deep, -170m below the deposit's existing Mineral Resources estimate. Cock-Eyed Bob emerging as one of three potential underground mines at Randalls

Importantly, the high-grade results at Cock-Eyed Bob highlight its potential to become a source of underground production for the Randalls Gold Project, located 60km south-east of Kalgoorlie in Western Australia. The two deepest holes drilled to date at Cock-eyed Bob returned extremely high grade intercepts of 8.80 metres at 16.24 g/t gold and 4.2 metres at 14.99 g/t gold with excellent potential to extend these high grades further at depth.

Chris Cairns, managing director of Integra, said today that construction of the Randalls Project is almost complete, with the first gold pour scheduled for next month. Randalls is forecast to produce at an average rate of 90,000 ounces a year, rising to 140,000 ounces with a Phase Two process facility expansion.

The latest results show that Cock-Eyed Bob, which sits 13km east of the production plant, has now joined Santa and Maxwells as a potential source of high-grade underground material for the Randalls Project.

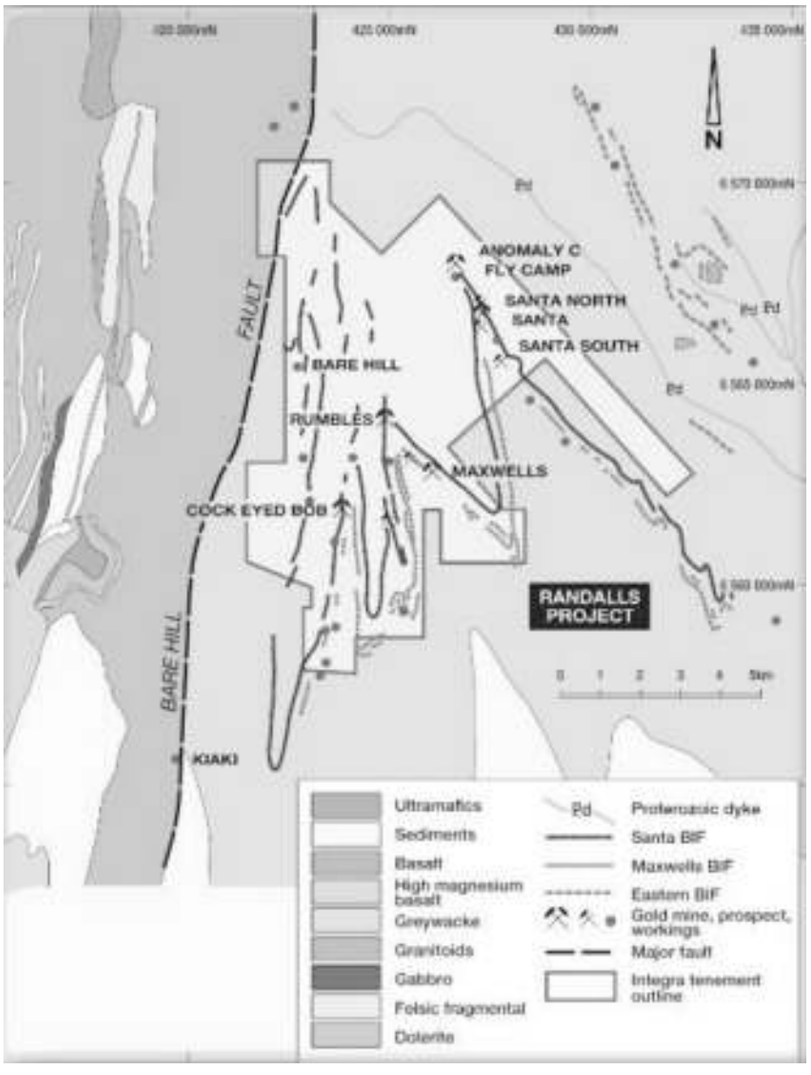
Cock-eyed Bob has a current Mineral Resource of 440,000 tonnes at 5.9 g/t gold for 84,000 contained ounces (63,000 ounces in the Indicated category and 22,000 ounces in the Inferred category). The existing Mineral Resource extends to approximately 180 metres below surface. The high-grade drill intercepts reported here substantially extend drill-defined high-grade gold mineralisation to about 200 metres below previous drill intercepts.

With the latest results which will boost resources, Integra intends to revise its global Mineral Resources estimate later this year. This upgraded figure will include the depth extensions to the Maxwells, Santa and Cock-Eyed Bob deposits.

It will also include a preliminary resource estimate for the new Majestic discovery, which lies 22km north of Randalls and is emerging as another source of ore for the new plant.

Integra is also pleased to report today that it has drilled a 'conceptual target' at the Walkaway prospect located about 500 metres north of Cock-Eyed Bob in an area with almost no previous drilling. Shallow high-grade gold mineralisation was confirmed on two sections drilled approximately 400 metres apart.

Randalls is forecast to produce at an average rate of 90,000 ounces a year, rising to 140,000 ounces with a Phase Two process facility expansion.



Mining restarts at OK Decline

Norseman Gold has restarted underground mining operations at the OK Decline, which forms part of the Norseman mine in western Australia. Mining was temporarily stopped at the decline following a fatality on 5 August 2010.

The company said that investigations into the incident are continuing.Operations at the other two declines, the Bullen and Harlequin, have been unaffected and they continued to operate as normal throughout the period.

In the company's most recent result, Q4 interims, which were released just one week before the incident, Norseman reported production of 14,469 oz (ounces) — most of which came from the two unaffected declines. In the three-months ended 30th June 2010, just 561oz of gold were produced from the OK Decline, meanwhile Bullen and Harlequin produced 4,170oz and 9,641oz respectively.

The OK Decline is the newest of the three declines, and the company has been ramping up production since OK began producing early this year. On 30 July, Norseman said it expected the OK Decline to steadily increase its production profile with more ore development undertaken and stoping.

The company upgraded both the reserves and resources at its Western Australia mine.Reserves increased by 5 per cent to 420,000 ounces of gold from 1.7 million tonnes at 7.7 grams of gold per tonne. The resource base, meanwhile, creeps up 3 per cent to 3.8 million ounces of the precious metal from 21 million tonnes at 5.3 grams per tonne.

Of the total Reserves, 330,000 ounces of gold are located within the Bullen, Harlequin and OK declines.

Maxwell goes underground

The Maxwell open pit is located about 15 kilometres east of Salt Creek and carries extremely high grades for a JORC resource of 410,000 ounces at 5.2 grams per tonne to an open pit depth of 150 metres.

A drill program to a depth of 400 meters was recently completed and targeted a conceptual resource of between 3.7 — 6.4 million tonnes, containing 580,000 — 1,300,000 ounces below the pit. Potential underground gold production to 60 meters below the pit identifies a recovery of 120,000 ounces at a grade of 5.5 grams per tonne at a "all in" recovery cost of A$750 per ounce. A twin decline to access this underground ore will cost $9 million to open up an estimated $174 million in revenues at very shallow depths. The decline can then be extended to deeper gold resources, which have been identified by drilling down to 404 meters, intersecting 2.2 meters at 9.86 grams per tonne. A full suite of assay results, resource definition and feasibility studies for underground mining should follow over the coming months.

Maxwell is one of a number of projects owned by Integra Mining. Integra Mining Ltd. is a West Australian explorer that will transition to substantial gold producer status in September. IGR operations are based east of Kalgoorlie, within one of the world's premier gold belts.

The June Quarterly confirmed that a fast paced, aggressive growth phase is now in full swing. IGR has already sold forward 91,952 ounces of gold at A$1,359.00 per ounce and forecasts production of 90,000 ounces in its first year for a projected initial operating profit of $75 million.

Integra has three drilling rigs at Maxwells that are testing depth extensions.``The deepest drillhole in the Maxwells gold deposit has tested gold mineralisation to a depth of only 150m below surface and there is excellent potential for gold mineralisation to extend several hundred metres depth."

The company said its intention was to define the first underground mining section in advance of a possible early decision to develop the underground mine as a supplement to its open pit mine that is now under construction. Integra expects gold production from its open pit operations in September at an initial rate of 75,000 ounces a year.

Eroc wins contract to take Telfer underground

Brisbane-based Eroc continues its aggressive push into the key Western Australian mining market. EROC has won the underground development contract at Newcrest Mining's huge Telfer gold project on the edge of the Great Sandy Desert in the north of Western Australia.

The initial phase of underground mining uses the sub-level caving mining method as higher grades occur at the top of the ore body. The development of the mine is based on similar procedures and techniques which proved successful at the Ridgeway operation. The main difference at Telfer is that crushed underground ore is hoisted to the surface via a 1,100 metre deep haulage shaft.

Gold and copper mineralization at Telfer is hosted within reef and stockwork domains in Proterozoic sediments. Mineralization has been defined in Main Dome to a depth of 1.3 kilometres below surface and in West Dome to a depth of 1.5 kilometres below surface.

Both deposits remain open at depth and are subject to ongoing exploration. The Telfer sequence is generally oxidized to a depth of up to 200 metres below surface with local weathering along permeable structures up to 1,000 metres below surface.

Japan to invest in Ensham mine

Idemitsu Kosan Co, the biggest coal seller among Japanese oil refiners, said it plans to invest A$140 million in Australia's Ensham mine to begin underground mining in the middle of 2011.

The Ensham mine has been producing thermal coal via open-cut mining, a process that will become more costly as it goes deeper into the layer below the surface. Full-fledged underground mining will allow it to continue securing coal efficiently, the company said.

'We estimate that the deeper the layer, the higher the cost in open-cut mining,' a company spokesman said. 'Through underground mining we can avoid a rise in costs, and can maintain cost competitiveness at the current level.'

The move, subject to Queensland's approval, will not lead to higher coal output, the spokesman added.

Idemitsu has an 85 percent stake in the mine, which annually produces a total 7.6 million tonnes.

New Zealand's Largest Premium Hard Coking Coal Deposit

Pike River Coal Limited is New Zealand's only listed coal mining company, becoming an NZX Top 50 company in July 2008. Pike River is owned by more than 8,000 shareholders and is in the business of mining and exporting premium hard coking coal.

Hard coking coal is the most valuable type of coal and is used by steel mills and coking plants to make coke, an essential ingredient in the steel making process.

Pike River is mining the Brunner seam under the Paparoa Ranges on the West Coast of the South Island, 50 miles north-east of Greymouth. At least 18 million tonnes of the 58 million tonne resource is expected to be recovered over a mine life of at least 18 years.

In a mark of support from the National-led Government for Pike River's economic development initiative, the mine was formally opened in November 2008 by its third highest ranking Cabinet Minister, Hon Gerry Brownlee.

The mine lies under the rugged Paparoa Ranges, almost 50 kilometres northeast of the coastal town of Greymouth on the west coast of the South Island.

Production started in mid-2009 and the new Pike River mine will become the second largest coal export mine in New Zealand.

It was 10 years in the making, including two years in cutting a 2.4 kilometre access tunnel under the Ranges to intersect with the main Brunner coal seam.

The underground coalfield holds the largest known deposit of premium hard coking coal in New Zealand, with firm export markets in Japan and India and strong interest elsewhere.

It has an inground resource of 58.5 million tonnes, with estimated recovery of at least 18 million tonnes over 18 years.

Initial core drilling suggests the Paparoa seam, 200 metres below, could produce up to another 8 million tonnes. Pike River metallurgical hard coking coal is particularly sought after by coke makers and steel mills because of its high quality, including the lowest ash content in the world at one percent, and very low phosphorous levels.

The coal has a high fluidity level, a measure of how fluid the coal becomes when heated to form coke.

Because of these special qualities, it is about 50 percent more efficient in making coke than lesser quality coking coals, generating far fewer carbon emissions.

While hard coking coal prices fluctuate in line with steel demand, Pike River maintains a strong marketing edge because of the special qualities of its coal.

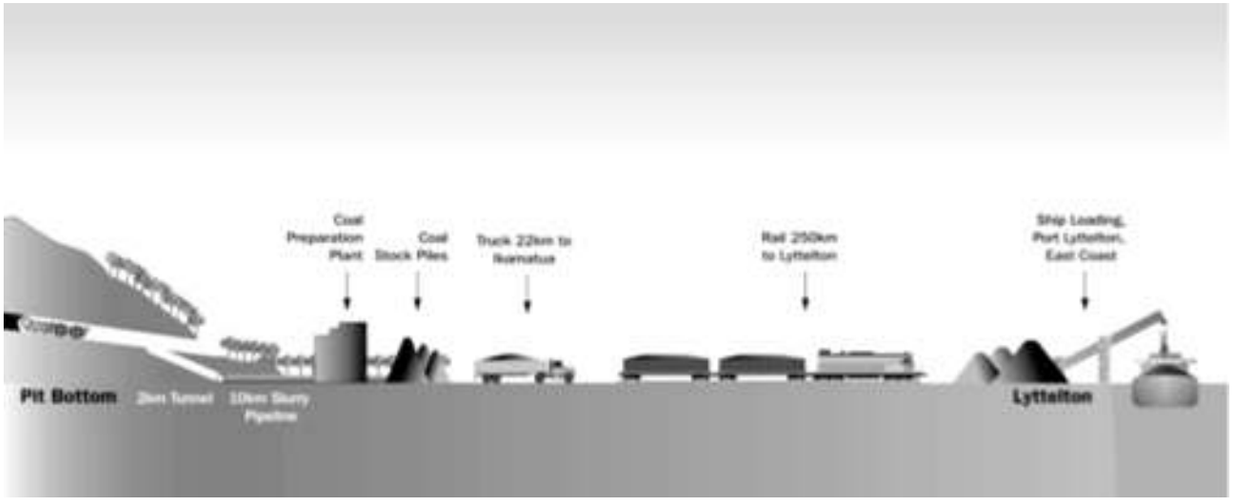
Two mining methods are used. The first involves large cutting machines to create roadways in the Brunner seam and the second uses hydraulic monitors (water cannons) to break up the coal face at the rate of 2,000 tonnes-a-day using high pressure blasting.

The crushed coal is washed down flumes into a low pressure water pipe which carries the coal 10 kilometres downhill to a coal preparation plant for cleaning, grading, and stockpiling.

From the coal preparation plant, the coal is trucked 20 kilometres to the nearest railhead near the small community of Ikamatua and loaded onto coal trains for a 250 kilometre journey to the east coast export port of Lyttelton.

Much of Pike River Coal's output from the Brunner seam is pre-sold.

76 percent is contracted over the next three years to Japan and India and 55 percent for the remaining life of the mine (at least 15 years) to India.



Further exploratory drilling over the next one or two years will confirm whether the Paparoa seam is worth developing and, if so, much of the infrastructure is already in place.

Pike River Coal was listed on the New Zealand and Australian Stock Exchanges in July 2007 and has been in the NZX Top 50 listed companies since July 2008.

It has three major shareholders: cornerstone shareholder New Zealand Oil & Gas Limited (30 percent), and Indian customers Gujarat NRE Limited (7 percent) and Saurashtra World Holdings Private Limited (6 percent).

It now has almost 350 million shares on issue, currently held by more than 8,000 shareholders, and a market capitalisation of NZ$400 million in mid-2009.

The greatest care has been taken to safeguard the remote natural environment in which Pike River Coal operates.

Not only does the mine have a particularly small surface footprint but the steps taken to minimise interference with the native flora and fauna have been formally recognised by the Department of Conservation.

Conservation Minister Tim Groser has described the mine as an environmental "showcase".

Pike River Coal Celebrates Milestone

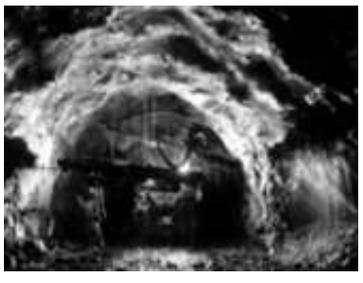
Pike River is marked a milestone in the history of the company on 18th February 2010 with the first export shipment of its premium hard coking coal to India. "This is a significant event for the company and the culmination of intensive efforts to bring the mine into production," says Pike River's chief executive Gordon Ward.

Pike River's inaugural export shipment of 20,000 tonnes of premium hard coking coal is being shipped from the Port of Lyttelton on board the Tian Bai Feng to Bedi Port in Gujarat, India. From there, it will be transported to coke-maker, Gujarat NRE — one of Pike River's life-of-mine customers. Gujarat and fellow Indian life-of-mine customer, Saurashtra Fuels have agreed to take 55 percent of Pike River's coal.

Pike River also has three-year supply contracts with Japanese steel mills. These contracts account for the supply of 22% of Pike's total coal production.

"Once hydro-mining is underway in the July-September 2010 quarter, the typical export shipment size of premium hard coking coal will be approximately 60,000 tonnes. Once full production rates from hydro-mining are achieved, the mine is expected to produce an average of approximately one million tonnes of premium hard coking coal a year."

Pike River's inaugural export shipment coincides with a buoyant international market in which world coking coal prices are expected to rise even higher than previously forecast.



Drilling boosts Tasmania Mine

BCD Resources has reported that recent drilling has added 66,000 oz of high-grade resources (18.9 g/t gold) at the Tasmania Mine in northern Tasmania. The interim JORC resource for the new Western Zone as at 26 May 2010 is estimated to be 155,000 tonnes at 16.0 g/t gold containing 80,000 ounces.

The company said this represents an additional 66,000 ounces or 12% increase on the December 2009 total Tasmania Reef resources of 571,000 ounces. The proximity of the Western Zone to existing underground development will facilitate early development. The best Western Zone hole to date (J26) intersected 46.7 g/t gold over 11.4m downhole, including 115.7 g/t over 2.7m.

Bill Colvin, chief executive officer, said "it is very pleasing to announce an addition of 66,000 ounces to our December 2009 gold resources as a result of our on-going drilling campaign. Importantly the additional resources are very high grade at 18.9 g/t."

"This new Western Zone is much thicker than typical Tasmania Reef mineralisation. We plan to extract it using our new radial-in-reef, remote mining method which offers substantial cost savings over our previous remote mining method. The new mining method, the ore thickness and the high gold grade indicate that mining of the Western Zone should be very profitable."

The company said an on-going campaign of underground diamond drilling is delineating high grade ore in the western area of the Tasmania Mine, now known as the Western Zone. The Western Zone is close to existing underground development. Two underground rigs are drilling to further extend the gold resources.

As considerable potential exists to add further high grade mineralisation to the resource, the company said drilling has been accelerated with the manning of an additional diamond drill crew.

The interim JORC resource for the new Western Zone as at 26 May 2010 is estimated to be 155,000 tonnes at 16.0 g/t gold containing 80,000 ounces.

Contract Mining at Daisy Milano

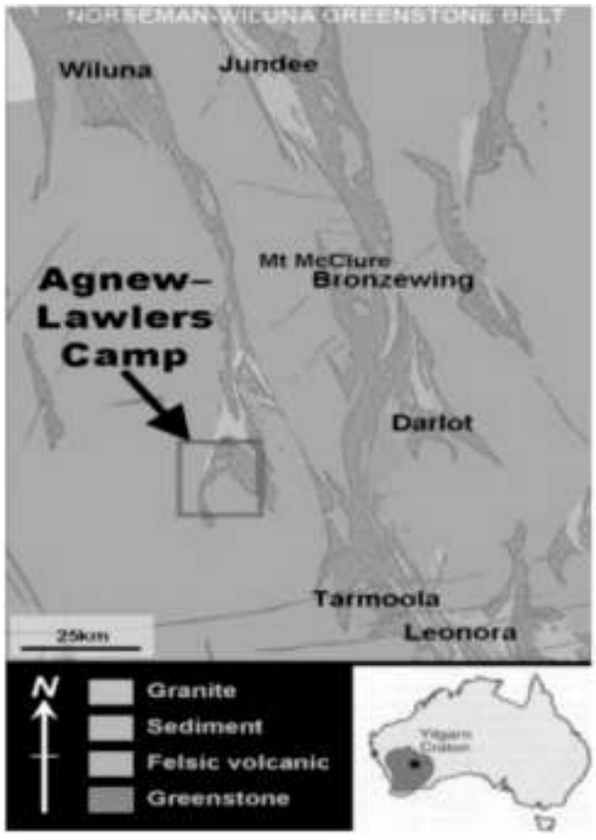
HWE Mining is part of Leighton Contractors' Resources Division, which operates at over 20 mine sites and employs more than 3,500 people in Australia and New Zealand. As a contractor with an operator's focus, HWE Mining is committed to fostering enduring and collaborative client relationships. To this end, we work alongside mine owners to provide innovative whole-of-mine management solutions.

With a firm commitment to Safety and Health above all else, HWE Mining combines the strength of Australia's premier contract mining and services provider with our reputation as a leader in large-scale materials handling and minerals processing, which provides unparalleled expertise and total service capabilities to mine owners. We also specialise in underground mining and we provide contract maintenance and fabrication services to the mining industry.

HWE Mining provides underground mechanised development and stoping at the Daisy Milano gold mine in Western Australia, where gold is mined using a mixture of mechanised and handheld stoping methods. Daisy Milano has a long history of gold mining and has been worked by several mining companies. HWE Mining's contract at Daisy Milano has been underway since February 2008. The mine produces gold ore for delivery to the Silver Lake Resources mill, located near Kalgoorlie.

Agnew Gold Mine

The mine is situated 23 km south of the town of Leinster in Western Australia and is located within the same Norseman- Wiluna Greenstone Belt as St Ives. The existing operations exploit shear hosted auriferous zones from both surface and underground operations and is processed through a single CIL plant.



Geology

The Agnew gold deposits are within the north-west sector of the Norseman-Wiluna Greenstone Belt. The succession in the Agnew mining area comprises basal metamorphosed basalt, gabbro, dolerite and ultramafic flows of the informally named Lawlers Greenstone formation. These are unconformably overlain and/or fault bounded by conglomerate, arenaceous metasediment and greywacke of the Scotty Creek Formation.

Operations

The mining operations currently consist of the Waroonga Underground Complex and the Songvang Open Pit. The Waroonga Underground Complex includes underground mining of the Kim and Main Lodes.

The Waroonga Underground Complex is accessed via a decline in the decommissioned Waroonga open pit, and is mined by mechanised, sub level stoping method.

The mining method in the Kim Lode orebody involves removing primary stopes and back filling with CAF

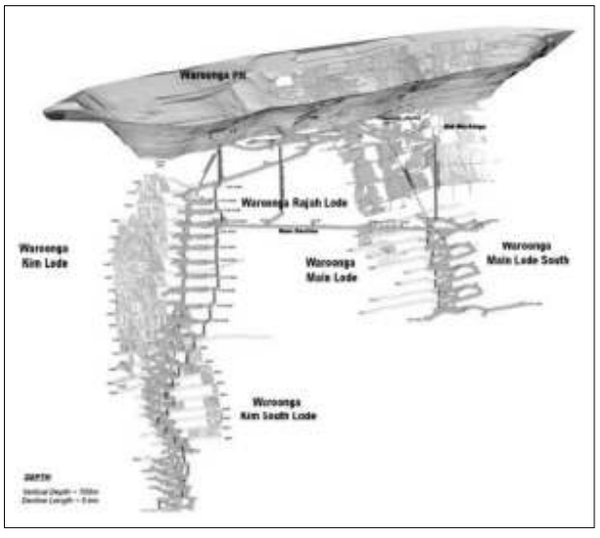
(Cemented Aggregated Fill) prior to extracting the larger secondary stopes. The Main Lode orebody is mined predominately using mechanised longhole open stoping, and CAF as required based on geotechnical parameters.

Processing

Up to 1.3 million tonnes of ore is treated at the Agnew processing plant annually. The processing plant consists of: a three stage crushing is used at the front end of the plant circuit, two ball mills, in-line leach reactor and associated gravity circuit, three pachuca leaching tanks and six adsorption tanks, leading into the elution and electrowinning process.

Exploration

AGMC has a significant tenure holding in the district of over 1000 sq.kms., and has an active an robust exploration program exploring the area with advanced geophysical and geochemical methods, as well as substantial drilling programs. Success in this area will ensure the future of the mining operations into the future.



SAPPHIRE MINING IN AUSTRALIA

Sapphire has been mined in Australia for over 100 years and Australian mines have produced commercial quantities for at least 50 years. For several decades recognition of the quality and quantity of sapphire produced in Australia has been concealed by many international vested interests in an effort to control the supply and price of sapphire gems.

As a result the best Australian sapphire has often been sold as being "Ceylon" or "Thai" material and this has concealed the very high quality and outstanding colour range of Australian Material.

The history of sapphire gems in Australia stretches back over 150 years. One of the first reports is from 1851 when sapphire was recovered during gold mining on the Cudgegong and Macquarie rivers in New South Wales. In 1854 sapphire was reported from the New England area of New South Wales and in 1875 Sapphire was discovered in Retreat Creek, Central Queensland. Numerous small deposits have been found up and down Eastern Australia.

The discoveries near Inverell on the New England tableland in Northern New South Wales and at Sapphire and Rubyvale in Central Queensland lead to the development of a commercial Sapphire Mining Industry in Australia. The much later discovery of sapphire at Lava Plains in North Queensland further complemented this industry.

Most of the early production from Australia went through German jewellery agents and was sold into other European countries. The reason for for early export into Europe came from Russian Miners who worked the Central Queensland gem fields in the late 1800s. A good number of Australian sapphires found their way into the crown jewels of the Russian Imperial family and other

Russian nobility. After the collapse of this market because of the Russian revolution, the impact of wars and the depression, sapphire mining saw hard times until the advent of machinery mining and the arrival of Thai Buyers in the 1970's.

There are still plenty of sapphires to be found, however most of the remaining ground is restricted to hand mining, consequently the supply is limited.

Xstrata to expand Black Star mine

Xstrata plans to spend $130 million to add another four years to the life of the Black Star Open Cut at the Mount Isa Mine. The Black Star extracts ore from underground mining areas.

Xstrata Zinc Australia chief operating officer Brian Hearne says this expansion will maintain 190 jobs and create 100 more. "We've invested quite a bit of money in north west Queensland and have been working on the Black Star 'deeps' project for some time," he says. "This year we're currently looking to mine about 4.6 million tonnes of ore from, so it's one of the significant operations we've got here."

‘New generation’ underground coal loader

Sandvik Mining and Construction has released the LS151, a 6 tonne payload capacity underground coal mining loader, delivering increased safety and ergonomics, more power and torque.

It is the first in a new generation of low-emission Sandvik LS series underground coal loaders, designed and manufactured in Australia at the company’s Hexham facility near Newcastle.

The LS151 is powered by a Tier 2 emission-rated MWM 4.10 TCA turbocharged engine — incorporating an automated electronic shutdown system for increased safety — rated at 107 kW.

Power is 25 per cent greater than on its predecessor and, along with 30 per cent more torque, gives greater tractive effort and increased towing power.

The new underground loader is designed for smaller underground applications to meet market demand for a modern, up-to-date 6 tonne capacity underground loader, said Richard Osborn, Sandvik Mining and Construction’s global product line manager for underground flameproof load-and-haul equipment.

“Sandvik’s former offering in this class of machine, the Eimco 913 LHD was an ‘iconic’ underground loader for the coal industry — with over 90 per cent market share — but its design goes back many years,” he said. “Over the past few years, we’ve received many requests from customers for a modern, up-to-date successor to this machine — and the LS151 achieves just that.

“Customers and operators told us what they wanted in this class of underground loader and that’s what we have delivered.

In developing the LS151 — and its other new generation underground loaders — Sandvik has paid a lot of attention to increasing safety and ergonomics features, to ensure that all machines in the range are the safest and most comfortable on the market.

“With the LS151, we’ve also gone for a modular design that allows us to easily customise loaders to meet different site requirements, as well as greatly simplifying maintenance and servicing,” said Osborn. The ergonomically designed operator’s cabin has a certified ROPS/FOPS canopy and is mounted forward of the articulation joint for improved visibility and ease of operation.

Osborn said that noise levels had been significantly reduced with the use of improved sound proofing insulation, while cabin access/exit improvements included wider doorways and three points of contact. “Other OH&S-related features include cleaner engine emissions through the use of Tier II engine technology, methane protection, a flameproof electronic shutdown system, exhaust particulate filtration, a water bath exhaust conditioner, a spring applied braking system with automatic brake accumulator pressure bleed down, and optional fire suppression,” he said.

Additional design elements of the new loader include:

- Electronic monitoring display and diagnostics in the cabin
- Load-sensing hydraulic system operating the bucket
- Wet scrubber system.

“The LS151’s modular design allows for a canopy height range from 1790 mm to 2150 mm, to suit different site requirements, as well as for alternate engine arrangements to be easily integrated,” said Osborn.

“Other modular elements include an engine module that is pinned to the main frame, bolt on hydraulic oil tank, fuel tank, hydraulic control module and a bolt-on operator’s canopy with choice of three height options.

“In addition, its compact profile allows it to work in wider variety of environments, and operate more effectively in confined spaces.”

Brief specs of the Sandvik LS151 are: Maximum payload, 6000 kg; bucket capacity, 2.2 cu m; powered by MWM 4.10 TCA turbocharged diesel rated at 107 kW; tractive effort, 14,582 kg; height 1800-2100 mm (depending on cab configuration); length, including bucket, 8532 mm; width (including cab), 2250 mm; operating weight, 20,480 kg.

Jundee Mine promotes monorail

The Western Australian School of Mines and Adelaide University case study at Newmont Mining's Jundee mine in WA identified major benefits from using roof-mounted monorail systems for transport and haulage in hard rock mines. While monorails are common overseas, particularly in South African metalliferous mines, Australian miners like to use the biggest diesel loaders to feed the biggest trucks they can fit into the mine.

Perth miner and inventor Mick Roberts, is WASM's monorail project coordinator. Roberts has been promoting electric monorail transport systems (EMTS) for mining haulage and transport for over 25 years. The decline, providing mine access and haulage route, presents the greatest excavation task and a major financial and technical challenge in new underground mines.

Current declines are usually about 5m wide by 5m high and have a maximum grade of eight degrees. The study based on a 4m x4m decline — tunnels as small as 2m x 2m may be possible — at 20 degree gradients and tighter curves found it would reduce decline length by over 62%, development costs by 22% and development time by nearly 72%. Smaller tunnels cut the risk of rock falls and even reduced floor grooming offers major cost savings. Monorails offer the chance to exploit currently unviable narrow vein orebodies.

WASM associate professor Emmanuel Chanda says in the study report that the large excavations associated with current underground mining practices are economically and geotechnically inappropriate. The orebody can be worked using the cut and fill retreat method much more efficiently than the discontinuous drill-blast-load-haul cycle, working up from the bottom of the orebody and reducing losses from crown pillars and gold left on open stope benches.

For Mick Roberts, the most exciting aspects are the health and environmental benefits. Diesel engines produce heat and diesel particulate matter, a class one contaminant, requiring powerful ventilation and emission systems. Monorails powered by an above-ground gas-fired power station would greatly reduce ventilation requirements and avert serious health risks.

Manufacturers such as SMT Scharf produce monorail systems that could be used in metalliferous mining and processing equipment manufacturer Gekko Systems says its in-mine crushing and pre-concentration plants would suit EMTS mines.

A leading global manufacturers of continuous coal miners is understood to be assessing how it could adapt machines to suit monorail hard rock operations.

The case study team is now seeking industry support for an in-mine demonstration to prove the concept and produce operational data for a full-scale integrated monorail system.

Australian to mine coal in West Bengal

Australian mining company Resources Ltd, has decided to enter into contract mining of coal in India The Australian firm has inked a letter of intent with Bankura Coal Co to mine coal in Raniganj, West Bengal, at a total investment of over Rs 100 crore.

This is also perhaps the first instance of contract mining by a foreign company in the coal sector which is dominated by public sector major, Coal India Ltd. Towards this, Perth-based IRL and Bankura Coal Co Ltd of West Bengal have formed an SPV to operate the underground coal mine in West Bengal for captive use. Incidentally, India Resources has made a foray into India's mining sector by taking up contract mining of copper for Hindustan Copper Ltd (HCL). As part of it, IRL has been producing 300 tonnes of copper concentrates at Hindustan Copper's Surda mines in Jharkhand Bankura Coal has six sponge iron companies under its wing and has been allotted a lucrative coal block in the heart of the state's Raniganj coal belt. The mine has total reserves of 95 million tones. India Resources will start operations at the new mine within three years"The output from this mine is expected to peak in the seventh year of operations when it is estimated to produce half a million tonnes of coal," Mr. Arvind Misra, Managing Director of IRL said. This is part of India Resources Ltd 's strategic move to get into exploration side of the mining business in India. "Apart from contract mining, we would like to grow the exploration business," Mr Misra added. In step, IRL has also applied for some 15 prospecting licenses for iron ore in Orissa and Jharkhand. "We have also applied for licence to explore lead and zinc in the Aravali project in Rajasthan," Mr Misra said.

Mt Ida Gold Project

The Mt Ida project is a small low cost per ounce underground deposit located 200 kilometres northwest of Kalgoorlie-Boulder and 70 kilometres north west of Menzies and includes 530km2 of tenement area.

Swan Gold has a 50 man operating camp servicing the mining and an airstrip at the nearby abandoned Bottle Creek mine. Mt Ida is located 120 kilometres north of the Carnegie plant. Gold was first discovered in the late 1890's and the Mt Ida region has since then produced in excess of 265,000 ounces of gold at an average grade of 16.3g/t. Mt Ida has Resources of 139,000oz at 13.8g/t Au (Indicated 81,000oz, Inferred 58,000oz) and Probable Reserves 64,000oz at 17.4 g/t Au.

Swan Gold commissioned consultants Mining One Pty Ltd to carry out a comprehensive technical study on the Mt Ida project. Issues encountered by the previous operators have been addressed through extensive metallurgical testwork of the ore body leading to an improved understanding of metallurgical recoveries. An ongoing review of resources and geological controls, improved mine planning, together with stronger management control, a focus on cost controls and increased gold prices will enable significant free cash flow to be generated.

Mining at Mt Ida is by underground mining methods consisting of small scale rail mounted trucks and hand held development and stoping. Access to the workings is via the refurbished Timoni shaft. The mining assets include underground mining equipment, a refurbished shaft and hoisting system and two production drives largely grade controlled and production drilled — for immediate continuous production at the hoisting capability of 6,500 tonnes per month (78,000 tonnes per year). Swan Gold is aiming to recommence mining operations at the Mt Ida project during second half of 2010.

Wattle Dam 100,000oz milestone

WA-gold miner Ramelius Resources Limited has passed 100,000 fine ounces of total gold production from its Wattle Dam mine — now an underground mining operation — 25 kilometres west of Kambalda.

Total output to date from Wattle Dam is split between 50,000 ounces from the mine's former open-cut operations, and a contribution of a further 50,000 ounces since Wattle Dam moved to an underground gold mining operation since the December 2009 quarter.

A testament to the high grade nature of the ore, the underground mine has averaged around 30 grams per tonne in the first two quarters of production, making it the highest grade producing underground gold mine in Australia.

Current underground production, achieved in six months, has delivered the same output it would take three years of open cut mining, vindicating expansion underground.

Work on developing the current underground mine commenced in May last year with the first high grade underground ore processed last November though Ramelius' 100%-owned Burbanks mill nearby at Coolgardie.

Exploration drilling at Wattle Dam is ongoing with a 30 hole underground diamond drilling program now underway.

Historic Mt Morgans gold mine re-opens

Range River Gold has officially opened its mining operations in the historic Mt Morgans area between Leonora and Laverton in Western Australia.

The company acquired the area from Barrick in May last year and has since confirmed the resource potential, obtained mining permits and awarded open pit mining and ore haulage contracts.

The company has also arranged accommodation for staff and recruited a site management team.

The company's chairman Dr Kevin Tuckwell said the project last week yielded its first ore for production, only around two months after initial mining restarted in December last year. "This phase of mining is planned to deliver 40,000 ounces of gold per annum over the next five years, involving open-cut and underground mining, from the resources already known," he said. "Range is confident that there is more gold to be recovered from the 800 km2 of Mt Morgans leases.

There are numerous high grade drill intersections recorded in previous exploration that have not been followed up and which are close to existing mine facilities and infrastructure."

This will be the third phase of production at the site since it was discovered in 1896. The first phase occurred between 1896 and 1911 and resulted in the 320,000 ounces of gold production.

Dominion Mining restarted mining at the site in 1985 and produced a further 900,000 ounces of gold, taking total production from the area to well over 1.2 million ounces.

Tuckwell unveiled a plaque at the Mt Morgans Municipal Chambers building, which was built in 1900 and is the last remaining building of the municipality.

Mt Morgans Commence Underground Development

Range River Gold Ltd is to proceed with the underground mining of the Craic deposit and reopening of the Transvaal and Westralia underground mines at Mt Morgans.

A mine planning study undertaken on these projects by Mining One indicates a base case of mining 1.42 million tonnes of ore at an average grade of 5.26 g/t Au to recover 215,000 ounces of Au over five years.

The upside case based on extensional exploration success at these deposits indicates a total of 306,000 recovered ounces of gold.

At A$1,200 per ounce gold price the base case would generate a pre-tax total free cash of $56.2 million and the upside case $93.3 million.

At A$1,400 per ounce gold price the pre-tax total free cash rises to A$97.4 million and A$152 million respectively.

A rising gold price and brown-field exploration success provide opportunity for further upside. A rising gold price would offer the opportunity to lower the grade of ore mined. The Company will develop a more detailed plan to respond to the proposed Resources Super Profits Tax by the Federal Government. This plan will be based on mining high grade gold to maximise after tax cash-flow but at the expense of current life of mine.

The underground mining development plans for the Craic and Transvaal deposits are on schedule for the second half of calendar year 2010 production. The underground mining of these two deposits are the cornerstone production opportunities for the planned 40,000 oz of gold production for five years.

The Company is in the final stage of award of contracts for drill and blast services and grade control drilling. Arrangements have been made for supply of explosives from Orica batching plant located at Minara Resources Limited's Murrin Murrin Operations approximately 15 km from Mt Morgans. Hampton has been awarded the ore handling contract for mining and has preferred tender status for the ore haulage contract.

The underground mining development plans for the Craic and Transvaal deposits are on schedule for the second half of calendar year 2010 production.

Mt Martin development

Australian Mines sees potential to establish underground mining reserves at Mt Martin on the East Shear below the deepest old workings that could be accessed via a decline from the current pit.

Additional diamond drilling is planned to extend this resource on the East 2 shoot. The second phase of diamond drill testing of the East Shear in June –July 2010 intersected strong gold mineralization on the East 1 Shoot in a position down plunge of the existing stopes.

Hole AUZD14 pierced the East 1 shoot receiving 12.0m @ 3.2g/t. Additional diamond drilling is planned to follow up this intersection.

The revised Mt Martin resources model was announced on 25 June containing Indicated and Inferred Resources of 4.7m tonnes at 2.19g/t for 328,000 ozs of Au.

The company also announced on 21 July that the Mt Martin resource model has been optimised for a cut back to the current open pit on the current gold price, various treatment and haulage costs and indicates it is very profitable at the current gold price of A$1,300/oz producing approximately 50 — 60,000 ozs of gold.

AUZ purchase the head lease to the East Location 45 freehold block of 110 m2 in july 2007, but did not gain control of the Mt Martin gold mine until January 2010 when an existing sublease arrangement expired. Since gaining control of Mt Martin the company has been actively interpreting the gold system and has now drilled 8 deep diamond holes plus 18 RC holes to increase the gold resources.

Historic Gold Production

Mt Martin gold mine has produced to date approximately 200,000 ounces of gold from intermittent mining dating back to 1923. Gold ore was initially produced from a set of 4 shafts with the deepest underground workings at the 6 level which is 165 metres below the surface.

During the period 1994 to 2004 production was from an 800 metre long open cut which was mined down to a maximum depth of 90 metres in the central portion of the pit.

In 2009-2010 Dioro Exploration N.L steepened the ramp and mined down to a maximum depth of 115 metres in the central portion of the pit, to recover 743,223 tonnes of ore grading 1.5 g/t for 31,231 ozs of gold.

Geology

The Mt Martin Fault system is interpreted to be a first order splay off the regional 'Woolibar to Boorara Shear' , and at the Mt Martin gold mine the host lithology is a series of folded and faulted ultramafic flow units. Ore has been mined from two north trending systems , namely the 'Main Shear Lodes' and the 'East Shear Lode' plus orehoots along the north west trending splay known as the 'West Shear Lodes'.

The gold shoots are hosted in ultramafic rocks which have been altered and silicified by quartz veining and ore bearing fluids, such that the ground conditions are judged to be suitable for mechanised mining.

Swick Mining Services Secures $50 million Contract

Swick Mining Services Ltd (SWK) is pleased to announce that it has been awarded a new underground diamond drilling contract with global gold major Newmont valued at in excess of $50 million in revenue over three years.

The Newmont contract is one of the largest contracts secured by Swick in its history, underpinning the Company's revenue for the next three years and further demonstrating Swick's leading position in the Australian drilling industry. Swick is forecasting a record number of 63 rigs in work across Australia and North America by July 2010. Under the new contract, Swick will provide underground diamond drilling services to Newmont at the Jundee and Tanami Gold Mines, commencing in April 2010 for up to a three year term, with a one year option held by Newmont to extend the contract into a fourth year. Swick has provided underground diamond drilling services to Newmont at Jundee and Tanami since April 2007, utilising the market leading Swick Mobile Diamond Drill rig. In addition, Swick is concluding discussions with Newmont in relation to a surface diamond drilling program, further building upon the Company's strong relationship with Newmont.

Swick Mining Services (SWK) is one of Australia's largest mineral drilling contractors, providing high quality, high value underground and surface drilling services to a diverse group of mining houses in gold, iron ore, nickel, copper, lead, zinc and manganese. The Company has a strong reputation for innovation in rig design and drilling practices that delivers improvements in productivity, safety, versatility and value. Swick recently committed to expanding its operations outside of Australia and building a global brand through an expansion into targeted international markets, with an initial focus on North America.

North Goonyella record concrete pour

Two Australian concrete pouring records were set at the North Goonyella coal mine late last year. The records were set while solving a major problem experienced at the mine, 160km west of Mackay in Central Queensland.

Mine owners, Peabody Energy Australia Pty Ltd, faced the daunting task of resurfacing a 1040-metre-long underground concrete roadway (drift) that had deteriorated over time.

The challenge involved replacing rough and potholed sections of the 5.2-metre-wide concrete access drift with a minimum of 150mm of new reinforced concrete as well as repairing a section where the clay base had heaved, resulting in a loss of headroom and associated safety concerns.

This would involve pumping 1300 cubic metres of concrete along a narrow opening over a one-in-seven fall, terminating 150 metres below the surface.

The difficult task was completed over 10 consecutive nights, setting new Australian records for the country's longest concrete pour (1040 metres) and the longest distance that steel fibre reinforced concrete had been pumped (360 metres).

Apart from the engineering and technical issues involved in the complex task, Outbye Superintendent Mark Riemer insisted that the job be completed in a cost-effective, safe and timely manner so as to minimise mine production delays.

Kevin Walters of Capital Consulting Engineers, Mackay, was given the task of solving the many engineering issues involved in the project.

A team of top-flight contractors was gathered together to tackle the complex challenge.

The team included:

1. Mark Combe of Fibercon, concrete fibre specialists, based in Brisbane;
2. Paul Morris of PV and JM Morris Builders, Mackay;
3. Troy Brell of Brell Concrete Pumping, Mackay;
4. Gary Blackburn of Mansell Premix Concrete, Mackay;
5. TRM underground road maintenance experts, Mackay; and
6. Jak Kidd of BASF (concrete additive supplier).

Mark Combe of Fibercon said he was proud that his company's concrete fibre product had been selected for the first 360 metres of the drift entrance project because of its inherent strength and proven resistance to wear.

"The incorporation of steel fibre into concrete significantly increases its strength — this was a major consideration with the North Goonyella project," he said.

"The complexity of the challenge set new standards in innovation simply because a project of this size had not been attempted before. "It was a challenging but rewarding project," he said.

Mr Riemer said contractors had to take all possible steps to prevent delays to the setting of the fresh concrete during the pour to avoid blocking the pipeline.

This involved pouring at night and lowering the temperature of the concrete by adding chilled water so that the concrete could be pumped at a constant 18C.

Keen attention was also paid to the layout of the pipeline, mix design and the level of additives to maintain concrete integrity and workability.

Communication between the pump operator and the placer proved critical as the concrete was beginning to form a solid plug under pressure during the pipe change period of 8-10 minutes per change from about 850m onwards.

Slump tests were performed for each truck and the slump adjusted gradually to avoid excessive pump pressures as there was a decrease in slump from the pump to the end of the pipe of up to 40mm. Concrete samples were taken every 50 cubic metres for strength testing.

Mr Riemer said the concrete was reinforced with F102 mesh with additional reinforcing bars added where the broken sections occurred.

The original concrete was removed from the clay section that had heaved upwards, allowing the team to stabilise the clay with ballast and concrete binding before placing a reinforced 250mm slab over the area.

Troy Brell of Brell Concrete Pumping said his machines were able to maintain a constant pumping rate of 30 cubic metres per hour.

"Washout was by water method in the interests of the environment and to satisfy safety concerns," he said.

"Only one blockage occurred in 100 hours of pumping and this was due to human error."

Mr Brell said, initially, he was unsure they could reach a depth of 1000 metres, as they only had 150 bar of pump pressure available to pump the concrete.

"We knew we weren't going to get the full 35 bar of gravitational head advantage and as it turned out, we only got about 10–15 bar advantage, but due to the superior

quality of the concrete which involved slump retention, water reducer, viscosity modifier and retardants, we made it," he said.

The level of detailed planning was so critical that Gary Blackburn, Production Manager of Mansell Mining and Shortcrete, changed quarries to ensure the shape of the rock was suitable for such a long pour.

"The moisture rate was crtical in this job — if each stone wasn't completely saturated with water, we would have run the risk of the concrete drying out," said Mr Blackburn.

With concrete at 120-130 slump being pumped over such a long distance, there was a chance that the stone could be left behind unless it was an integral part of the mix.

"The raw materials were tested prior to the commencement of the project and stockpiled separately to ensure the material gradings were uniform.

"This was a crucial step in the mix design process as we wanted to achieve little or no variation in the mix, given that we had previously dealt with a complex project such as this," he said.

"The concrete mix we supplied was specially designed to provide high-quality concrete through careful selection of sand, stone and additives to retain slump and to retard the mix. "We incorporated a viscosity emulsifier (Suretec) supplied by Jak Kidd of BASF to ensure the concrete did not separate under pressure and over the long pumping distances.

"With this attention to detail and great teamwork by the professionals involved in the project, we made it," said Mr Blackburn.

Dump truck collision safety alert

The Queensland Mines Inspectorate has issued a safety alert after operator of a loaded rear dump truck fell asleep at the wheel, crossed the lanes and collided with an approaching empty rear dump truck.

According to the Inspectorate, it was fortunate that there were no injuries in the incident.

The operator of the empty truck saw what was happening, tried to avoid the collision and also attempted communication on the two-way radio without success.

The Inspectorate is recommending the mine's risk management process must regularly review the operational procedures to identify any changes in circumstances.

This includes the availability of other control options, new technology or innovations, such as hard barriers, proximity detection devices and fatigue detection devices. This improvement process is fundamental to the mining safety and health legislation, ensuring that risk is maintained "as low as reasonably achievable."

Mars and Moon Mining Technology goes Underground

Scientists involved in CSIRO's Minerals Down Under Flagship are transferring technologies developed for space exploration and mining on the Moon and Mars, into new applications for the Australian mining industry.

The link between space exploration and mining has a long history, dating back to NASA's original Apollo missions. For instance, technologies used in space navigation have been successfully transferred to provide solutions for mining navigation.

A good example is CSIRO's longwall shearer automation which was developed from early space industry technologies and is now being used in underground coal mines around the world.

The Space Technology Transfer initiative is being undertaken by scientists from the CSIRO Earth Science and Resource Engineering (CESRE) Automation Group, who recently provided opportunities for some of Queensland's best students to be involved.

An engineering mechatronics student from the University of Queensland, Justin Tang, is one of four outstanding students who joined the Automation Group's 2009-10 vacation experience program at the Queensland Centre for Advanced Technologies (QCAT) in Brisbane.

Mr Tang focused on understanding how space-related technologies can be transferred to benefit mining automation including the development of a radio astronomy station using a NASA-designed receiver to measure decametric radio waves from Jupiter.

Building the station involved the development of hardware, software, data processing and communication components that are also highly applicable technologies for advanced mining automation systems.

The Space Technology Transfer project continues to gain momentum and has attracted support from key agencies around the world, including NASA.

The next stage for the Mining Automation Group will focus on development of a remotely controlled in-situ resource utilization (ISRU) demonstrator station.

CSIRO initiated the National Research Flagships to provide science-based solutions in response to Australia's major research challenges and opportunities. The ten Flagships form multidisciplinary teams with industry and the research community to deliver impact.

Narrabri wins NSW approval for longwall mining

Whitehaven Coal has received New South Wales government approval to start the $A300 million stage two development of its Narrabri mine in the Gunnedah Basin.

The first of three continuous miners started cutting coal a month ago with stage one development of the mine costing $227 million for 500,000–700,000 tonnes per annum of production.

The stage two approval is a significant step to allow the mine to be transformed into a longwall operation with production of up to 8 million tonnes per annum. The last hurdle is federal government environmental approval.

Whitehaven expects full production to result in 6Mtpa of low-ash, high-energy, low-sulfur thermal and pulverised coal injection coal for the export market. "We are extremely pleased by the minister's decision to award project approval to the Narrabri Coal stage two project," Whitehaven managing director Tony Haggarty said.

"The coal handling and preparation plant, and other key stage two facilities have already been designed and tendered, and construction will commence as soon as we complete the final steps in the approvals process, which includes final approval under the federal Environmental Conservation and Biodiversity Conservation Act."

The installation of the Bucyrus longwall, which can be retrofitted for longwall top coal caving (LTCC), is scheduled for delivery in early 2011. Installation at the first longwall panel is expected in the September quarter of 2011.

Full-time employment is expected to reach 208 once longwall mining starts, while more than 120 people and 25 contracting businesses were involved in stage one construction of Narrabri. Stage one development is almost complete with only a final section of the third access drift remaining. The second continuous miner unit is scheduled to head underground in August.

The final design of the CHPP will include a dense medium cyclone unit which is expected to produce up to 40% of the processed coal as a PCI product. Construction of the CHPP is expected to take 12 months.

Stage two mining covers 26 longwall blocks targeting the bottom section of the 4.25-9m thick Hoskissons seam. Each panel will be 305m wide and extracted to an average height of 4.2m, while the face height will be 3.5m high at the main gate and tail gate ends, matching the 3.5m-high gate entries.

Cover depths are expected to range between 160m and 180m over the eastern area of the minesite and extend up to 380m over the western ridge area.

Full-time employment is expected to reach 208 once longwall mining starts, while more than 120 people and 25 contracting businesses were involved in stage one construction of Narrabri.

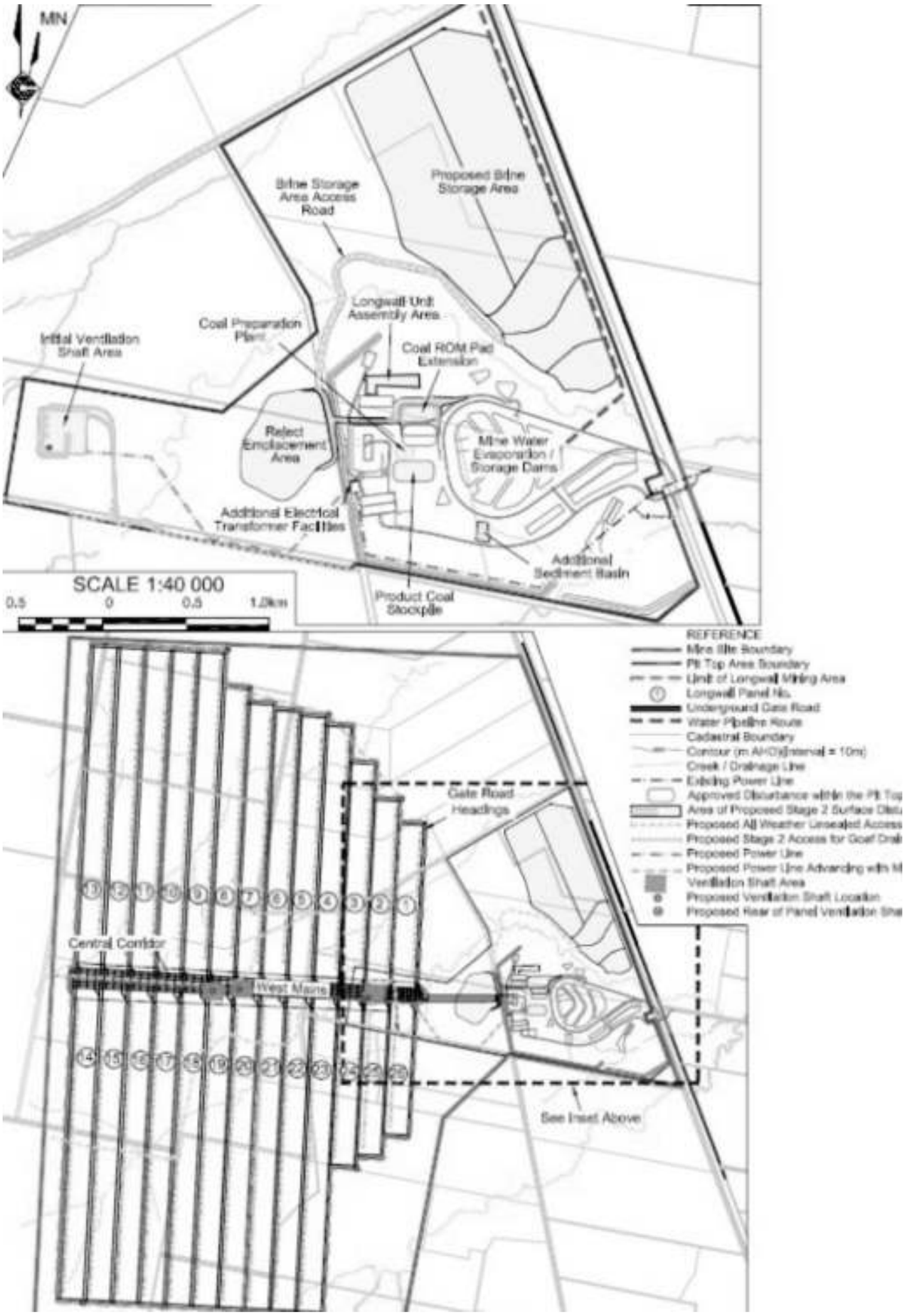
The JV behind Narrabri consists of Whitehaven (70%), Upper Horn Investments (7.5%), Electric Power Development (7.5%), EDF Trading (7.5%), plus Daewoo International and Korea Resources Corporation (7.5%).

Quarterly production results

Whitehaven's Tarrawonga, Werris Creek, Rocglen and Sunnyside open cut mines were impacted by wet weather in the March quarter but performed well in the June quarter.

Total run-of-mine coal production reached 1.19Mt for the recent quarter, up 11% year-on-year. For the 2009–2010 financial year, production was 4.22Mt — a 20% improvement on the previous year. June quarter sales of 1.04Mt were in line with the corresponding 2009 period, while sales for the recent financial year of 3.48Mt were up 24% from the previous 12 months.

Whitehaven purchased the Vickery coal project in the Gunnedah Basin from Coal & Allied in January for $31.5 million and the project is expected to produce metallurgical coal. "Indications are that Vickery could provide Whitehaven with a significant increase in metallurgical coal reserves," Whitehaven said in its quarterly report. There are nine coal seams contained within the Vickery tenements of which three, the Shannon Harbour, Stratford and Cranleigh seams, are believed to have economic potential. The quality of these coal seams ranges from high-volatile soft coking coal to low-ash, high-energy thermal coal."


MIN
Brine Storage Area Access Road
Proposed Brine Storage Area
Longwall Unit Assembly Area
Coal Preparation Plant
Initial Ventilation Shaft Area
Coal ROM Pad Extension
Reject Emplacement Area
Mine Water Evaporation / Storage Dams
Additional Electrical Transformer Facilities
Additional Sediment Basin
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Approved Disturbance within the Pit Top
Area of Proposed Stage 2 Surface Distu
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Proposed Stage 2 Access for Golf Club
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Gate Road Headings
Central Corridor
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See Inset Above

Sandvik coal loader makes Narrabri debut

Narrabri coal mine in New South Wales has taken delivery of the first of Sandvik Mining's new range of underground coal loaders — two LS171s and two LS191s.

Two Other machines are on order for a major customer in Queensland, with more in the pipeline, according to Sandvik Mining and Construction's product line manager for underground flameproof load-and-haul equipment Richard Osborn.

"We are now looking at exporting these to major overseas markets, including South Africa, China, and eventually the US," he said.

Sandvik's 7-tonne LS171 and the 10t LS191 deliver lower emissions, increased safety and ergonomics, better power and torque delivery and easier servicing, according to Osborn.

Both loaders are powered by a low-emission Tier 3 Caterpillar C7 engine through a Sandvik-specified electronic engine management system, for reduced emissions, improved performance and lower fuel consumption.

"The underground coal mining industry has been crying out for Tier 3 engines for many years, because they are so much cleaner," Osborn said.

"While we can achieve the required emission levels on Tier 2 and even Tier 1 engines, Tier 3 engines give a major reduction in NOx emissions, as well as further lowering particulate emissions."

The Cat C7 ACERT engine delivers gross power of 172 kilowatts at 2200rpm and maximum torque of 940 Newton metres at 1650rpm (up 25% on the previous models), giving greater tractive effort and increased towing performance.

This engine is controlled by a Sandvik-specified electronic management system specifically designed for underground applications.

Both the LS171 and LS191 loaders share a high degree of parts and components commonality, including the engine electronics and some drivetrain components, with the main difference being in the hydraulic systems of the two machines.

The LS171 uses a conventional fixed displacement hydraulic system for its loader system, based on a proven design that is robust and easy to repair, while at the same time incorporating upgraded pumps for higher efficiency.

The LS191 — as with its predecessor the LS190 — has a pressure compensating hydraulic system which allows it to act as a prime mover unit for Sandvik's 50t hydraulic drive roof support trailer, used for relocating longwall shields and equipment.

This pressure-compensating hydraulic system allows the LS191 to efficiently deliver hydraulic power to drive the trailer, for faster, more effective moving of large longwall components. An upgraded hydraulic system features new, more efficient pumps to allow a reduction in engine speed — 2300rpm compared with 2600rpm for its predecessor — resulting in lower noise levels.

The engine's electronic management system — which has been specifically developed by Sandvik for underground operations, in close consultation with customers and engine and electronics systems suppliers — meets the latest underground mining requirements.

To comply with underground explosion protection requirements, all exposed field devices for the engine electronics are either intrinsically safe or encapsulated.

In addition, the electrical components have been fully certified by Australian certification authorities.

Osborn said other major changes to both machines included safety, cabin ergonomics and serviceability. "In terms of easier and safer maintenance, we have moved major components so that all daily and weekly check points are at ground level," he said.

"Only service points for 250 hour and greater service checks require access to the top of the machine — and we've greatly improved access there."

In the cab, the operator's display includes details such as solenoid status, pressure switch status, faults log and engine diagnostics, so if there is an issue, the operator can quickly and easily let the maintenance technicians know what's causing it.

"That makes troubleshooting much quicker and easier, plus service technicians can plug in specialist diagnostics tools, while data logs, giving a complete log of all machine activity and conditions, can be downloaded to a laptop," Osborn said.

The Caterpillar C7 engine system used in the new units meets the requirements of AS/NZS3584.2:2008, the latest version of the standard for diesel engines used in underground coal mines.

"We have put a lot of time and effort into assessing the safety performance of the engine control system," Osborn said.

The braking system has also seen safety-related improvement, with the safety-related parts of the braking control system meeting AS4024.1501 Category 3 requirements.

Stability levels have also been improved, while both loaders are fitted with Sandvik's fully ISO-compliant (to ISO 3471:2008 and ISO 3449:2005) ROPS/FOPS operator's canopies, available in a range of heights to suit different minesites and operations.

To comply with underground explosion protection requirements, all exposed field devices for the engine electronics are either intrinsically safe or encapsulated.

Noise levels have been reduced significantly through the fitting of new engine bay covers, which have been designed so that operators and maintenance personnel are discouraged from leaving them open during operation.

In addition, a temperature-controlled fan only runs at full speed if it needs to, further contributing to lower noise levels.

Other safety and operational features include in-cab engine/shutdown system diagnostics, wet scrubber system and improved cabin ergonomics and layout. There have been major changes to the cabs on both machines.

"We've removed everything above the operator's eye level to improve visibility and minimise distractions — and greatly improve safety — plus we have incorporated a detailed operator's display," Osborn said.

A self-levelling seat in the cab always returns to the same height for greater comfort, plus it self-adjusts to the weight of the operator.

Cabin access/exit improvements include wider doorways and three points of contact.

"While environmental legislation in some jurisdictions still doesn't require low-emission engines for underground mining, demand is being driven by the mining companies who are insisting on the highest environmental and safety standards for their operations globally," he said.

"These loaders really represent the future of underground coal loaders for us."

Exploration mobility underground coring rig

Boart Longyear Drilling Services has developed and tested a new mobile drill rig (MDR) in Australia and North America. Based on proven LM® underground technology, "this powerful and robust rig excels in demanding conditions," the company reports. A picture of the MDR is published in the May issue's underground drilling article.

The MDR sets up quickly, and is versatile enough to handle both wireline and conventional drilling methods. It features powerful self-diagnosing CANBUS technology for efficient rig operation, and is completely self-contained-carrying rods, water pump, tools and safety equipment on board.

Integrated hydraulic rod making and breaking reduces manual handling for increased productivity and safety, and a self-contained, ergonomically designed operator panel ensures safe and efficient operation.

The design of the MDR provides lower fuel consumption and reduced emissions, and offers superior vehicle stability.

With up to 7 t of pull-back capacity, the ability to drill using electric or diesel power, and an AQ to HQ rod capacity, MDR testing has confirmed reliability, power, and versatility in underground applications. Its turn radius is 3.9 m (internal), 6.9 m (external).

Redpath brings raisebore fleet to Australia

Mining contractor and supplier of raiseboring equipment, Redpath, announced that it will begin rolling out its fleet of raiseboring equipment into Australia.

Initial plans involved Redpath bringing in its entire fleet of raiseboring equipment by the end of 2010 with the aim to take 25 per cent of raiseboring contract market share by 2015.

"Australia's contract raiseboring sector has been in our sights since Redpath decided to expand into Australia in late 2008," said Redpath Australia CEO Gordon Shannon. "Despite proposed government policy, key Australian mining operations still need sophisticated raiseboring services and equipment, which is where Redpath excels, but we plan a more conservative approach now."

Headquartered in Canada, Redpath is the original equipment manufacturer of the Redbore range of raiseboring equipment and also operates one of the world's largest fleets of raisebores. It is renowned for the development of major innovations such as the volts per hertz drives which are now the industry's manufacturing standard and together with its semi and fully automated operational capabilities is widely recognised as a world leader in raiseboring equipment.

The company already has a foothold in major underground mining areas around the globe with offices in Asia, North and South America, Africa, Europe and now continues its global expansion into Australia — and the company has some big contracts in its sights.

"As a global company, we have never been in a better position to commit to a major market such as Australia," said Allan Brady, general manager of raiseboring in Australia. "Despite market uncertainty, our reputation as leading raisebore operators, and our ability to now provide full turn-key mining solutions, gives us the ability to compete strongly in all underground sectors. Redpath's first Redbore 40 raise drill arrived in Australia on June 29th, with further models to land before the end of 2010. Designed primarily for production slot programs, the Redbore 40 is capable of drilling from 700 millimetres to 1.5 metres in diameter and lengths of up to 150 metres.

The first wave of machines, due before the end of 2010, includes another Redbore 40, a Redbore 50 MDUR and Redbore 50E with further models including the Redbore 100 expected soon, when it is hoped the market will be strong enough for the entire range to be on Australian shores. The Redbore 100 is the most powerful and technically advanced raise drill ever manufactured, capable of drilling from 3.6 metres to 8.0 metres in diameter and depths of up to 1000 metres while still maintaining the low profile of all the Redbore series of drills.

Underground Coal mining accidents

Two miners were injured at North Goonyella at the end of June following a shuttle car accident. The incident saw a 38 year old fitter/mechanic pinned between the car and the mine wall, fracturing his pelvis.

The 26 year old driver of the shuttle car also had his left hand crushed in the accident. Peabody confirmed the North Goonyella shuttle care incident.

This latest shuttle car accident comes just over three years after the accidental death of miner Jason Blee at Moranbah North, when he was pinned by a shuttle car against the rib of continuous miner.

Construction Forestry Mining and Energy Union (CFMEU) safety and health representative Greg Dalliston told the Daily Mercury that at least seven miners have been pinned by shuttle cars in the Bowen Basin over the last four years alone. The most recent incident saw a 51 year old miner pinned at Anglo Coal's Bundoora mine in November last year.

The previous year also saw the coronial inquest into Jason Blee's death hand down 18 recommendations on operations in underground mines. CFMEU spokesman Steve Smyth has called for an investigation into the shuttle car incident at North Goonyella to determine whether Peabody applied the coroner's recommendations.

"They need to be ensuring that the guys that are in and around the pit have the best available equipment and training so that if something unfortunate like this happens, they've got the ability to recover the situation," Smyth said. Both miners at North Goonyella were evacuated to hospital for treatment. Peabody has stated that the company "will continue to provide assistance to the injured men and their families as they embark on their recovery."

Three-boom drill RIG debuts

Designed for use in rapid decline development in hard-rock mining, as well as in civil construction tunnelling operations, and suitable for drilling 12-75 sq m cross sections, it is Sandvik's first new generation three-boom jumbo in Australia.

According to Peter Bates, Sandvik Mining and Construction Australia's product line manager for underground drills, the DD530 represents a substantial advance in hard-rock tunnelling productivity.

"It's a combination of our TCAD system, which ensures very accurate drilling precisely as per planners' design specifications, with the three booms, which give up to 50% higher production than two-boom jumbos, make it a highly productive, accurate drill rig.

"Our TCAD system, which has been considered as proven technology in Europe for several years now, but which has only gained acceptance in Australia in the past couple of years, is a major contributor to increased productivity and drilling accuracy on Sandvik drills," he said.

This system means the tunnel planners or design team can provide their computer-designed optimum drill patterns to the operator on a USB memory stick. This is plugged into the TCAD, and indicates to the operator precisely where to drill via an in-cab on-screen display.

"This means far more accurate drilling — typically to within 200 mm for mining tunnels and within 100 mm for civil applications — and there's no need to mark up the drilling points on the rock face, substantially speeding up productivity," said Bates.

With mines demanding ever-tighter tolerances on tunnel excavations, to reduce overbreak and the need to rebuild over-excavated sections — often at penalty rates — drilling accuracy is becoming more critical, he said.

Associated with TCAD is Sandvik's TLOG logging system, which logs all drilling activity back to the memory stick, and allows the mine planners or tunnel designers to check that the required drill patterns have been drilled.

The DD530's three drills use high-frequency HFX5T rock drills powered by 75 kW power packs delivering up to 25 kW of rock drill power at 86 Hz.

The unit has been designed with all daily maintenance points at ground level, for ease of access, and increased safety.

Other design elements incorporated into the drill include Sandvik's NFP1000 Foam Fire Suppression system.

The carrier is powered by a Mercedes OM904LA Tier 3-compliant engine rated at 110 kW. Fully electronically controlled, it is more fuel-efficient and burns fuel more cleanly, minimising emissions.

This higher power engine — up from 66 kW on previous versions of this jumbo — allows faster tramming speeds of up to 16 km/h on level ground and 4.7 km/h on 14% inclines.

The first DD530 in Australia is on the East Coast for potential upcoming tunnel construction work in Sydney and Brisbane.

"We are getting a number of customers coming to have a look at it, and see if it will suit their future applications," he said.

"We also see applications for this unit for rapid decline development in underground mining projects in around Australia."

Largest mining motor in the world

ATB Morley says the 11 kV motor it recently supplied to Xstrata Coal "is the very first of its kind; historically most large electrical motors supplied for underground coal mining have been manufactured suitable for a maximum voltage of 3,300 V. [This] motor weighing in at 10 t currently stands as the largest underground mining motor in the world."

ATB Morley is a designer, manufacturer and exporter of high voltage electric motors for the global coal mining industry. This unique motor was designed specifically for operation at Xstrata Coal's Blakefield South mine in New South Wales, Australia. The mine is a new longwall operation that replaces production from the Beltana mine. Blakefield South is to be fully operational soon.

Motors such as this are managed by Peter Henderson, Principal Electrical Engineer at Xstrata Coal. Results from performance testing on the motor have confirmed that moving from a 3,300 V to 11,000 V has been a successful and beneficial decision for Xstrata. Morley says "the increase in supply voltage reduces motor currents at these higher than normal power levels, leading to reduced cabling and voltage transformation issues.

"The motor also reduces the likelihood of the motor causing issues with the electrical supply in other parts of the mine, particularly during starting. The new Joy AFC was tested over a two-month period toward the end of 2009. This included stalling the output of the Voith TTT coupling to establish the maximum power of the motor." Henderson commented: "This truly is the world's most powerful AFC."

Sandvik AutoMine underground mining system

Sandvik's AutoMine system is a comprehensive solution for improving safety and efficiencies of underground mining operations.

AutoMine is an open and flexible system that can be adapted to the unique requirements present in each underground mining operation, with individual systems designed to meet each customer's specific requirements.

Overview of AutoMine

AutoMine allows remote operation and supervision of an automated underground loader or truck fleet from a surface control room.

The autonomous fleet is operated in an area that is isolated from personnel and other equipment, greatly enhancing underground mine safety.

Driving (tramming) and dumping are fully automated, while bucket loading is performed using tele-remote operation. A single system operator is able to manage the operation of multiple automated machines.

A wide range of Sandvik underground loaders and trucks can be fitted with the AutoMine onboard package.

This onboard package includes:

- A navigation system that continuously determines the location of the machine within the underground mine environment, and controls the autonomous tramming and dumping operations. The navigation system uses laser scanners to scan tunnel wall profiles to verify machine position — and thus does not require additional infrastructure such as reflective strips or RFID tags
- An onboard video system to provide the high-quality video necessary for tele-remote operation
- A Wireless Local Area Network (WLAN) mobile terminal to provide the radio link between the machine and the communication system installed in the autonomous production area.

The WLAN system provides a high-quality communications link between the production area and the autonomous machines and has been designed to meet the demanding real-time requirements for such operations.

It is based on the WLAN 802.11g standard, with additional features to guarantee real-time control and supervision of operations.

Safety is ensured by isolating the autonomous production area with a dedicated physical barrier system.

This barrier system prevents access to the area; any breach of this system will immediately stop the autonomous machines.

It can be adapted as required to provide additional flexibility — for example, the autonomous areas can be split into zones which can be operated independently if required.

The autonomous operations are managed from an operator station located in a comfortable, air conditioned control room -– which can be on the mine site, or at a remote location many kilometres from the mine.

From the operator station, the system operator is able to:

- Plan and monitor production
- Operate machines tele-remotely
- View machine operation information such as alarms, measurements, gear selection, engine RPM and tramming speed
- Monitor and operate the barrier system
- Control and supervise the fleet
- Generate production and condition monitoring reports.
- The key to Sandvik's AutoMine system is a sophisticated, reliable server system which controls, monitors and manages the entire automated mining process. The capabilities of this service system include:
- Controlling the dispatch of machines based on the production plan and availability of load points and dump points
- Supervising the carrying out of autonomous operations via the onboard navigation system
- Managing the traffic, allowing multiple autonomous machines to operate in the same area
- Monitoring fleet production, with tonnages stored to a database along with loading and dumping point identification and cycle time information

- Monitoring fleet condition, with onboard machine measurements and alarm information provided to the system operator, as well as being logged to a database.
- Depending on the fleet size, additional operator stations can be added to the system as required.
- Benefits of the AutoMine system include:
- Increased safety and improved working conditions for personnel
- Improved utilisation by allowing continuous operation during shift changes
- Improved productivity through real-time monitoring and control of production loading and hauling processes
- Improved draw control through accurate execution of the production plan and collection of production data
- Lower maintenance costs through smooth operation of equipment and reduced damage
- Lower operating costs through lower workforce requirements, including a markedly reduced need for skilled operators — an increasingly important issue in these times of on-going skill shortages.

The success of mine automation using AutoMine depends on a customer's ability to change from conventional traditional thought processes and ways of doing things, to using AutoMine applications and its associated disciplines and requirements.

Sandvik Mining and Construction's AutoMation team plays a major role in developing a professional AutoMine project implementation plan with our customers for each installation — including detailed and comprehensive operator and technical personnel training.

Two additional AutoMine-related products will be released in Australia in 2010: AutoMine Lite and OptiMine.

Sandvik AutoMine Lite

Currently under development by Sandvik is our AutoMine Lite technology, which focuses on single loader automation for open stope and transfer level applications.

The philosophy here is that the system will be simple to install, so that the loaders and the system can be quickly and easily moved between various areas within the mine as and when required.

Its major advantage over other remote systems is that operators are only required to load the machines remotely, using the onboard video and weighload monitoring systems. Tramming and dumping of the machines are fully autonomous, so minimising damage resulting from remote driving is a major cost reduction.

AutoMine Lite units can also achieve maximum speeds under good road conditions, which is not achievable with other remote systems.

Production control and onboard condition monitoring systems are also being developed in order to provide our customers with more in-depth knowledge on the condition of the equipment (for maintenance purposes), as well as production monitoring (to manage draw and production control more effectively).

Sandvik OptiMine

Sandvik's forthcoming OptiMine system is designed to cater for both condition and production monitoring, and can be installed without the infrastructure required for full automation.

It is suitable for mines where our loaders and trucks are operated manually, and extends the value created due to the advanced onboard control systems fitted to all our new underground mining trucks and loaders

Longwall hydraulics failure prompts safety alert

Industry and Investment NSW has issued a safety alert after the "catastrophic failure" of hydraulic isolation valves on a mine's longwall system, as a result of high pressure.

The hydraulics were over-pressurised, causing the failure and leading to the release of fluid.

Fortunately, no one was injured in this incident, but the Department has warned that the uncontrolled release of high-pressure hydraulic fluid has caused fatalities in the past.

In August 2006, a contractor was killed when taking fluid samples from a large hydraulic system used to power longwall machinery at an underground coal mine in NSW.

There were also several serious injuries caused by the same problem across the state in 2005.

According to the Department, a pump station was shutting down regularly as a result of over-pressure trips.

When investigated the trips, two tradesmen isolated two of the three pumps and the face delivery line. However, when the third pump was started, the pressure rose quickly throughout the remaining hydraulic system, causing various valves and fittings to catastrophically fail.

The Deparment's investigation into the event revealed that the system's pressure transducer was contaminated by water and faulty. Similarly, the two mechanical system safety relief valves did not activate as they had been closed up from corrosion.

The Department has recommended that mines review their maintenance management systems to ensure safety-critical systems that control hydraulic pressure are running properly.

Automated production control reaches underground mines

Australian mining software company Micromine is capitalising on the current trend towards installing wireless networks in underground mines.

During the past few years, Micromine has implemented its production control system, Pitram, in a number of underground mining operations.

Pitram is a real-time mine production control system that records and manages mine site operations. Its planning functionality aligns daily production planning with weekly and short-term mine plans. Pitram's scalable data collection records real-time information relating to equipment locations, equipment status, personnel allocations and production measures.

The system's real-time viewing environment helps users to visualise mining operations, from risk management and asset tracking to grade optimisation and stockpile management. This provides an overall picture of a site's operations and the capacity to manage them. Further, Pitram's reporting, analysis and data integration platform ensures that the data obtained from different sources is presented in an organised and integrated fashion.

The system's automated solution makes use of wireless networks to transfer data captured by vehicle operators or onboard systems. Pitram uses wireless or radio frequency identification tags to determine equipment and personnel locations. This reduces the amount of information entered and communicated over voice radio channels, and the use of a touch screen provides immediate feedback to operators on equipment alarms and operator errors.

Pitram features a real-time three-dimensional (3-D) visual of mine production and includes tag positions. This is new to underground mines, says Micromine technical manager Ivan Zelina. Underground mines traditionally use 2-D visualisation techniques.

Micromine develops mining software solutions which cover the entire mining process, from geological exploration and 3-D mine design applications to mine production management, mine production control and data management. All Micromine's solutions are used in Africa by several mining companies that specialise in different commodities.

Although Pitram has been installed in openpit mines for a number of years, Micromine is now aligning the product with underground mines because of their increased wireless capabilities. Owing to the success of Pitram's implementation in Australia and North America, the automated system is ready for general distribution. A significant number of underground mines are showing interest, says Zelina.

He emphasises that Micromine does not install underground wireless networks, but works with other companies to install the technology.

Latest Version

Zelina also notes that Micromine 2010, the company's latest version of exploration and mine design software, has been well received by clients. Micromine 2010 continues to build on its well-recognised key advantages, such as ease of use, user-friendly interface and industry-standard compliance, he says.

There have been significant updates to features such as plotting, which has been redesigned using the same Vizex seamless 2-D/3-D interface used in all Micromine products. Pit optimisation has also been upgraded. Optimisation parameters can now be set as functions.

Wireframe enhancements include smoothing, edge highlighting and the ability to colour any attribute. New section control files instantly jump to previously defined sections, geolinked windows and fly- throughs, which produce visual animations using fewer viewpoints.

The company is also introducing a sche- duling module within Micromine 2010 this year to ensure the product's relevance to the entire mining value chain, from resource

Micromine develops mining software solutions which cover the entire mining process, from geological exploration and 3-D mine design applications to mine production management, mine production control and data management.

modelling to mine design, pit optimisation and production scheduling. Scheduling is currently in beta-test phase.

Product Development

Micromine has a significant history of prioritising research and development (R&D), dedicating 30% of annual revenue to R&D. It has processes in place to ensure that product developments are relevant, can be integrated with other solutions, are easy to use and will benefit the mining community, he says.

Customers are consulted on the features they require within future releases, and a large repository of users' ideas and requests is frequently used. This ensures Micromine's software solutions continue to meet and pre-empt industry demands.

Zelina adds that Micromine's products are available globally and in five languages, including Portuguese, Spanish, simplified Chinese, Russian and English. He notes that the Johannesburg office is its third-largest, after the Perth and Beijing offices.

Curtin University to commercialise deep vision camera

Curtin University of Technology has established a company, Deep Vision 3D, with the aim of commercialising a new three-dimensional video camera that can be used in hostile underground mining environments.

According to Curtin, the company will promote two models of the stereoscopic mini-cameras; one for use in mining and the other for subsea inspection use in the oil and gas industry.

In trials to date, the camera has realistic depth perception when using remotely controlled equipment in hostile environments, the University said. The cameras were developed at Curtin's Centre for Marine Science and Technology by research fellow Andrew Woods.

According to Woods, the systems can determine object size and depth more accurately than existing two-dimensional cameras.

"Previous attempts at enabling 3D video camera systems have not been successful due to issues of cameras losing critical alignment, and user eye-fatigue," he said.

"Our camera design is capable of addressing these problems."

The company will initially focus on deploying the technology, but will also conduct research and development to design new generations of the cameras.

Curtin's IP commercialisation director Rohan McDougall said the University had provided seed investment in the company and will remain a shareholder while it establishes itself.

"The company has tremendous potential to succeed, by offering a key enabling technology in strategic industries, with expected demand for the cameras likely to be strong," he said.

Deep Vision 3D was a recent recipient of the Federal Government's Commercialising Emerging Technologies (COMET) grant.

DMS receives first underground coal utility vehicle

DIVERSIFIED Mining Services (DMS) has received its first delivery of its Australian-made Atlas Copco Coaltram CT10 underground coal utility vehicle.

The company's agreement with Atlas Copco allows DMS Underground division — formerly called the Anderson Group of Companies — to produce and supply the world coal market with the Coaltram vehicles, which will be sold and supported in Australia and New Zealand exclusively by DMS Underground and internationally through the global Atlas Copco network.

The mining services group says the delivery is a major breakthrough in the development of its underground coal business. The DMS Underground division has sold three of the vehicles to Hunter Valley-based miner Donaldson Coal for use at its mines near Maitland in New South Wales. The sales follow more than three years and $25 million of research and development. Formal approval for use by the New South Wales Department of Primary Industries was achieved in May, 2009.

DMS Managing Director Terry Young says the sales were a positive sign that the business would expand rapidly and allow the company to further diversify its operations in the maintenance and support of open cut and underground mining. Young claims the partnership between DMS and Swedish mining equipment giant Atlas Copco is an enormous asset to the business which has taken many years of painstaking work to develop. DMS says that is has already received approvals in Australia and international approvals for the Atlas Copco Coaltrams are expected soon.

The low-profile vehicles, in combination with a variety of interchangeable attachments, can perform a wide range of utility functions underground including loading, lifting, materials handling, drilling and bolting, longwall shield relocation, cable handling, grading and dozing. The two vehicles — the CT13 and smaller CT10, were developed by a dedicated team of seven engineers and over 20 support staff over a period of three years, with all of DMS' designs and modifications approved by Atlas Copco.

DMS General Manager of Coaltrams Craig Anderson said the Coaltrams, the CT13 and the smaller CT10, represented the pinnacle of modern underground engineering. Anderson says the Coaltrams incorporate new technology, safety and operator comfort never before seen in an underground coal environment. They are also fitted with the latest electronically controlled Tier 3 based low emission diesel engines with greatly reduced diesel particulate matter and are more compact than comparable vehicles yet provide excellent stability due to their low centre of gravity.

CHINESE leader in underground mine vehicle technology

Anchises Technology has become known as the Chinese leader in Underground Mining Vehicle technologies and since the company started in 1982, it has been at the forefront of eight leading industry innovations for underground trackless equipment.

The company markets its underground mine vehicles under the trade name SinoMe.

This year, Anchises has expanded its range of products and services to Africa and Australia setting up a distributorship and maintenance and support base in both South Africa and Australia.

In 1982, Anchises introduced electric underground load haul dump trucks to China. Nine years later the company developed China's first electric underground loaders which had a bucket capacity of 4 cubic metres. In 1997 the company developed China's first multi-disk wet brake and has holds three patents over this technology. The following year, the company developed China's first civil aviation medium-sized aircraft towing tractor. In the same year, Anchises developed the first underground low profile dump truck with a hauling capacity of 25 tons in China. In 2002 the company became the first private enterprise to manufacture and supply underground trackless equipment in China.

In 2004, the company launched a series of underground trackless equipment using its own proprietary designs. Later that year, the company made its first export of a 2 cubic metre capacity underground loader to South America.

In 2005, the company became the first manufacturer to establish a research centre for underground mining vehicle technologies in China.

Anchises Technology president Maolin Feng says: "Our technology is based on vehicle technology, engine drive lines, hydraulics, brake systems, safety and tyres. "We have a very strong design in drive lines including engines, converters, transmission and axles," Maolin Feng says.

"We do not incorporate high technological components in our equipment, rather we simplify the working mechanisms because companies are looking for good performance, quality and above all easy maintenance. This has been ideal for the smaller mine operators." Anchises Technology Sino Me range of underground mine vehicles is growing at an average rate of 25% year on year. During the 2007-2008 year, sales were 60% domestic and 40% international, however during last year's global downturn, sales were predominantly to the domestic market.

Underground truck launch

The Caterpillar AD55B articulated truck for underground mining replaces the AD55 with more power and enhanced braking and retarding for faster speed on grade.

The 55-metric-ton-capacity truck also features a Cat C27 ACERT engine that produces 805 gross horsepower.

Automatic Retarder control (ARC) also contributes to high productivity, as it electronically controls retarding on grade to maintain optimum engine rpm and oil cooling for faster downhill hauls.

ARC protects the engine from overspeeding, improves fuel efficiency, provides better control of the truck, increases productivity and frees the operator to focus on other tasks.

The Cat oil-cooled braking system combines the service, secondary, parking brake and retarding functions in the same system.

New Mining Tyre Monitoring System

Bridgestone Earthmover Tyres has announced a new tyre monitoring application to increase the longevity and safe operation of its tyres in underground mines. The UTM (Underground Tonne Kilometres per hour Monitor) is designed to allow underground mine operators — and the manufacturer itself — to analyse the key factors at play in the wear experienced in particular situations. It measures vehicle speed; distance travelled; the angles of ascent and descent; side loading movement; and the lateral, longitudinal and vertical forces exerted upon the tyres — a measurement achieved through the fitment of a three-dimensional accelerometer.

The demand for increased productivity and efficiency has led to the development of new mining equipment, which must run much greater distances, in addition to carrying extra weight at higher speed. Mining tyres have also had to meet the new specification machinery, but Bridgestone suggests that the underground mining sector has lacked the ability to log operational feedback and verify the operational severity experienced by the tyres.

Paul Comninos, Bridgestone Earthmover Tyres' senior manager engineering services suggests this is an issue that needed to be addressed: "Underground mining applications are notoriously difficult in which to get a realistic appraisal of the severity of the conditions and, until Bridgestone Earthmover Tyres developed the UTM, an onboard monitoring system has simply not been available as a component on underground production equipment. To our knowledge this is currently the only system of its kind in operation."

"Our engineering team worked closely with our technology partner to develop the system, a process which took about five months. For the past year it has been trialled in over 20 underground mines across Australia. For our customers, the UTM provides detailed operating knowledge about their production equipment and validates that the specification of the tyres being used are in line with production expectations."

"From Bridgestone's point of view, the system gives us an insight into the differences between the various customers and operations that we service, so we can compare and contrast between different sites. Before we developed the system we were running a bit blind. Now, with accurate information on different sites and applications we service, we are better able to accurately recommend the most suitable tyre specification for each mine's operation."

High energy absorbing mesh for increased safety underground

Technology invented at the University of Western Australia (UWA) to increase safety for underground miners is likely to be used around the world soon, following an agreement signed today.

Through its Office of Industry and Innovation, UWA will collaborate with DYWIDAG-Systems International (DSI) to further commercialise the High Energy Absorbing (HEA) Mesh internationally. The mesh, made of recycled scrap metal, is easy to install, has high load-bearing capacity and was reviewed in detail in the Rock Mechanics Innovations article in International Mining June 2009.

HEA Mesh, invented by Winthrop Professor Yves Potvin, Director of UWA's Australian Centre of Geomechanics, won the 2008 WA Inventor of the Year 'Ready for Market' category.

"The major benefits of this mesh will be to improve mine safety, especially where the ground conditions are rockburst prone and challenging," Professor Potvin said. "I'd like to thank the staff at UWA's Office of Industry and Innovation and in particular Project Manager Tom Schnepple, for his work in making today's agreement with DSI a reality."

DSI Chairman and Group CEO Alan Bate said: "We are very pleased to be working with the University and Professor Potvin to make this a product in the international mining sector. This agreement is our joint commitment to making this product a proven benefit to DSI's clients."

UWA is a leading Australian research university with an international reputation for excellence, innovation and enterprise.

Its Office of Industry and Innovation was established in 2001and is responsible for commercialising UWA's research outcomes and negotiating industry research contracts.

DSI is a market leader in the construction and mining technology sector with a strong manufacturing base. The company's products are mainly used to strengthen concrete, stabilise slopes and provide strata control for tunnels and mines. The company is headquartered in Munich, Germany.

Industrea boosts order book

Global mining products and services provider Industrea today announced new contract wins totalling $3.9 million over the last four weeks for underground mining vehicles and power generation units supplied to China and Australia.

China's leading energy group Shenhua Energy Company has extended its relationship with Industrea by ordering four PJB Nipper flame and explosion-proof vehicles for a total of $1.2 million.

In the domestic market, Industrea has signed a $1 million contract with BHP Billiton Mitsubishi Alliance (BMA) for the manufacturing and commissioning of a PJB high-performance, underground power generation 'Flitmate' unit at BMA's Gregory Crinum Mine near Emerald.

Also in Australia, Industrea Mining Equipment (IME) has secured $1.7 million of orders for two of its underground mine graders for Rio Tinto's Kestrel Mine in central Queensland, and for BIS Industrial Logistics as part of its hire fleet. Industrea Managing Director and CEO Robin Levison says the contract wins show the company's internal R&D process is producing globally competitive products for the wider mining sector.

"Industrea's mining equipment subsidiaries PJB and IME are currently running at near full capacity, and these latest orders show the potential for further growth in our domestic market along with the key export market of China," Levison says.

"This diversification is one of the strengths of the Industrea group, and our consistent winning of repeat business from existing customers shows the depth of our relationships with leading miners and reputation for delivery," he says.

Headquartered in Brisbane, Industrea has developed a strong presence in the world's top resource market of China. According to Levison, the business is also pursuing opportunities in other overseas markets such as India, Russia and North America.

"A recent investor roadshow in the United States showed the scale of international investor interest in Industrea, along with the growing global demand for our leading mining productivity and safety equipment," he says.

West Wallsend's IS-approved communications and tracking solution

NLT Australia, a subsidiary of NL Technologies in Canada, was recently awarded the contract to supply a complete tracking and two-way messaging cap lamp system for West Wallsend coal mine (WWC) in New South Wales. The Intrinsically Safe (IS) Messenger cap lamp system allows users to receive messages from any PC on the company's network. Underground users can reply directly to the individual initiating the message. All messages are time stamped and stored on the system server for future reference.

Another feature of the system is the ability for the users to raise an 'Emergency' message from their Northern Light® Messenger cap lamp should an emergency occur or assistance be required. This 'Emergency' will instantly be displayed on all monitoring PCs. NLT will also be supplying IS tracking for cap lamp users and underground vehicles. The IS tracking system operates over the same fibre optic-based Ethernet backbone as the IS Messenger system and therefore does not require a separate network infrastructure to be installed. Through the NLT Software suite the mine will have the ability to locate users and equipment throughout their underground workings. The complete system will assist the mine in managing any emergency situation.

IS Messenger cap lamps will use NLT's newest IS approved LED Headpiece expected to significantly reduce the incidence of bulb failures a common challenge with the older incandescent cap lamp systems. This combination of NLT Messenger cap lamps and the digital network infrastructure will provide the mine with the most innovative and advanced certified products available on the market today.

NLT says WWC chose it's tracking and messaging systems "after evaluating other available systems. NLT's Digital Mine applications are technologically-advanced and IS-approved. The Northern Light Digital Network is the only system designed to stay active during a mine emergency."

The selection team from West Wallsend Colliery, Xstrata Coal, explains "We chose NLT Digital because it is totally IS, it provided us with true two-way communications and tracking required for both safety and productivity reasons even in the hazardous zones." The safety benefits of the cap lamp system are in being able to instantly locate and communicate with system users, which is an unparalleled function in an underground coal mining situation. Adding to these safety benefits is the strong potential to increase productivity by being able to more readily locate equipment and specifically skilled personnel. This benefit alone provides the potential to dramatically decrease production downtime through timely and appropriate response to equipment breakdowns

Aquacrete's technology and innovation pays off

Underground ventilation control specialist, Aquacrete, has been hard at work developing new ventilation control and geology consolidation solutions for Australia's underground mines.

Aquacrete's managing director, John Whitfield, confirmed the company has developed several technologies to address the productivity, safety and performance needs surrounding underground ventilation.

The computational engineering model, developed in association with international engineering firm, PB, continues to be introduced to mine sites across Australia with positive results.

"Predicting the performance of ventilation control devices (VCDs) has posed a significant challenge for underground mines for some time," Whitfield said. "Our client feedback has reinforced the need for accurate VCD engineering to form an integral part of the ventilation management plan. Aside from providing ventilation officers with the assurance of knowing that their ventilation control devices conform to industry regulations, our clients reiterate that accurate VCD planning contributes to the safety of their underground mine environments."

WetRepel, the company's water-resistant shotblast product continues to be a clear success for Aquacrete. With sales of the product increasing exponentially as more and more sites put the product through its paces, it is evident that the company's investment in developing WetRepel was well-placed.

WetRepel has been put to the test for five years as Aquacrete strived to introduce a single application, water-resistant product that would uphold the strength and rapid-setting properties of the company's flagship shotblast product, OPR2.

Seals crushing out, water erosion and gas permeability are some of the major concerns that Aquacrete identified when developing WetRepel.

"Our client feedback has indicated that WetRepel continues to perform extremely well in all these areas over an extended period of time," Whitfield said. Whitfield believes that the level of interest in Aquacrete products and specialist services emphasises the need for new advancements in ventilation control management. In line with the company's reputation for ongoing investment in technology and innovation, Aquacrete is currently upgrading its WA-based manufacturing plant and expects to see the new manufacturing processes well in place later this year. The technical services team is currently concluding trials on a further addition to the Aquacrete product stable and also expects to introduce new on-site testing technology in the near future.

World first commercial wireless initiating system

In a world first, Orica Mining Services has unveiled a commercial Wireless Initiating System that has the potential to revolutionise modern mining methods.

In an *Australian Mining* exclusive, Orica Mining Services Chief Executive Officer John Beevers and General Manager of Technology and Marketing Jez Smith talk about the development of this system.

"We believe this technology has the potential to enable blasting techniques that have not previously been thought possible," Mr Beevers said.

The in-hole Wireless Initiating System is an assembly based on the i-kon electronic detonator technology.

It removes the need for any wire or signal tubing to be connected to the detonator in the hole or between detonators on the surface, allowing one way communication through rock and most importantly can be operated a significant distance from the blast box.

The first commercially available technology of its kind, the system has been successfully trialled and patent applications filed widely with respect to the device itself but also its deployment in particular mining applications.

Smith likened the technology to the introduction of mobile phones in every day life.

"When mobile phones were first introduced there were naturally some early adopters, but before long, there was mass uptake and mobile communications are now common place in society.

"The point to note though is that the technology provided a step-change in the way people operate, and we believe the same will apply for the mining market with the introduction of the Wireless Initiating System," he added.

Chief executive John Beevers spoke at length of the value the system could generate due to its precise remote firing capability.

"It has distinct and direct potential to offer a step change in mine development methods.

"The new methods would have a direct relationship with both profitability and safety improvements." Beevers said. "For example, in underground mining it could increase productivity by reducing cycle times in many stoping applications through modification of stope and pillar design, allowing better positioning of broken ore for more efficient extraction.

"The technology could also reduce the number of development levels and additional ground support" he added. In the case of open cut coal, "the technology could change the economic strip ratio for dragline-operated coal mines by delivering increases in cast achieved by placing and timing charges in deeper holes than currently practical with wired detonators," he said

The pair also spoke of the potential gains in mining efficiency in open pit hard rock mining through pre-loading benches that can be fired later, reducing unproductive drill tramming time.

The initiation technology also improves safety, and with the correct application of the system, there will be no need for underground personnel to enter near brow areas to prepare blasts for initiation.

The technology is applicable for a range of industries but is expected to be of greatest value to the coal and metal open cut markets, underground operations and oil and gas or seismic markets.

It is expected to be available in 2011 as a component of Orica's Blast Based Services.

Radio-Style System Of Communication Via Magnetic Waves Demonstrated In Deep Mines

A new system developed by Lockheed Martin aims to change that, by using magnetic waves to carry voice and text messages.

The MagneLink Magnetic Communication System works like a radio, but at extremely low frequencies. Unlike radio waves, magnetic energy can penetrate coal and rock, says Dave LeVan, the research engineer at Lockheed who developed the system.

It can connect to the short-wave radios miners use to communicate within mine shafts, but it has a much longer range and can reach the surface.

Each MagneLink system consists of two units, one on the surface and one inside the mine. The in-mine unit is encased in an explosion-proof box and uses very little power, so if it were to short out, there wouldn't be enough energy to produce a spark that could ignite methane inside the mine.

It would be placed near the mine's refuge chambers, which are now required in underground mines and are designed to shelter miners in case of an explosion.

After 13 miners were trapped in a coal mine in Sago, West Virginia, four years ago, rescuers didn't know where to look for survivors — they could have been anywhere between 3300m and 4000m from the entrance. Radio waves can't penetrate very far through rock, so there was no way to communicate with the miners. The Sago disaster was the impetus for the work, along with some inspiration from a former Lockheed engineer whose uncle worked in West Virginia coal mines. He learned that mine telephones may only be placed near elevators, and that in any case, the wires would melt in a fire or an explosion. He wanted to develop a wireless system instead.

Initially he considered sonar, familiar to Lockheed's engineers who work on submarine communications. But LeVan found that sonar takes a lot of power, and any mine device needs to be low-powered enough to prevent a spark.

The MagneLink system modulates text and voice much like a radio would. Each unit includes a keyboard for text messages and a device to capture voice, but the audio input takes longer to reach the surface. Its battery lasts 24 hours and it would most likely be turned on only in an emergency, LeVan says.

Lockheed tested the system last month and found it works inside the mine to a distance of 853m. It can penetrate about 472m from the surface.

Warren Gross, Lockheed's project manager for MagneLink, says he expects the system to be certified by the US federal government in the next couple of months. Lockheed has worked with the National Institute of Occupational Safety and Health to develop the system.

IECEx-certified cordless caplamps make underground mining safer

Underground mines are hazardous environments. Fire, flood, explosion and collapse are among the potential dangers to the many people who work in them. Miners work in confined spaces with low lights and visual contrasts that increase manifold the risks of injury or death. Proper illumination and protection against Ex (explosive) atmospheres are critical in such harsh conditions.

Slow development for a century…

The first electric mine lamps appeared in the early 1900s and lead-acid battery and incandescent light-bulb miners' caplamps have been used for more than a century. But inventors and manufacturers were confronted with numerous problems. Could lamps be made that would not ignite mine gasses? Could they produce enough steady and uninterrupted light for at least one shift? Would they burn in any position, be bright enough, simple to operate and durable?

…rapid evolution in the 2000s

Thanks to the rapid development of various technologies, compact rechargeable batteries have significantly advanced in the past decade. LEDs (light-emitting diodes) have become increasingly more efficient. Today's integration of compact rechargeable battery cells with highly energy-efficient white LEDs into an IP67 caplamp case, compliant with IECEx protection requirements, has made the traditional belt-worn battery pack and electric cord redundant. [IP refers to Ingress Protection Rating codes. See below for an explanation.]

The first cordless caplamps

An Australian company, Kinyun Australia, developed a cordless caplamp a few years ago. The lamp was designed with miners' security and comfort in mind. It dramatically reduced the risk of injury and eliminated accidents caused by tripping on electrical cables.

This first model also had a number of features that significantly improved the safety of the lamps. Because there was no battery, there was no acid or toxin to spill, no heat on lens surface, no burning parts to cause fire. The elimination of the battery and cable also improved work efficiency. Last but not least, the low maintenance of this new product drastically reduced costs.

In 2006, the first cordless caplamp was granted certification by IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres. The product became very popular. More than 100 Australian mines embraced the new technology.

Kinyun Australia's cordless caplamp series recently was awarded IECEx certification

In 2006, the first cordless caplamp was granted certification by IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres. The product became very popular. More than 100 Australian mines embraced the new technology.

In subsequent years, Kinyun fine-tuned the lamp and expanded its product line to include models such as external charging lamps, light-weight lamps, flood light lamps, side-worn lamps, rear beacon lamps, traffic control lamps, rescue lamps and multiple-pattern beacon lamps.

The complete cordless caplamp series recently was awarded IECEx certification by TestSafe Australia. Every model is also certified as a helmet lamp because it can be worn on any helmet.

IECEx has been testing and certifying equipment used by the mining sector for many years.

WINNER OF THE DAVID SUGDEN AWARD 2010

3 Dimensional Structural Modelling of Segmental Tunnel Lining

Using Finite Element Software

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ABSTRACT

Closed-face shielded TBM driven tunnels are supported using precast concrete segmental linings. In the past these types of lining have been assessed without consideration being given to the coupling action along circumferential joints of adjacent rings or the true behaviour of joints along longitudinal joints, especially where these have a taper. The mechanical and geometrical characteristics of these joints strongly affect the structural behaviour of tunnel lining. The current practice is to use closed form solutions or adopt two-dimensional 'beam-spring' modelling techniques to assess the structural behaviour of segmental linings when loaded. However, it can be argued that this simple two-dimensional approach do not fully take account of the coupling action or joint behaviour and so will not provide accurate results. Particularly with respect to: the structural behaviour of the tunnel lining in longitudinal direction; the deformation of the lining due to the rotation along longitudinal joints; and the relative displacement in the circumferential joints. It is suggested that a more comprehensive three dimensional finite element method (FEM) is required to more accurately explore the coupling action and joint behaviour. The paper aims to show how the behaviour of the rings and joints can be modelled in an appropriate way. The paper describes an approach that uses the Strand7 structural software to develop a three dimensional model. A description is given of how loading assumptions have been derived. Comparisons are made with the results from traditional two-dimensional beam spring models.

1. Introduction

The behaviour of a segmental tunnel lining under applied loading is very different to that of amonolithic cast-in-place concrete lining. For precast segments, the stiffness and resistance todeformation of rings depends on many factors. These factors include: the number of segments ineach ring; anticipated joints rotation under load; the joint profile; the amount of force appliedbetween segments in each ring; the quality of the ring build geometry; and the interaction betweenthe relative rings.

The squatting of precast rings under load is generally a consequence of non-uniform appliedground pressures, where vertical applied pressures are either greater or less than horizontalpressures. This imbalance will cause rings to deform. Depending of the ring rotation of adjacentrings and the staggering of joints, this relative deformation may differ. This change in deformationprofile will have an impact on the imposed structural actions on each ring.

Relative ring behaviour is to a large degree dictated by the behaviour of joints, as the segmentsrotate about these points. Where longitudinal joints are tapered this rotation is complex andrequires special attention, given the tendency for local torsional stresses to develop. Therefore,the behaviour of the joints needs to be considered in the design of the segments and in this paperit is shown how these joints can be modelled by using a three dimensional FEM approach.

2. Traditional analysis approaches

Traditional methods of analysis provide a means of determining imposed structural actions oncircular tunnel linings at ultimate limit state and lining deformations at serviceability limit state.Closed form solutions provide a first pass approach to assessing segment behaviour. Thisapproach uses hole-in-a-plate theory and in effect assumes the lining deforms to form an ellipticalshape. These solutions are based on the equilibrium equations for a hole in a prestressed plate.The formulae used have been developed from the work of Morgan [1], Muirwood and Curtis [2, 3].The formulae take into account the resistance of the lining to determine the imposed maximumaxial 'hoop' loads and bending moment caused by assumed loading. The equations can also beused to determine lining 'squatting' deformation.

By determining expected lining deformation an assessment of ideal segment behaviour can beundertaken. Employing geometric equations enables longitudinal joint rotation (or bird-mouthing)to be determined. This calculation generally includes allowance for build tolerance. It is typical thatprecast segmental tunnel lining designs are checked against an absolute deformation value of 1%of the lining radius in combination with worst case ground loading deformation to determine theamount of associated birdmouthing that can be expected. This percentage is a well establishedfigure that complies with the BTS Specification for Tunnelling [4].

Knowledge of joint behaviour provides another approach to understanding imposed structuralactions of the tunnel segments, which is different to that assumed by closed form solutions bythemselves.

The calculated joint rotation when considered in combination with applied axial forces will causethe development of an asymmetric strain profile across the joint faces, with the greatest strain atthe point of rotation. This pressure distribution in turn causes flexural bending within segments.Segments are designed to resist this bending by included reinforcement

either in the form of steelfibres or conventional steel reinforcement bars. Segments are also designed to take account ofthe tensile bursting pressures that accompany these segment-to-segment contact pressures.More complex structural analysis methods can also be used to assess segmental linings.Following a 'beam-spring' approach provide another approach to determining the structuralresponse of segmental linings to imposed loading, which considers the confinement offered by thesurrounding ground. Using this approach requires that a numerical model is created in a structuralanalysis software program (such as Strand7). The lining is modelled as a series of interconnectedbeam elements with assumed loads applied at the ends of the beams. These beams arerestrained in position by a series of 'compression only spring', whose stiffness is adjusted toreplicate the restraint provided by the surrounding annulus comprising grout and rock mass. Thestiffness of these springs can be calculated using any one of a number of linear load deformationrelationships. A relationship commonly used is that proposed by Duddeck and Erdman [5].This simplified two dimensional approach is in many respects restrictive in the way it takes intoconsideration joint behaviour. One approach used to account for joints, is to simply reduce thestiffness of the ring by a linear relationship to the number of longitudinal joints that are present.To truly understand joint behaviour and its influence on imposed structural actions requires athree dimensional approach to be undertaken. Especially where tapered joints are specified, suchas in the case of trapezoidal ring configuration.

3. Case study

A case study is presented where a three dimensional approach has been taken to design liningfor water conveyance tunnels, forming part of a major project in Australia. The project involves theconstruction of 4m internal diameter TBM driven tunnels that are supported using a precastconcrete segmental lining system.

These rings have been designed follow a universal lining system, with each ring formed by sixsegments that are either trapezoidal or parallelogram shaped. These universal rings are taperedfor negotiation of the designed alignments.

The lining has been designed to include Ethylene Polythene Diene Monomer (EPDM)compression gaskets for waterproofing of the lining. Longitudinal joints are connected in the shortterm using spear bolts, whilst rings are secured to one another using dowelled connectors.

4. 3D finite element model

The three dimensional model was developed for the project using the finite element packageStrand7 [6]. The finite element model has been created to replicate the tunnel lining. Theparticular features of the model are described below.

Each segment has been modelled as a discrete structure comprised of a grid of quadrilateralplate elements.

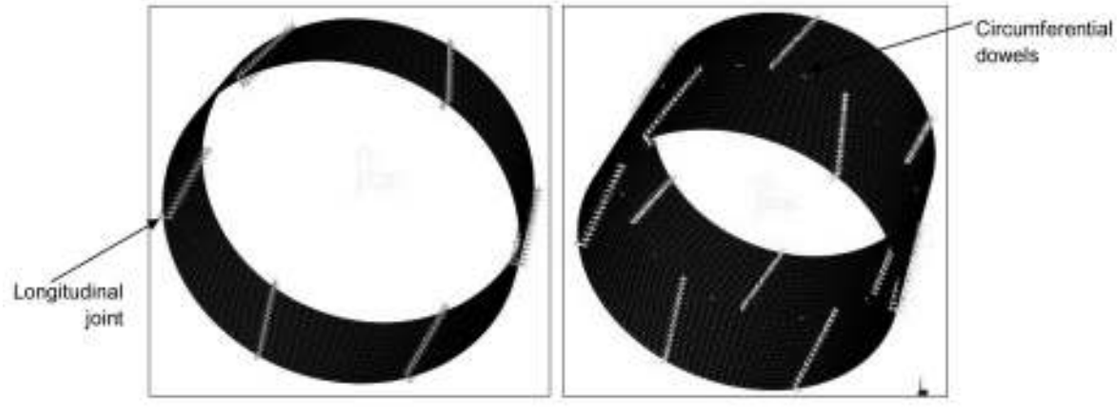

Figure 1: (a) 3D model of tunnel ring with tapered longitudinal joints (b) 3D coupled model.

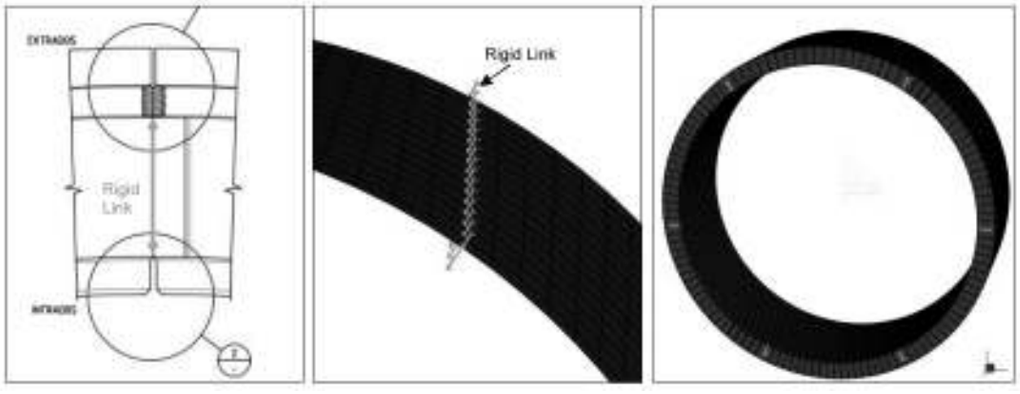

Figure 2: (a) Longitudinal joint (b) Rigid link used to model tapered joint (3) 3D solid model showing joint behaviour.

The geometry of these segments incorporates a taper of 100 degrees along longitudinal joints. Atthe interface between adjacent segments, rigid links and contact elements have been used tomodel the action of joints permitted to pivot about the inner or outer edges of the joint bearingsurface. The rigid links along each joint face extend perpendicular to the plate elements to eitheredge of the bearing surface. The links have been connected with compression-only springs toRigid Link allow separation to occur and so allow joint rotation. Each compete ring consists of 2400 nodes,287 beams, 1800 plates and 384 links elements.

The confinement provided by the rock has been modelled using face and edge support of plateelements as shown in Figure 3(a, b). These types of support resist lining movement in directbearing and tangential shear across the grouted lining annulus. The stiffness of these springswas calculated using linear load deformation relationship according to Duddeck and Erdman [5].

$$C_r = \frac{E_c}{R} \text{ [MN/m}^3\text{] and } k = C_r \times A \text{ [MN/m]}$$

Where the constrained modulus is given by $E_c = \frac{E(1-\nu)}{(1+\nu)(1-2\nu)}$ [MPa]

Where the constrained modulus is given by

E, ν = Young's Modulus and Poisson's Ratio of the ground

R = equivalent tunnel radius

A = area of rock that is to be represented by the equivalent radial spring. This is the distance between adjacent radial springs multiplied by unit length.

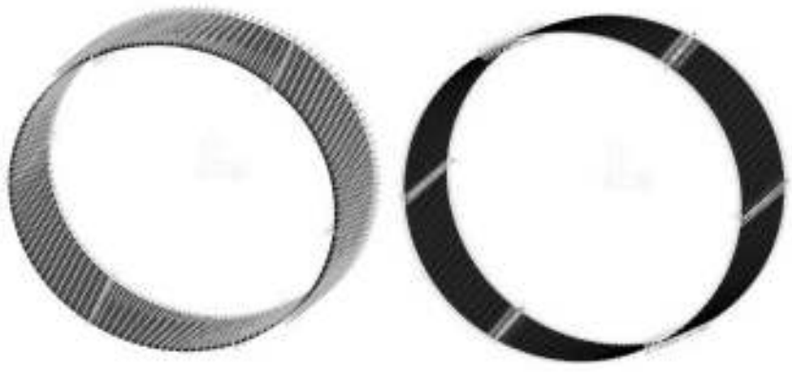

Figure 3: Confinement provided by rock (a) Face support (b) Edge support of plate element.

The effect of ring coupling has also been investigated by by the introduction of a second ring which has been rotated by 60 degrees as shown in Figure 1(b). The presence of the circumferential dowels between rings has been included to assess the true interaction of adjacent rings. The dowels are simulated in Strand7 by using special connection element, whose properties are provided in terms of translational and rotational stiffness.

5. Loading assessment

The analysis and design of the tunnel linings is driven by the types and combinations of long termloading assumed. These loadings assumed for the design of the segmental lining are describedbelow. Short term loads imposed during construction were assessed during the design, but theseand the associated capacity assessments are not discussed in this paper.

Long term loading of the lining, once installed, will come from the weight of any loosened rock thatmay be present immediately above the tunnels, external pressures imposed by groundwater andthe pressures imposed by the injection of grout behind the lining. In the short term, sources ofloading that can be applied to the segments during construction will come from their handling,stacking and installation. The following loads have been used to analyse and design thesegmental tunnel lining.

5.1 Imposed ground loading

The tunnels are interpreted to align through a varying rock, including sandstone andmudstone/siltstone units. Critical loading was interpreted to be due to rock loosening triggered bydeformation of the rock mass around the excavated tunnel opening. Mechanisms for this type ofloading are governed by the presence of geological discontinuities, as well as the quality, strengthand stiffness of the rock mass along the tunnel alignment. Loosened rock pressures have beendetermined based on Terzaghi's rock pressure theory. In calculating loosened ground loading,worst credible material parameters have been assumed to generate the highest expectedloosened rock loading. This loading is assumed to be uniformly distributed across the full tunnelspan.

The height of the loosened rock zone as calculated using Terzaghi's rock pressure theory hasbeen compared with the results of FEM modelling using Phase2 software. Ground reaction curveshave also been developed to assess the way in which load is shared between the tunnel liningand the surrounding ground. In the first instance an axis-symmetrical model was created. Figure4(a) shows this model and the summation of the results from this modelling. From the model itwas determined that over 90% of total convergence would occur prior to lining installation. Theresults from axis-symmetrical modelling results were noted to correlate with methods used toestimate loosened rock loading as described earlier.

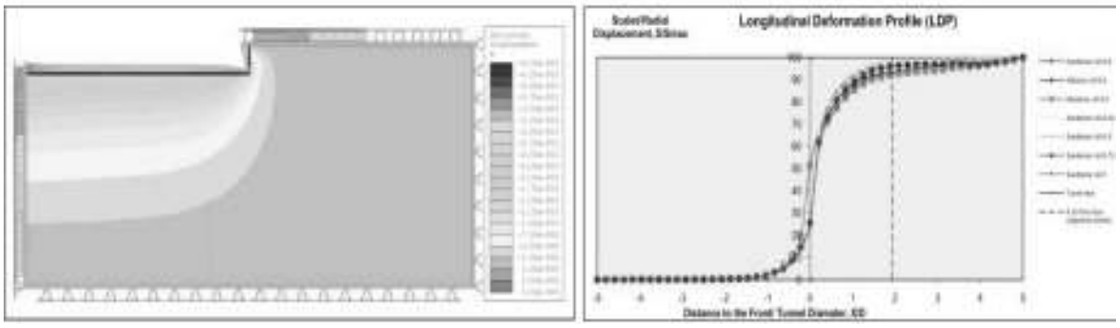

Figure 4: (a) Axisymmetrical modelling using Phase² software (b) vertical loading applied in 3D model.

5.2 Imposed groundwater pressures

The precast segmental tunnel lining provides a fully tanked tunnel support solution. In this regardthe lining has been designed to resist full water pressure. Pressures have been calculated toreflect true as expected conditions.

Uniform groundwater pressures were applied around the circumference of the lining and in allcases (operational and when dewatered) the groundwater exhibits a net external pressure. These pressures have the effect of confining the structural lining and so increases the lining ability toresist induced flexural actions, such as that caused by loosened ground loading. To ensure worstcredible conditions have been accounted for, a loading combination reflecting 'dry' conditions wasassessed in combination with a full hydrostatic case.

However, there are some loading combinations where the pressure exerted by groundwater hasan overall adverse impact, such as when considering high axial loading in combination with thestructural effects of tunnel non-circularity (as caused by build tolerances and non-uniform loading)For these cases the design hydrostatic pressure was considered and applied to the threedimensional model developed for the project.

The premise for applying full groundwater pressures is that there will be full hydraulic connectivitythrough the rock mass, such that water can migrate through geological discontinuities (e.g.jointing and faults) in the rock mass.

Figure 5: Applied loading in 3D model (a) Vertical rock loading (b) Lateral pressure (c) Hydrostatic loading.

5.3 Grouting pressure

Segmental linings are grouted in place. Grout is injected under pressure into the annulus createdbetween the excavated profile and the outside of the lining.

These pressures can be locked-in with time and so remain around the outside of the lining oncethe grout has set. Maximum grout pressures are based on the assumption that grout pressures will be limited to 1 bar above prevailing water pressure. This water pressure is assumed to beequal to the full head of water overlying the tunnel alignment. A sensitivity analysis was conducted during the design process to assess the impact of varying the assumed locked in grout pressure.

5.4 Loading combination

For the long term loading conditions the tunnel lining has been designed to provide sufficient capacity to resist worst case credible combinations of imposed loading applied along their entire lengths. Loads have been factored in accordance with the principles outlined in AS 1170 and AS5100.5 to undertake structural assessment at ultimate and serviceability limit states.

6. Summary of results and discussion

Table 1 summarises the results from the three dimensional modelling undertaken. Figure 6 presents some resulting output from Strand7.

Table 1 also provides a comparison with the results of various other traditional approaches employed during the design process, such as the use of closed form solutions and the two dimensional beam- spring approach.

In the case of the beam-spring approach, models where created which investigated a single ring (uncoupled) and models that, like the three dimensional approach, included two side-by-side rings (coupled). In the latter case rings were connected to replicate the presence of connecting dowels.

Of particular note are the results from the coupled and uncoupled models, which indicates that the three-dimensional model predicts the presence of greater applied bending moments, as compared with the two dimensional approaches. This suggests that conventional analysis approaches underestimate these induced actions.

Table 1: Summary of results from long term structural modelling of lining.

Description of analysis approach	Bending moment (kNm/m)	Axial force (kN/m)
Closed form solutions	41	775
2D bedded beam model (single uncoupled ring)	51	735
2D bedded beam model (two rings coupled)	62	748
3D plate element mode (single ring)	64	1084
3D plate element model (two rings coupled)	80	1065

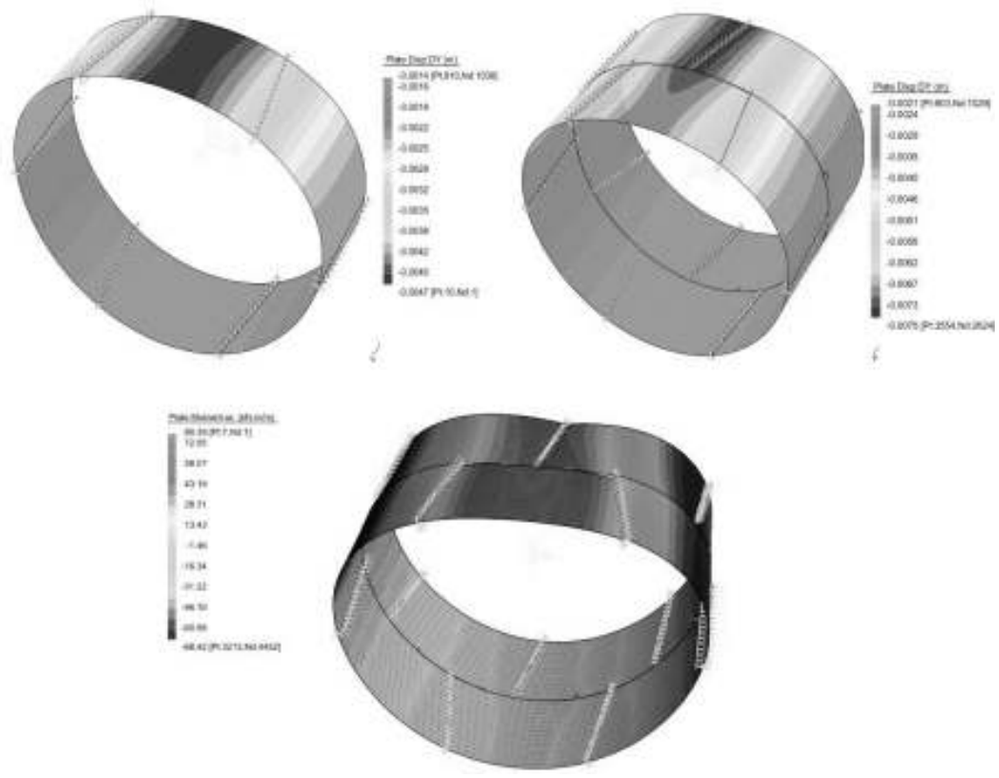

Figure 6: (a) Displacement vector in single ring (b) displacement vectors for coupled ring (c) Bending moment for coupled model (exaggerated diagram)

Also vertical displacement deformation for coupled models is calculated to be greater. This is thought to be due to the 'dragging down' effect of adjacent rings that have a different ring rotation. Finally, the taper of longitudinal joints has an impact on the bending moments imposed to segments close to joints. The bending moment contours shown on Figure 6 (c) show a complex pattern that cannot be fully appreciated using two dimensional modelling techniques.

7. Conclusions

In this paper a complex three modelling technique is described, which in the author's opinion predicts lining behaviour more accurately than conventional two dimensional methods, especially where tapered longitudinal joints are detailed. It can be seen from the results of analysis that induced bending moments applied close to longitudinal joints are affected by this taper. Different methods of analysis have been undertaken in order to compare traditional closed form solution and 2D beam spring models with a more complex three dimensional approach. The results show that there are cases where the use of three dimensional methods is warranted to ensure that the segmental linings are designed to have sufficient capacity.

Acknowledgement

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Fibre sprayed concrete relevant test of characterization to choice the right fibre for the right used

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ABSTRACT: Steel fibre reinforced concrete is used for many years in spray concrete for tunnel as temporary lining and even final lining. Multiple research studies and tests on the behavior of steel fibre reinforced concrete have been carried out in recent years in various countries. They have greatly contributed to a better characterisation of Steel Fibre Reinforced Concrete (SFRC), and have thus allowed to gain a better understanding of the behaviour of this material and to specify minimum performance requirements for each project. The state of the art is well known and lot of international standards provides clear guidance and performance criteria to used safely steel fibre reinforced concrete. Macro synthetic fibre is also proposed today for different application. Specific technical strength and weaknesses of the different fibres, are often less well known, and lead to confusion. This paper discusses the important characteristics of steel and polymer fibre reinforced spray concrete when used for ground support and provide the last test result from different laboratory.

1. MATERIAL PROPERTIES OF STEEL AND POLYMER FIBRES

1.1 Modulus of Young of the fibres

The reinforcing ability of a fibre depends on the anchorage of the fibre into the concrete, the tensile strength and modulus of Young.

The Young's modulus of concrete is typically 30.000 MPa, of steel fibre typically 210.000 MPa, and of polyolefin fibre typically 3.000 to 10 000 MPa.

For well anchored fibres, and equal solicitation of the fibre, the elongation of the polymer fibre, and the corresponding crack width in concrete, might be considerably higher compared to steel fibres. This might have an impact on the durability of the concrete, especially in combination with traditional reinforcement.

1.2 Tensile strength of the fibres

The tensile strength of steel wire is typically 1.000-2.000 MPa, versus 300-600 MPa for macro synthetic fibre.

1.3 Specific density of the fibres

The specific density of steel fibres is typically 7.850 kg/m^3, versus 910 kg/m^3 for polymer fibres, and 1.000 kg/m^3 for water. Polymer fibres are light, which is favourable for health and safety, but they are lighter than water: the polymer fibres actually float on water, with potential risks for fibres at the surface.

1.4 Fire resistance of the fibres

Metallic fibres have a neutral to positive impact on the fire resistance of structures. Due to a decreased spalling effect, a structure in metal fibrous concrete behaves rather better in the presence of fire than a mesh reinforced structure according to tunnelling specialists (segmental lining). Steel keeps its mechanical performance up to a temperature of 350-400°C.

The macro synthetic fibres though start to loose their mechanical properties as soon as the temperature reaches 50°C and even disappear at 160°C. In a fire, a structure with macro synthetic becomes rather soon unreinforced — with no load bearing capacity left at all — and may result in an unsafe situation from the first hours onwards.

Micro Polypropylene fibres typically melt at temperatures around 160°C. Therefore micro polypropylene fibres (monofilament, length 6mm, diameter nominally <20 micro mm) are proven to be suitable to improve the fire resistance. The exact reason is now fully understood, as it is generally accepted that the fine micro fibres start to melt in extreme fire conditions, thereby leaving small channels through which the pressurized vapour can escape. Consequently less damage, less spalling of the concrete is to be expected.

Macro synthetic fibres do melt at equal temperature, but are not fine enough to provide the concrete under fire with the necessary network of channels. Moreover since the fibres melt, they are not suitable in those building constructions, where the reinforcing effect of the fibres is important.

1.5 Resistance against oxidation

Polymer fibres don't rust, even if the fibres are sticking out at the surface.

Regarding metallic fibres: experience and research conclude:

Steel fibres need only a concrete cover of 1-2 mm compared to 30-40 mm for normal rebar and mesh.

Corrosion of the fibres at the surface may cause discolorations but does not affect the mechanical properties of the steel fibre concrete reinforced structures.

Fibres in crack openings smaller than 0.25 mm do not corrode (Brite Euram project).

When no stains required, galvanized fibres can be applied.

1.6 Mix ability of the fibres

Some macro synthetic fibres tend to fibrillate during mixing. This fibrillation process goes on in the truck mixer, until all fibres are completely destroyed. Quality degradation during mixing does not occur for steel fibres.

1.7 Fibre content in the fresh and hardened concrete

This European Standard 14721 specifies two methods of measuring the fibre content of metallic fibre concrete.

Method A measures the fibre content of a hardened concrete specimen. Method B measures the fibre content of a fresh concrete specimen.

This point should be solved with polymer, no method available, for the moment in order to meet the quality control requirement for many projects.

1.8 Water proof membrane

Double shell tunnel construction includes in between the sprayed concrete support and the final cast in-situ concrete layer a waterproof membrane combined with a geo textile as a buffer to level out the irregularities of the sprayed concrete.

There was a concern about the danger of steel fibres protruding from the sprayed concrete surface to punch through the waterproof membrane.

The CETU in 1993 (French tunnel administration) had already financed puncture tests (under hydraulic pressure) on the geo membrane (600gr/m2) placed on fiber-reinforced shotcrete supports. These revealed the importance of the lower protection geo textile, without however revealing puncturing risks when it was placed between the PVC geo membrane and the fiber-reinforced shotcrete (at that time DRAMIX fibers type RC65/35BN has been tested)

As others test performed and the practical experience on many sites, these test results confirm clearly that there are no problems with the membrane/protection sheets in combination with steel fibre reinforced sprayed concrete.

However for some project 3 cm of non fibre concrete are applied. In fact the key issue remains the irregularities of the spray concrete. It should be noted that several experiments have been carried out on the use of macro polymer fibers in spray concrete. The presence of these polymer fibers may increase the roughness of the support irregularities formed by the fiber/concrete mix.

Recommendation on this subject remain in discussion.

2. PROPERTIES OF STEEL AND MACRO SYNTHETIC FIBRE CONCRETE

Fibre concrete is well known for its ductility. The effect of fibres is a combination of reinforcement and networking. Steel fibres in particular mainly change the behaviour of the concrete: steel fibres transform a brittle concrete into a ductile material which is able to withstand fairly large deformations without loosing its bearing capacity. Ductility means load redistribution and a higher bearing capacity of the structure with the mechanical properties of the basic concrete material unchanged.

2.1 Usual Performance criteria for spray concrete

The test plate usually used (600 x 600 x 100 mm panels) (see EN 14.488-5) is designed to determine the energy absorbed from the load/deflection curve. Slabs intended for the punch-flexure test shall be made in receptacles of 600 x 600 x 100 mm. In this case, care will be taken to obtain an even surface and a thickness of 100 mm.

Spraying shall be carried out rigorously under the same conditions as recommended for the works: constituents, machine, lance holder and spraying methods in particular.

This approach tries to simulate the real lining behaviour. It gives a good idea of the load bearing capacity and the energy absorption of a shotcrete lining.

Instead of determining a material characteristic, which requires a proper design model in order to calculate the allowable solicitation of the structure, the EN plate test approach allows skipping that step and immediately checks the energy absorption and the load bearing capacity of the lining.

It has to be stated very clearly that the statically indeterminate slab test is a structural test to check the behaviour of a construction. It is not a test to determine material properties to be used as design values.

Based on this plate test, three SFRS classes (E500, E700, and E1000) are defined for a C30/37:

- 500 Joules for sound ground/rock conditions
- 700 Joules for medium ground/rock conditions
- 1000 Joules for difficult ground/rock conditions

These values are proposed for a concrete class C30/37, usually specified for a temporary support. Compressive strengths with a too low and too high strength class may have undesired side effects.

In case o higher compressive strength, the performance criteria proposed by the EN standard should be increase in order to keep the same level ductility required for the safety.

The plate test is also appropriate for a comparison of different fibre types and dosages. It allows for a comparison between mesh reinforcement and fibre reinforcement concrete, provided that the failure mode is the same according to EN 14 487-1 Sprayed concrete, definition, specification and conformity. That is why the performance criteria based on this test and currently

proposed test should only be used to compare steel mesh and steel fibres (material with same E modulus of young).

The relative importance of load carrying capacity at small crack widths, and hence small deflections and rotations, is of recent times, assuming much greater importance to the designers of civil engineering tunnels

NB: Due to the very low E-module of macro-synthetic fibres and the mode of failure observed with this type of fibres, the plate test is not sufficient to compare steel fibres and macro-synthetic fibres. In case of using polymer fibre another criteria should be added in order to have complete information, as residual strength.

2.2 Residual strength: Reinforcing effect measured in wide beam tests

To determine the residual strength, the European EN 14651 is mainly used: Test method for metallic fibered concrete — Measuring the flexural tensile strength (limit of proportionality (LOP), residual).

This test procedure is mentioned in the final recommendation Rilem TC162TDF "test and design method for steel fibre reinforced concrete".

This European Standard specifies a method of measuring the flexural tensile strength of metallic fibered concrete on moulded test specimen. The method provides for the determination of the limit of proportionality (LOP) and of a set of residual flexural tensile strength values.

This testing method is intended for metallic fibres no longer than 60 mm. The method can also be used for a combination of metallic fibres and, a combination of metallic fibres with other fibres.

The characterization test enables the contractor who proposes an FRC to check that this FRC satisfies the "mechanical" specification resulting from dimensioning.

In order to improve this approach, we could propose to follow the following requirements:

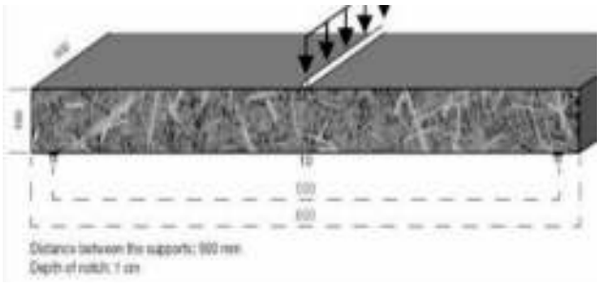

Figure 1: 3 point bending test

The geometry and dimensions of the specimens, as well as the casting method adopted, should ensure distribution of the fibres in the matrix, which is as close as possible to that encountered in the actual structure as spray concrete or flooring

The dimension of the test specimen is acceptable for handling within a laboratory (no excessive weights or dimensions).

The test is compatible, as far as the experimental means permit, with use in a large number of normally equipped laboratories (no unnecessary sophistication).

The geometry should be the same as in the EN 14 488-5 plate test for Energy absorption

One geometry for isostatic and hyperstatic test. Easy to manage a test program could also be sprayed on the job site with the same procedure as the plates test lower scatter than the beam test.

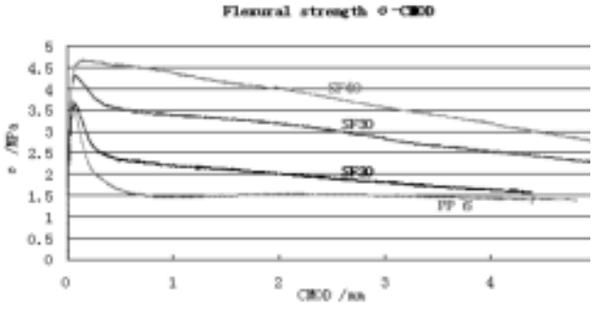

Figure 2: Flexural strength σ-CMOD

Result for different CMOD (crack mouth opening displacement according to EN 14 651)

PP= Macro polymer fibre 6kg/m3

SF20/30/40 = Steel fibre (Dramix RC65/35BN) at 20, 30,40kg/m3

After the first cracking, the load bearing capacity of Macro fibre drops down about 60% rapidly. This means that the 6kg/m3 fibers have lower influence on the residual strength than steel fibers.

Higher dosage of macro synthetic will have big influence on the concrete mix workability and pumpability.

2.3 Creep of steel fibre and macro synthetic fibre concrete

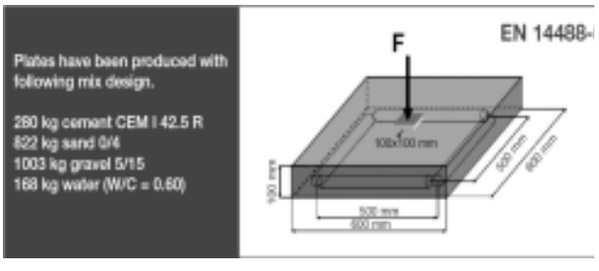

Figure 3: creep test — square panel according to EN 14488-5

The plates have been tested in a displacement controlled manner as described in EN 14488-5. At a deflection of 3 mm the load has been removed.

The plates are now ready to be subjected to the creep test and have been reloaded with 60 % of the applied load at a deflection of 3 mm. The deflection is measured and shown on the Y-axis in 1/100 mm as on the graph.

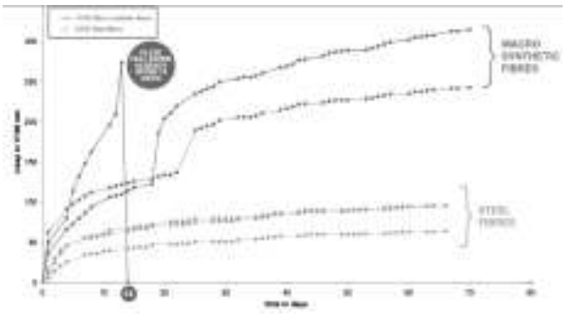

Figure 4: Creep result on square panel

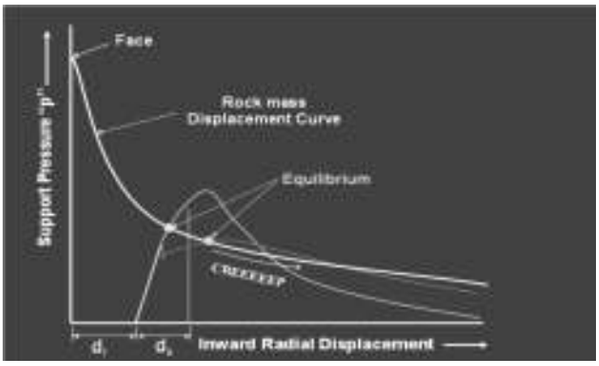

Figure 5: Curve support pressure- inward radial deformation

Consequence due to creep: this type of material will not provide significant reinforcement with the aim of stabilising the ground and minimising any future movement it may well be necessary

2.4 Design rules for steel and macro synthetic fibres

Since October, 2003, Rilem TC 162-TDF design guidelines are available for steel fibre concrete. No such guideline is available yet for macro synthetic fibre concrete.

Quality control of steel versus macro synthetic fibre concrete

As part of the quality production control, wash-out tests are quite common in order to check the dosage of fibres in fresh concrete. This is possible when the fibres can be removed by a magnet, as is the case for steel fibres.

3. CONCLUSION

Steel fibre used for spray concrete spray concrete has proven over the years to be a reliable construction material for tunnelling application. After 30 years of experience, the return of experience is very positive. Official international standard are now available.

Macro synthetic may be used, in sprayed concrete support for some mining applications (could be in combination with mesh) or specific technical need.

However only steel fibres, no macro polymer fibres can act as structural reinforcement of concrete for the following reasons:

- Polymer fibres melt at 165°C; in a fire any "reinforcing" effect of the macro fibres fades away as the temperature rises.
- The Young's Modulus is 3 — 10 MPa, which is largely insufficient to reinforce concrete material with a modulus of 30 MPa.
- Macro polymer fibres creep (see further more elaborated).

Clear test procedure and performance criteria should be specified for each project in order to meet the technical requirement and ensure the safety.

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The European standards *EN 14 487-1* Sprayed concrete, definition, specification and conformity

The European standards *EN 14.488-5* Testing sprayed concrete — Part 5: Determination of energy absorption capacity of fibre reinforced slab specimens

Brite Euram Project (Durability final report)

History of Australian Tunnelling Conferences

The first recorded conference in Australia on aspects of tunnelling was organised in 1970 by the Victorian Group of the Australian Geomechanics Society (AGS).

In 1973 the Institution of Engineers, Australia (now Engineers Australia) and the Australasian Institute of Mining and Metallurgy (AusIMM) collaborated in the formation of the Australian Tunnelling Association (ATA) to operate independently from AGS. Conferences were organised by ATA in 1974, 1978 and 1981. Later in 1981 the name of the association was changed the Australian Underground Construction and Tunnelling Association (AUCTA). This reflected the objective of the association to advance knowledge in all factors relating to the use of tunnels and underground space. Following its establishment AUCTA operated as a Technical Society sponsored by Engineers Australia and AusIMM under statutes approved by the Councils of both organisations. AUCTA organised triennial tunnelling conferences from 1984 to 2005.

In late 2005 a New Zealand Chapter of the Technical Society was formed, and in order to better reflect its international membership, AUCTA changed its name to the Australasian Tunnelling Society (ATS).

The CD accompanying this journal has been compiled from proceedings of Australian tunnelling conferences preceding the last conference in Melbourne in 2008. For conferences earlier than 2002, the papers have been compiled from scanned copies of the printed proceedings retrieved from personal libraries of members and former members of the ATS Executive Committee.

The committee hopes the CD will be of interest to ATS members and other participants in the tunnelling industry.

The CD accompanying this journal has been compiled from proceedings of Australian tunnelling conferences preceding the last conference in Melbourne in 2008.

Lake Eppalock

Lake Eppalock is located on the Campaspe River, near Bendigo in central Victoria. Lake Eppalock was constructed between 1960 and 1964 to provide irrigation from the Campaspe River, and to supply water to Bendigo.

BURRA MINE – SA

Burra is situated about 160 km north of Adelaide, and it was at that lonely and isolated place that copper was discovered by shepherds in 1845. By the end of the decade it had its own mine, smelters and a population of 5000 people. The mine produced high grade copper until 1877 when falling world copper prices, and the high cost of running the mine, resulted in it being closed.

The discovery of this copper deposit proved to be of tremendous importance to the young and still struggling colony. It resulted in a major investment drive to come up with the money needed for a special survey before mining could get started. Two rival syndicates, the Nobs and the Snobs, had to join together in the end to pay for it. After the survey they drew lots. The Nobs, which included the owners of the Kapunda mine, drew the section without the copper. The Snobs, who drew the northern section of the survey, were rewarded beyond their wildest dreams.

The Burra Burra Monster Mine was an underground mine reaching a depth of 183 metres. This mine, in operation during the mid 19th century produced 50,000 tonnes of copper metal during 30 years of operation.

The mine was worked by the South Australian Mining Association which did extremely well for itself and its shareholders. The effects of the fortunes paid by the Monster mine were felt far and wide. For many years Burra became one of the greatest copper producing centres in the world. At the same time it attracted migrants from all parts of the world.

Most of these migrants lived in their own little villages, built around the mine, such as Redruth, Aberdeen, New Aberdeen, Hampton, Copperhouse, Kooringa, Llwchwr and Lostwithiel. Some of the early directors, and particularly its secretary, Henry Ayers, did extremely well and lived in Adelaide. Although the majority of the miners came from Cornwall, there were also men from Wales, England, Germany, China and South America.

Mining, which had started in earnest after a three month strike by the miners over the company's assay procedures in 1848, and a two year interuption by the Victorian goldrushes, came to an end during the late 1870s when it became uneconomic to mine the poorer grades of copper.

Naturally, many of the miners and other workers who had depended on the mine left in search of other mines for employment. Many went to the Broken Hill or Moonta and Wallaroo mines or to some of the mines in the Northern Flinders Ranges such as Blinman or Sliding Rock.

Reactivated in the 1970s, it produced additional 24,000 tonnes of copper metal in a decade. Today it is open to the public as an open air museum, showing numerous buildings of the interesting mining history.

The Powder Magazine was built in 1884. There is a reconstructed Cornish engine house, called Morphett's Flue from 1860. Today it contains a comprehensive display on beam engines and engine houses. An excavated tunnel with access to the pumping shaft is the underground component of this mining museum.

Mittagong Mushroom Tunnel

Dr. Noel Arrold is founder of Li-Sun Exotic Mushrooms which houses itself in an abandoned railway tunnel originally built in 1886. Although the tunnel is still Australian state property,

Dr. Arrold secured himself a five year lease and re-fashioned it into a lovely mycological growing facility. Dr. Arrold has actually been growing mushrooms in the Mittagong tunnel for more than twenty years--varieties such as Shimeji, Wood-ear, Shiitake, and Oyster thrive there. The tunnel is 650 metres long, 30 metres deep and remains at a constant 15 degrees Celsius, fluorescent lights illuminate the space for 12 hours.

Charming Creek Railway

A converted tractor tows coal-filled wagons across a suspension bridge over the Ngakawau River in the 1940s. Coal was transported along this small bush railway from the Charming Creek mine to the railhead at Ngakawau between 1929 and 1958, but in later years it was trucked out through Seddonville.

The railway line through the Ngakawau gorge and the lower reaches of Charming Creek was hewn through solid rock, about 9 m above the river, and includes several tunnels and bridges. The largest is a 37-m suspension bridge across the Ngakawau River. Tractors modified to run on rails pulled the coal trucks.

The line from the mine to Ngakawau drops more than 100 m. To assist braking with a heavy load of coal, a raised wooden centre rail was installed in the steepest sections of the line; the brake was applied by winding a handle at the back of the engine.

The railway closed in 1958, and coal was then trucked to the railhead at Seddonville. The Charming Creek walkway now follows the line of the old railway, and is one of the most spectacular bush walks on the West Coast.

Wittenoom, Western Australia

Wittenoom is a locality in the Pilbara region of Western Australia about 1,106 kilometres (687 mi) north-northeast of Perth. During the 1950s, Wittenoom was the Pilbara's biggest town, but was shut down in 1966 due to health concerns from asbestos mining at the nearby mine. The mine was located inside a hill near natural water springs and overlooking the spectacular beauty of Wittenoom Gorge. CSR closed the mine in 1966, after 23 years of operation, and it was never re-opened. Today, more than 40 years on, the mouth of the disused mine is clearly visible in the hillside and the slagheap still stands.

Most of the workers were Italian immigrants who were keen to make money and get ahead in their new life in Australia. The tunnels of the mine were less than a metre high, and miners often worked in a kneeling or squatting position. The temperature regularly rose above 40 degrees Celsius in Wittenoom, and in the mine the heat was trapped. It was even hotter in the mill, a building of corrugated iron with poor ventilation, no windows and air thick with dust.

In Wittenoom asbestos tailings were used to cover roads, pathways and gardens, creating a permanent haze of dust. Many former residents of Wittenoom have died as a result of their exposure to asbestos dust there.

Today it is a ghost town with approximately eight residents who receive no government services. In December 2006, the Government of Western Australia announced that the town would be degazetted, and in June 2007, Jon Ford, the Minister for Regional Development, announced that the townsite status had officially been removed. The town's name was removed from official maps and road signs and the Shire of Ashburton is able to close roads that lead to contaminated areas.

Wittenoom was named by Lang Hancock after Frank Wittenoom (1855–1939) who was his partner in the nearby Mulga Downs Station. The land around Wittenoom was originally settled by Frank Wittenoom's brother, politician Sir Edward Horne Wittenoom.

Hancock discovered Wittenoom Gorge in the early 1930s and in 1937 started mining crocidolite (commonly known as blue asbestos) there. In 1943 the mine was sold to a CSR Limited subsidiary, Australian Blue Asbestos Pty Ltd. By the late 1940s, there was a need for a nearby townsite to house the mine workers and their families, and this was gazetted in 1950. The following year CSR requested the town name be changed to Wittenoom Gorge, and in 1974 it was changed back to Wittenoom.

From 1950 until the early 1960s Wittenoom was Australia's only supplier of asbestos with 161,000 tonnes being mined. During that time, 20,000 people lived and worked in Wittenoom. Since then, over 1,000 people have died from asbestos-related diseases including asbestosis, lung cancer and mesothelioma. The National Health and Medical Research Council estimates that the final death toll will eventually rise to over 2,000.

Christchurch–Lyttelton road tunnel

A road tunnel connecting Christchurch with the port of Lyttelton was completed in 1964. Before then, all road traffic went over Evans Pass on the Port Hills. This view is of the entrance at Heathcote, soon after the tunnel was opened. At that time motorists had to pay tolls to help cover the cost of the tunnel.

Mount Misery Underground Gold Mine & Gold Museum

Nundle is an archetypal small NSW country town, tucked away in gorgeous countryside of the upper Peel Valley near Tamworth. The Hills of Gold tag came about when alluvial gold mining was big here in the late 1800s. The ruins of old mine workings and equipment lie scattered about the valley floor and up the mountainsides to this day.

At the Mt Misery Mine, a quaint museum in Oakenville Street with lots of mining memorabilia and an old shaft you can explore, the ghost of Cranky Jack waits for visitors.

Located in a quaintly restored coffin factory, the museum reflects the glory of the old goldrush days. There is a 120-m underground mining tunnel, an old shaft, mining memorabilia, arts, crafts and antiques for sale. Gold panning equipment can also be hired here, but tread warily the ghost of Cranky Jack waits for visitors. Reportedly, he struck it big but was killed in the mine before he could claim his riches, the reason for his crankiness.

The Bennelong Stormwater Channel

The Bennelong Stormwater Channel is of high historical and technical significance as it was one of the five original combined sewers built in Sydney around 1857. The other four sewers were; Blackwattle Bay, Hay Street, Tank Stream and Woolloomooloo.

These five sewers were responsible for greatly improving public health, hygiene and living standards for the city's residents. This was done by diverting stormwater and sewerage from the streets and discharging it out into the Harbour currents. The introduction of BOOS in 1889 diverted sewer flow to the ocean and eventually led to the drain being used predominantly for stormwater, hence further improving public health. Of the five combined sewers, Bennelong is probably the most significant as it is the most intact and was originally known as the "main sewer" because it serviced the CBD area. It was also the first oviform sewer to be built in Australia. Furthermore, the Margaret Street Sewer, which was once attached to the Bennelong system, contains the first sewer aqueduct to be built in Australia. This aqueduct runs along Hunter Street, which is part of the Bennelong catchment.

The system was a combined sewer/stormwater drain. It is oviform in shape with dimensions of 1.5m x 1.2m. The system was made of brick and some sections were tunnelled in sandstone along Tarpian Way (Circular Quay East). This Stormwater channel drains the Sydney Cove Slopes to as far south as Bathurst Street. and extending generally from Macquarie Street in the east to York Street in the west. In total an area of about 65 hectares. The most upper stream point is at the Obelisk ventshaft at Hyde Park. From here it works its way down along Pitt, Castlereagh, Elizabeth, Phillip and Macquarie Streets to the outlet at Bennelong Point. The channel contains the following branches; Macquarie Street, Phillip Street, Elizabeth Street, Castlereagh Street and Pitt Street. The Macquarie Street Branch was originally constructed by the old city council in 1856. In 1916 it was reconstructed during the construction of the City Railway. Modifications were also made to the channel in the early 1970's for the construction of the Opera House and during the late 1980's for the building of the Harbour Tunnel.

In 1842 the City Council was formed to,among other things, establish a drainage system for Sydney. The Tank Stream, Sydney's first water supply, had by the 1840's become composed of foul water. This lead to the spread of disease and realisation that combined sewers needed to be constructed to take the place of polluted surface streams. Around 1857 the construction of five combined sewers commenced in order to dispose of the city's stormwater and sewage into the Harbour. This project was initially undertaken by 3 city commissioners (appointed in 1854) and then completed by the city council.

Bennelong sewer was the main sewer of these five, as it was built to service the Central Business District. The majority of the sewer was completed in 1856 by the old city council, the exception being the Pitt Street Branch which was completed in 1857. It was probably the first of the five combined sewers to be completed. By the 1870's the Harbour was becoming extensively polluted from the discharge of stormwater and sewage, this lead to the formation in 1874 of the Sewerage and Health Board. The Board's principle task was to draw up a scheme to intercept the sewerage entering the Harbour. One of the schemes formulated was the Bondi Ocean Outfall Sewer (BOOS) which would intercept most of the combined sewers discharge. In 1889 the BOOS was completed by the Government and this diverted the flow of sewage from all levels above the gravitatable limit to the ocean. Later around 1900 sewage pumping stations were introduced to divert sewage from low lying areas into the BOOS. Consequently, the volume of sewage in the combined sewer gradually diminished until the Bennelong channel was eventually used predominantly for stormwater.

The construction of the system was possible because of the wealth earned by the government from the Gold Rush of the mid nineteenth century.

Otira tunnel opening

A crowd gathers to celebrate the opening of the Otira railway tunnel on 4 August 1923. At the time the 8.5-km tunnel, which completed the important transalpine rail link between Christchurch and Greymouth, was the longest in the Southern Hemisphere and the sixth-longest in the world.

The opening of the 8.5-km Otira tunnel on 4 August completed the transalpine railway between Christchurch and Greymouth. Tunnelling work had begun in 1908, but the project was plagued by engineering problems and labour shortages. Due to the tunnel's length and steep gradient, electric locomotives were used to haul trains through it.

From the 1920s to the 1960s popular Sunday excursions were run from Christchurch to Arthurs Pass and Otira. Today, the line is a vital route for carrying West Coast coal to Lyttelton for export, while the TranzAlpine passenger train has become a thriving tourist operation, carrying 200,000 passengers a year across the Southern Alps.

Leighton Battery Freemantle

As part of Australia's coastal defence during World War II, the Port of Fremantle, Western Australia was defended by a series of gun emplacements, one of which was the Leighton Battery, north of Fremantle. This site has been preserved and restored by the Royal Australian Historical Society of Western Australia and is open to the public for tours.

Work began on the tunnels in 1942 in response to the fall of Singapore, Japanese attack on Pearl Harbour, bombing of Darwin, and no doubt, the sinking of the HMAS Sydney. With what appeared nothing stopping the Japanese at the time, there was grave concern that Fremantle would likely be a target for the next Japanese attack.

The tunnel system is carved from solid limestone and is quite extensive, totalling over 300m in length at an average depth of 10 metres. The tunnels were originally designed to service two 6 inch guns, hence there is two ammunition magazines and shell hoists.

The original two 6 inch guns were soon replaced by 3 brand new emplacements of 5.25 inch guns. The new guns were capable of both seaward firing and aerial(anti-aircraft) firing. These were installed in 1945 towards the end of the war and did not become fully operational until 1948. Despite the end of the war, the guns were still used for Regular Army and Army Reserve training purposes until 1963.

In 1963, the Coastal Artillery Branch of the Royal Regiment of Australian Artillery was disbanded. The guns and associated equipment were deemed obsolete. Guns were cut up and sold off for scrap. The tunnel entrances were bulldozed closed and very little else happened on the site until the army eventually sold the land. In the late 1980's developers decided the site would be used for housing with the exception of the small area containing the tunnels and guns emplacements which was to become a reserve and public open space.

Stairs leading down to tunnels.

Underground brick lined corridor of Leighton Battery.

Magazine #1 now has a display of various ordinance.

Hand operated ammunition/shell hoist.

Bullet hole damage to walls. The tunnels were used by the SAS for live firing exercises in later years.

Aerial photo of the Leighton Battery site in 1947.

Aerial photo of the same site taken in 2006.

OLD PICTON TUNNEL

The Picton-Mittagong line was originally built to extend the Main Southern Line. The line originally ran westwards from Picton Station, over the Picton Viaduct, across the Great South Road, thence through a 592 foot tunnel in the Redbank Range and turned southwest.

The original Picton tunnel was opened on 28 February 1867 and used for over 50 years until the double track was constructed.

In 1919, the main railway shifted eastwards to an alignment with 300 metre radius curves and much easier 1 in 75 grades; the track was also duplicated. The old line and stations continued to be used for passenger services until 1978.

The Picton loop line originally had a different (more easterly) alignment between Hill Top and Colo Vale. The old alignment is now actually the road.

A stone culvert crosses under the old embankment at the bottom of a high embankment. it is known locally as the convict tunnel, as broad arrow marks can be seen in the stonework. The old coach road ran parallel and crossed the same creek leading to an inn, of which only marks on a paddock remain.

Warrandyte Diversion Tunnels

The first recorded official discovery of gold in Victoria was at Warrandyte together with one in the Pyrenees, both declared on July 16, 1851.

The Warrandyte discovery was made by Louis Michel and his team. A cairn has been erected at the spot in Anderson's Creek and the locality was named The Victorian Goldfield in honour of the new colony of Victoria which had been inaugurated on July 1, 1851

Alluvial gold, discovered in the gullies in July 1851, was almost depleted by the end of that year. The search was revived in 1854 when prospecting began in the Yarra River and tributary creeks. This resulted in the diversion of the river at Thompsons Bend (The Island) in 1859 and through the Pound Bend tunnel in 1870

On February 8 1870 a public company named the Evelyn Tunnel Mining Company was formed. The object was to create a tunnel through the narrow section where the Yarra River turns back on itself and divert the river through it. This left five kilometres of river bed which could be mined for alluvial gold.

The tunnel took three and a half months to build. It is 196 metres long, sixmetres wide and four metres deep. The company encountered many problems, including having to remove up to 14 metres of silt prior to sluicing. The returns approximated the costs involved and as a result the company never paid a dividend and was wound up in September, 1872.

Trek through historic tunnel

The 2010 Trek the Trail will take participants on an eight-kilometre route featuring the historic Swan View Tunnel.

The 340m railway tunnel was completed in 1895 and was the only tunnel built for the Western Australian railway network prior to the construction of tunnels for the Mandurah line in 2004.

Trek the Trail is an annual event organised by the Shire of Mundaring, in conjunction with the Mundaring Visitor Centre, Mundaring and Hills Historical Society and Mundaring Arts Centre.

This year it will be held on Sunday 19 September, starting near the Parkerville Hall and finishing at the Swan View Station. A free courtesy bus service will transfer participants to the start point from Parkerville Oval and run all day between Swan View and Parkerville.

Now in its seventh year, the Trek is held on a different section of the Railway Reserves Heritage Trail each year in an effort to promote the Hills' beautiful trails, environment and significant history.

Shire President Helen Dullard said the Trek was one of the Shire major annual events. "This year's route will include Hovea Railway Platform, Hovea Falls, National Park Falls, the wooden trestle bridges, Swan View Tunnel, finishing at Swan View Station.

Trek the Trail also has a new look, in conjunction with a new marketing campaign to promote the Railway Reserves Heritage Trail. While the website address remains the same, the Trek information is now located within the Railway Reserves Heritage Trail website.

SU opens WWII tunnel — Phillipines

Talk of tunnels dug by Japanese soldiers under Silliman University's (SU) old buildings during the second world war have been running rife among treasure hunters seeking Japanese booty for many years, until the university in Dumaguete City decided to go public about it on Wednesday.

With an ambulance on standby, a team of laborers from the university, assisted by police SWAT and Bomb Squad units, gathered at the Hibbard Hall to have a look at one of its closely-guarded secrets from the war years.

Built in 1932, the Hibbard Hall was used during the World War II by Japanese soldiers, who dug a tunnel beneath it. This tunnel is said to connect to other old buildings in campus. Another tunnel inside Silliman campus, under the historic Guy Hall, was dug up by the University with the help of treasure hunters in 2008. The Guy Hall, built in 1918, was also used as a Japanese garrison during the second world war. All they found was the skeleton of what was believed to be an American soldier. Another previous digging in the mid-1990s underneath the University Cafeteria revealed unexploded bombs, which the police deactivated at the Bayawan City Sanitary Landfill.

These tunnels, though, had been sealed shut by previous administrations for unknown reasons, although some rumors of secret diggings by University personnel had been reported from time to time, usually timed with major building renovations or repairs. This is the first time that the University has asked the media to document the digging.

"We will dig and check this tunnel because we want to find out if the area is suitable for a vault which will house the records of the registrar's office," Dr. Nicol Elman, director for university security, said.

A worker then drove a sledgehammer on the bottom portion of a tiled wall of the women's comfort room, revealing a step of a cemented stairway leading downwards.

Built in 1932, the Hibbard Hall was used during the World War II by Japanese soldiers, who dug a tunnel beneath it.

The workers also broke part of the wooden floor of the adjacent room housing the Student Affairs Office, to reveal the beginning of what seemed like a spiral stairway to the tunnel.

But which way did the stairs go--left, right or straight down? "We don't have anyone to ask because the people who dug this up before have either died or have left Dumaguete," Edgar Ygnalaga Jr., head of the University's Buildings and Grounds Department, said.

From a distance, representatives of treasure hunters were watching the progress of the diggings. "If they only asked us, we could have done it faster," one of them, who did not want to be identified, said, but added that with so many people around, especially the police, no treasure hunter would want to even get near the site. "There are too many people to share with," he said, apparently referring to the prospect of finding buried treasure in the tunnel.

Wednesday ended without any progress in uncovering the tunnel's stairway. Little progress was reported on Thursday, with laborers exploring other areas to dig.

Silliman Information Officer Mark Raygan Garcia said they still don't know exactly where to dig. "We're still locating the pathway to the area," he said in a text message.

Progress might be made this week, when the digging continues. But this would definitely leave more people wondering, how many other tunnels are there beneath Silliman University?*AP

Kingdom's Thames Tunnel opens then closes for good

The Thames Tunnel, the brainchild of engineering geniuses Marc and Isambard Kingdom Brunel, opened to the public in April for the first time in 145 years. Opened in 1852, the tunnel gripped the nation's imagination: nothing had been seen like it before and it paved the way for the present day Tube system.

Lying deep beneath the River Thames, it is one of the Brunels' greatest engineering triumphs — and the only project they worked on together. The tunnel is 1,300ft long and, by the end of the first week of opening, more than half the population of London had paid to walk "the shining avenue of light to Wapping". There is a sad twist to the tale, however. The East London tube line is being opened later this year and will be going through the tunnel. That means, at the end of the two days, the tunnel will be closed — forever

Brunel's tunnel was the first under a river anywhere in the world. Victorians would come to fairs down here, with people selling items from the arches between the two carriageways. Even on foot in the middle of the tunnels, it's hard to imagine stalls between these small spaces. But the tunnel would have looked vastly different then — lit by gas and reflecting off fresh, clean brickwork — and no rails in the way. It was a commercial failure, and was later sold for railway use — with Victorian steam moguls eyeing this up as part of a route to the continent — via Baker Street, the Circle Line, and New Cross.

From May, it rejoined to the mainline once again, but to Croydon rather than Calais.

New Jersey War Tunnel exhibitions marking liberation

Two new exhibitions to mark the 65th anniversary of Jersey's liberation from Nazi occupation, which have cost a total of £300,000, will open next week.

"Resistance" and "Liberation", will be unveiled at the Jersey War Tunnels on Monday.

They aim to give greater insights into the issues and hardships experienced.

The exhibitions will feature stories and points of view of the UK Government, the island's government, occupiers and Jersey people.

They are designed to give authentic and balanced accounts of the actions and decisions of all those affected by the occupation, managers said.

The tunnels, formerly an underground hospital, are a permanent reminder of the German occupation of the island which lasted almost five years until the liberation on 9 May 1945. The tunnel complex now hosts a series of galleries detailing the occupation.

The Jersey War Tunnels attraction was formerly an underground hospital.

Engineering and Mining Surveying Commission SA

The Engineering and Mining Surveying Commission SA is the commission that represents the interests of Engineering and Mining Surveyors in South Australia. Our aim is to promote the Institute to Engineering and Mining Surveyors and to raise the public profile of Engineering and Mining Surveyors to the general public.

Engineering Surveyors carry out various types of work which include Topographic Surveys for road design, house design and other Engineering works such as manufacturing plant, Infrastructure such as pipelines etc. An Engineering Surveyor will also be expected to survey and set out points for construction of houses, multi-storey buildings, roads, engineering works and pipelines. An Engineering Surveyor will be expected to be able to use a Total Station electronic theodolite with electronic field book capabilities, a differential and real time kinematic GPS or GNSS system as well as utilising computerised CAD facilities and Surveying Software solutions.

Mining Surveyors carry out various types on Mining Surveying both underground and open cut. They can work with a big Mining company such as BHP and survey control both above the ground and below the ground and provide information to a complete Mine Management System, compute volumes of ore, stockpiles etc. Working underground involves specialised equipment and techniques to work in with such things as enclosed spaces, trucks and vertical drops. This can involve surveying in control marks and placing them on wall or overhead. Safety is vitally important and an Underground Mining Surveyor will provide 3D spatial information which is vital to Mine planning. A Surveyor working in an Open Cut mine can be expected to measure volumes of a Mining Campaign and this can be done using Total Station, GPS or, becoming more common, a Laser Scanner.

Most companies that utilise an Engineering or Mining Surveyor will expect a minimum of Associate Diploma level tertiary education and an ability to work in remote areas and out of the way places. A good grasp of Mathematics and Geography will certainly be an advantage.

The institute will be working with it members to promote professional development and certification of members to ensure a high quality of work and safety.

As the current Commission Chair, I am interested in feedback from members to ensure the commission stays up to date with the latest developments and is looking after the requirements of it members.

Grantley David Leith

Beneath Hill 60

The story of the Australian miners and soldiers who tunnelled under Hill 60 near Ypres and eventually broke through to create a new frontline and enable the march to Berlin.

We all remember images from WWI of massive artillery barrages and soldiers crossing shattered landscapes towards certain slaughter. Beneath these killing fields of the Western Front, another war was taking place, a deadly game 30 metres down, played between thousands of troops. These were not infantrymen, but miners. Their mutual goal was to tunnel beneath 'no man's land', under the opposing lines and destroy the German enemy from below. Unfortunately, the Germans had the same idea and were digging in from the other side.

Over 4585 Australian miners took part in this secret subterranean war, fighting under stress and conditions that terrified even the most hardened infantryman on the surface.

To coincide with ANZAC Day, the action packed story of Australia's cat-and-mouse underground mine warfare — one of the most misunderstood, misrepresented, and mystifying conflicts of WW I was told onscreen. This film tie-in book told the story not only of this secret struggle beneath the Western Front that combined daring engineering, technology and science, but also shared the exhilarating and horrific adventures of other soldiers and miners working along the front line.

Few on the surface knew of the brave, claustrophobic and sometimes barbaric work of these tunnellers.

The 1st Australian Tunneling Division was responsible for the mines set under 'Hill 60', a high point that dominated that part of the killing fields of Belgium. They were led by Captain Oliver Woodward who had started his mining career in Charters Towers, Queensland and went on to head BHP in Australia. His bravery and that of his men in guarding those underground mines and their subsequent massive explosions broke the gridlocked trench warfare that had continued for 3 years.

Through exhaustive research, Will Davies, has uncovered first-hand accounts of life for the tunnellers and soldiers at the front. In sharing their hopes, dreams, victories and disappointments he tells the broad story of day after day in the mud at the front line and uncovers the glorious spirit of these men who fought and died for their countries.

Beneath Hill 60 is an unforgettable story.

Northgate Stawell Gold Mine Emergency Rescue Team Wins 18th Annual Underground Mine Rescue Competition

Victoria's Northgate Stawell Gold Mine Emergency Rescue Team has narrowly defeated seven other teams from across the country to win the prestigious Annual Victorian Underground Mine Rescue Competition, proudly sponsored by WorkSafe Victoria.

Stawell finished in the top three in five of the seven competition exercises, demonstrating consistently high emergency response skills. Second place was the Cadia Valley Operations Emergency Response Team (NSW) and in third place was MMG Rosebery Emergency Response Team (Tasmania).

The participating teams competed in exercises in Bendigo over the weekend of August 6th -8th testing emergency response theory, rescue skills, first aid, breathing apparatus, fire fighting, search and rescue and rope rescue capabilities. Exercises were adjudicated by industry and emergency response professionals in realistic potential emergency situations.

MCA Assistant Director for Safety and Health, Ms Megan Davison said: "The Underground Mine Rescue Competition provides practical training experience to members of mining operations, encouraging them to apply teamwork to build skills that are vital to these specialised emergency rescue teams".

"Every year this highly regarded national competition is oversubscribed with teams being placed on a waiting list in the event that another team has to pull out. The competition is designed to improve the safety and health of all people involved in the mining industry and to provide realistic and practical training to the mine site rescue teams".

"The competition fosters strong team spirit, competitiveness and goodwill among the rescue teams as seen with 300 people attending the presentations on Sunday night. I congratulate all team members for their spirit of competitive goodwill and their commitment to emergency response."

"This competition is an important part of the MCA's health and safety strategy. Our goal of zero fatalities and injuries remains the minerals industry's number one value and commitment."

In presenting the overall winner's prize, Mr Tim Gosling, representing the competition Major Sponsor — WorkSafe Victoria, said "The emergency response volunteers should be very proud of their commitment to safety in the workplace and the leadership that they provide."

"While we hope they never need to use the skills they practised over the weekend, we take comfort from the knowledge they are there to respond," he said.

The teams that competed in the 18 th Annual Victorian Underground Mine Rescue Competition were:

- Bendigo Mining/Oscar1 Combined Mine Rescue Team (Bendigo Mining Ltd/CFA)
- Cadia Valley Operations Emergency Response Team (Newcrest Mining Ltd)
- CMPL-CSA Cobar Mine Rescue Team (CMPL-CSA Cobar)
- Fosterville Gold Mine Emergency Response Team (Northgate Minerals)
- Northparkes Emergency Response Team (Rio Tinto)
- Rosebery Emergency Response Team (MMG)
- Savannah Nickel Mine Emergency Response Team (Panoramic Resources)
- Stawell Gold Mines Emergency Response Team (Northgate Minerals)

The Minerals Council of Australia congratulates all the competitors in this year's competition and acknowledges the very strong support from the sponsors and volunteers from across the industry.

ATS Melbourne Group Report

Since the January 2010 report, the Melbourne Group has conducted the following technical sessions.

- 18th March 2010
  Bogong Power Development Project, presented by Russell Rooney from McConnell Dowell.
- 28th April 2010
  Northern Sewerage Project, Brearley Reserve Shaft, presented by Ben Clarke from John Holland Tunnelling.
- 30th June 2010
  The Story of Florence and Matilda, presented by Michael Huber from Baulderstone.
- 25th August 2010
  Tunnelling at OK Tedi Mine, presented by Nigel Sugden from Mott MacDonald Australia.

All sessions have been well attended with over 30 at all sessions. This has been a very pleasing trend, with many new faces present each time.

The April session was ably presented by a young engineer from John Holland and this proved to be a draw card with an increased number of younger people attending for their first time. Hopefully this will be reflected in increasing membership numbers.

The June session exceeded expectations with over 60 in attendance, with a number from State Government, a sure sign of an increasing level of tunnelling activity in Melbourne in the near future.

The program for the remainder of the year is as follows.

- 20th October 2010
  Who is responsible for Ground Support selection?

  The Melbourne Group will also hold its AGM on this evening prior to the technical session.
- 23rd November 2010
  The state of Underground mining in Victoria, Tasmania and South Australia.

I would like to formally record my thanks to the Melbourne committee for their ongoing support and dedication to providing a valuable service to ATS members in Victoria.

Ed Taylor
Chair, Melbourne Group

ATS Sydney Group Report

The Sydney Group Committee has held three technical sessions which have been reasonably well attended:

- 21st April
  Steel Fibre Reinforced Concrete presented by Alan Ross (BOSFA) following his recovery from an arachnid attack.
- 16th June
  Florence and Matilda (TBMs CLEM7 Tunnel) presented by Michael Huber.
- 18th August
  Remote monitoring systems for tunnel projects in CBD Areas presentated by Ronan LeRoy (SolData Limited).

The following technical sessions are scheduled for the remainder of the year:

- 20th October
  Tunnel power supplies, design and installation, presented by Mark Apthorpe (Rutherford Hire International).
- 8th December
  History of Tunnelling in Australia, presented by David Lees. Hopefully this will provide a valuable platform for the promotion of David's book

At present there is very little tunnelling activity in Sydney. The current State and Federal political climate has had and continues to have a substantial impact on the likely status of tunnelling infrastructure projects in the short term; we wait with bated breath.

The Sydney Group is currently planning technical sessions for 2011 and exploring the feasibility of holding breakfast technical seminars on specific design and construction issues. The possibility of hosting evening debates on topical tunnelling issues (similar to those organised by the British Tunnelling Society) is also being considered.

Paul Roberts
Convenor, Sydney Group

ATS Brisbane Group Report

Tunnelling activity continues at intense levels in Brisbane in 2010. The first of the TransApex tunnels, the Clem7 opened in March this year, the second project Airport Link Northern Busway is at the halfway mark and a contract award is imminent for the Northern Link project. Combined, those 3 tunnelling projects have a contract value around $8B. Following these is expected to be the $8B Cross River Rail project where detailed engineering studies are in progress and a go-ahead is anticipated late in 2011.

Our monthly technical sessions continue to attract audiences of between 80 and 120.

Date	Title	Speaker	Sponsor
March 2010	Melbourne's Utility Tunnels	E Stamatopoulos, John Holland	John Holland Tunnelling
April 2010	Constructing the Bogong Hydro Power Project	Brendan Hayes McConnell Dowell	McConnell Dowell
May 2010	City West Cable Tunnel, Sydney	Christian D'Hondt, Thiess	Thiess
June 2010	State of the Art Tunnel Formwork Systems	Aldo Ceresola, CEO of Ceresola	Ceresola
July 2010	Geological Considerations for TBM selection	Karin Bäppler, Herrenknecht	Herrenknecht
July 2010	The Electrics of the Clem7 Tunnel	Bryan Cheetham, United Group	ATS/ITEE
September 2010	Geological Constraints and Geotechnical Issues in Mechanised Tunnelling	Dr Paul Marinos, the 2010 Jahns Distinguished Lecturer	Jacobs Associates & BOSFA
September 2010	Geotechnical and Contractual Interaction	Prof Arnold Dix, Chairman, ITA Contractual Practices Group	Bamser

In addition to the technical sessions, our local committee meets half yearly and also publishes half yearly newsletters. Engineers Australia Queensland continues to support us by providing a superb venue for our technical sessions and also a videostreaming service via their EAQ website. An Industry Golf Day has also been organised for September.

Our local ATS committee comprises:

Andrew Day, Thiess (Chairman)	Alex DeAboitiz, City North Infrastructure	Charles MacDonald, BrisConnections
Scott Keniston, Bamser (Secretary)	Andrea Edney, Leighton	Jeremy Kruger, TJH
Alan Robertson, AusRocks (Treasurer)	Doug Maconochie, Parsons Brinckerhoff	Simon Strong, Herrenknecht
Warren Mahoney, BASF	Paul Wallis, Arup	
Craig Roberts, BOSFA	Matthew Norbert, GHD	

Andrew Day
Chairman Brsbane Group

ATS WA Chapter Report

Since last report in March, the WA Chapter held or is planning the following technical sessions:

- 27 July
  "Inspection and maintenance of tunnels and underground concrete structures" Joint event with Concrete Institute of Australia. Speakers Steve Doran (London) and Frank Papworth. 45 attendees.
- 10 August
  "Diaphragm Walls" speaker Ronan Leroy, Bachy-Menard. Joint session with AGS. 50 attendees
- 25 August
  Tour of Leighton Battery World War 2 Tunnel Complex. 15 attendees (tour size limit filled in 2 days, second group planned for later this year)

- 10 September
  Minibus tour to Binningup Desal 2 site approx 1.5 hrs south of Perth and inspection of TBM pipe jacks tunnels for ocean intake and outfall tunnels and plant site.
- 26 November
  Tour of Fremantle Prison Heritage tunnel system

The Public Transport Authority of Western Australia **Perth City Link Rail Project** involves lowering the Fremantle rail lines into cut and cover tunnel to some 0.7m above the existing Joondalup line bored tunnels, followed by lowering of the Wellington Street Bus Station underground to enable redevelopment of the Perth Rail Yard land for public open space, residential and commercial towers and other civic purposes. The first stage of the project, lowering the rail lines, is into alliance tendering mode, with two selected consortia due to be announced early in September at the start of a competitive Alliance TOC phase. The TOCs are due to be submitted by Christmas with an Alliance partner to be announced by March 2011 for commencement of the project. Completion is scheduled for 2014.

The Desal 2 Project at Binningup, about 1.5 hours' drive south of Perth is well underway. It will supply water to Perth, as well as the nearby regional city of Bunbury. It is designed to initially deliver 50 gigalitres of potable water per year or 20% of Perth's requirements. Capacity may be increased to 100 gigalitres/year at a future date. The project will deliver potable water into the South West Integrated System via a 30 km 1.3m diameter pipeline to a storage facility near Harvey. It is expected to be operational in 2011.

The site is located at about 1.2km from the coast with most of the plant situated in a now disused limestone quarry. The intake and outlet pipelines from the plant to the beach and under the ocean are being constructed using two tunnel boring machines and using both tunnelling and pipejacking technology to cover a distance of about 900m. One of the 2 TBMs has completed its 700m long tunnel under the sea and the other is scheduled to complete mid to late September. The project is being undertaken by the Southern SeaWater Alliance and the Water Corporation (SSJV) and the tunnelling work is being undertaken by Zueblin Australia Pty Ltd.

Your WA Chapter Committee comprises 6 members and meets monthly. The Chapter has 72 individual members plus 5 company memberships registered in WA. Keep an eye on the ATS website for future event details.

Eric Hudson-Smith
WA Chapter Chair

ATS New Zealand Chapter Report

Committee

The committee members for 2010 are:

Chair	Evan Giles — Parsons Brinkerhof NZ
Treasurer	Rory Bishop — Mc Connell Dowell
Secretary	Bill Newns — Aurecon
South Island Rep	Charlie Watts — Meridan Energy
South Island Rep	Ron Flemming — URS NZ Ltd
Member	Keith Dickson — Tankin & Taylor
Member	Tom Ireland — Aurecon
Member	Andi Padrutt — BASF
Member	John Cooper — AECON
Member	Bert Fourie — Fourie Tunnelling

Evening Meetings

There have been fewer technical evenings held to date this year. Towards the mid year, Tom Ireland gave a presentation on the construction of the Hindhead Tunnel in the UK. Discussions on shotcreting and waterproofing during the question sessions were vibrant. The visuals Tom used in the presentation were excellent and provided good detail of some aspects covered. Earlier in the year the tunnelling fraternity were entertained by Dr Roalf Winterberg (Maccafferri), who spoke on the use of steel fibre reinforcement in tunnel segment design. This too was supreme talk supported by excellent visuals.

Obituary

We record with sadness the passing of Iain Macleod who served on the committee as owner representative on behalf of Watercare Services Limited. We are thankful for Iain's solid contributions to the committee and express sincere condolences to his family.

ATS Conference 2011

The upcoming conference is the main activity driver for the committee at present and actions are steadily increasing. A monthly meeting is held with a telephone link to AusIMM in Australia. Sponsorship is progressively building up with 2 gold, 1 silver and 1 bronze sponsors confirmed as well as some booths and individual events such as dinner and welcome drinks. There is ongoing work underway to obtain more support.

Over 100 abstracts were received and draft papers are due at the end of September. Based on this excellent response, the conference was changed to a three day event with a half-day pre-conference workshop on Sunday 6 March 2011. The conference will run from Monday to Wednesday. The venue will be the Sky City Conference Centre in downtown Auckland. The facilities are good, with voluminous display areas well suited for wandering during a finger-lunch. Sky-City Hotel and hotels in the immediate environs provide ample accommodation.

Evan Giles
NZ Chapter Chair

Australian Shotcrete Society — AuSS

Shotcrete Guideline (2nd Edition)

Actual Title "Recommended practice — Shotcreting in Australia"

The 1st edition was very well received as "the guide book" to shotcreting in Australia, however several contractors and industry practitioners had asked if some additional fields could be incorporated in the next 2nd edition.

After the July 2010 workshop in Sydney , all editing and amendments were done and the draft 2nd edition sent to the publishers .

The final editing is done and publishing of the new 2nd edition should also be done. The new 2nd edition should be available this month via the CIA website.

International Shotcrete Conference — EDS 2010

The International Conference — Engineering Developments in Shotcrete , or EDS 2010 was held in Queenstown , New Zealand on the 15-17th March 2010.

The conference was a great success, both in technical content, numbers and financially for the AuSS. The number of registrations totaled 117 which was just below our maximum of 120 people. A total of 35 papers were presented over the 3 days , which allowed sufficient time for good question and answer sessions . The final 1 hour forum debated where the Society should focus in the future and the needs of the industry in the future. Training was a particular priority among the participants , ranging from consultants, contractors and suppliers.

Activities in brief

The Welcome event on the Sunday evening in the Millenium Hotel comprised a local Maori welcome followed by canapés and drinks. Everyone met friends and collegues old and new.

The main dinner on the Monday evening was a well organized trip up the river on very fast jet boats , to a magnificent sheep farm. A demonstration of the skills of both the shepherd and the sheep dogs in shepherding sheep into a holding pen ensued. Members of the AuSS committee also attempted to round up the sheep into a coral, but failed miserably. It did provide great comic relief for the onlookers, and exhaustion for the participating committee members.

A delicious 3 course meal was then served followed with a dance band in a local barn , properly decked out of course for the evening. Excellent NZ wines of the red and white variety assisted in the great party atmosphere.

Tuesday night was the historical pub crawl in two teams A & B , with lively networking the order of the day.

Although there has not been an AuSS meeting to confirm the financials and the future expenditure in the coming years, the initial forecast showed that the conference itself showed a net profit of over $57k, which was an excellent result. Add the sponsorhip and exhibitor revenues and the final net result will be a very healthy profit indeed.

The next AuSS meeting in Sydney is the 20st September where the future focus, strategies and expenditure of the AuSS will be determined by the national committee.

Regards

John Gelson
Shotcrete Group Representative

THE DAVID SUGDEN YOUNG ENGINEERS WRITING AWARD 2011

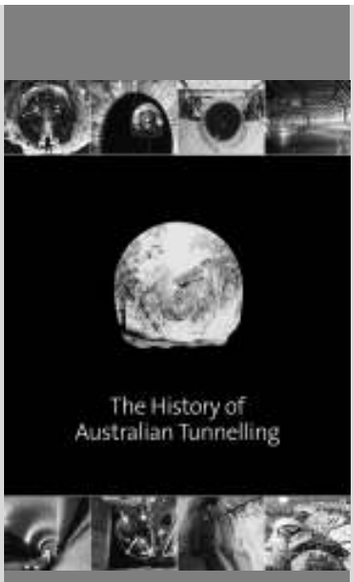
SPONSORED BY ATS

Win a chance to attend the 2012 ITA World Tunnel Congress in Bangkok, Thailand with accommodation

- The competition is open to all ATS Members and University Students under 35 years of age (as at 30 June, 2011)
- The task is to write a technical paper on any subject related to tunnelling and underground construction — not less than 2,000 words and not more than 5,000 words.
- Best paper to be judged by the ATS Executive Committee.
- Closing date 30th June 2011
- Winner announced by 31 August, 2011
- The prize includes complimentary conference registration fees and $2,000 towards personal travel and accommodation costs at the ITA World Tunnel Congress to be held in Bangkok, Thailand from 18–23 May 2012.

The winner may also be invited to be a member of the ATS Executive Committee for 12 months as the Young Engineers Representative.

For more information contact Sheryl Harrington at the ATS Secretariat
Phone 1300 653 113 — Email: sharrington@engineersaustralia.org.au



The History of Australian Tunnelling

A colour publication by the Australasian Tunnelling Society

Over 150 pages of unique Australian tunneling projects from early 1800s to projects completed in 2009

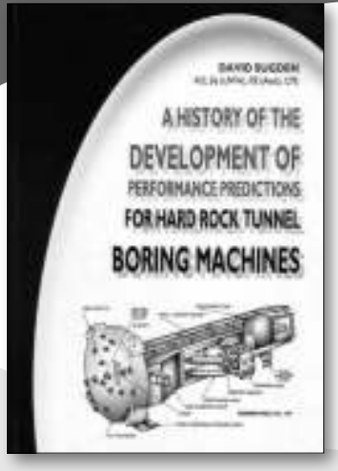
The book provides unique insights in the construction of water, sewer, cable, road and rail tunnels, underground storage and defense facilities.

The book also includes a comprehensive database of nearly 300 tunnelling projects.

The book is available from ATS Secretariat Narelle Folkard at Engineers Australia for $95 +GST

ATS First Publication

A compilation of technical papers by David Sugden AO



The history of the development of performance predictions for hard rock tunnel boring machines.

Only $95

+ postage and packing

14th Australasian Tunnelling Conference 2011

Development of Underground Space

8 – 10 March 2011, Sky City, Auckland, New Zealand

The race is on!

- **Over 100 abstracts received!**
- A great sprinkling of international submissions and a wide variety of topics and issues will be presented.
- Keen interest from the industry suggests a multitude of suppliers, constructors and designers will exhibit at the event.

The Conference Organising Committee is working hard to meet the raised expectations of a fuller, more meaningful conference to mark the start of the Second Decade of the 21st Century and to set a standard for the 2014 ITS Conference in Sydney.

We have the highest of expectations insight for all presenters and excitedly begin the countdown! We encourage all tunnelers, infrastructure owners and developers, and users to mark their diaries for 8-10 March 2011 in Auckland and contribute. We look forward to welcoming you and facilitating a network fiesta with ample exposure to the state-of-art of developing the underground.

Keynote Presentations

- **Professor Giovanni Barla, Turin Polytechnic University** never fails to infuse his audience with his enthusiasm and love for underground soil/rock mechanics and we look forward to his address.
- **Alan Morris, Project Manager for the XRL Tunnels , Mass Transport Railway Corporation, Hong Kong** will provide an overview of tunnelling in Asia while also outlining his views on where our industry finds itself in terms of technical developments.
- **Professor Arnold Dicks**, Chairman of the ITA Contractual Practices Group and Australian delegate to PIARC in tunnel ventilation, safety and environment will address operational issues in particular in vehicular tunnels.

Sponsorship

Showcase your business at the Conference by sponsoring the event. The sponsorship package contains a variety of levels and should you wish to discuss any of the levels, develop a package to suit your budget, or if you have any enquiries, please do not hesitate to contact event management.

Trade Exhibition

A Trade Exhibition will be held in association with the event. The exhibition will provide an excellent opportunity for companies to display their products and services to the participants.

Tours

Start or finish your Conference experience with scheduled tours of the Auckland region. Tours will include Conference related sites and tours of indulgence.

Pre Conference Master Class

An opportunity for immersion into European thinking and approaches with Giovanni Barla, Turin Polytechnic University.

Event Management: The AusIMM

For further information including sponsorship and exhibition opportunities, please contact:
Belinda Martin, Senior Coordinator, Conferences & Events, The AusIMM
Telephone: +61 3 9658 6125 | Email: bmartin@ausimm.com.au

Co-hosted by

Australasian Tunnelling Society

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www.atstunnellingconference2011.com

ITA COSUF AWARD

ITA COSUF
ITA Committee on Operational Safety of Underground Facilities

The ITA COSUF award is granted annually to students/young researchers who have recently completed an outstanding research work in theory and/or practice in the area of safety and security of underground facilities.

The winners of the award are selected by the ITA COSUF steering board. The award will be ceremoniously presented and handed over by the chairman of the ITA COSUF at an event of the ITA COSUF. The chairman will outline the reasons for the decision and will honor the winner. The award consists of a certification, a medal and Euro 500 in cash. The award winning work will be published on the ITA COSUF website.

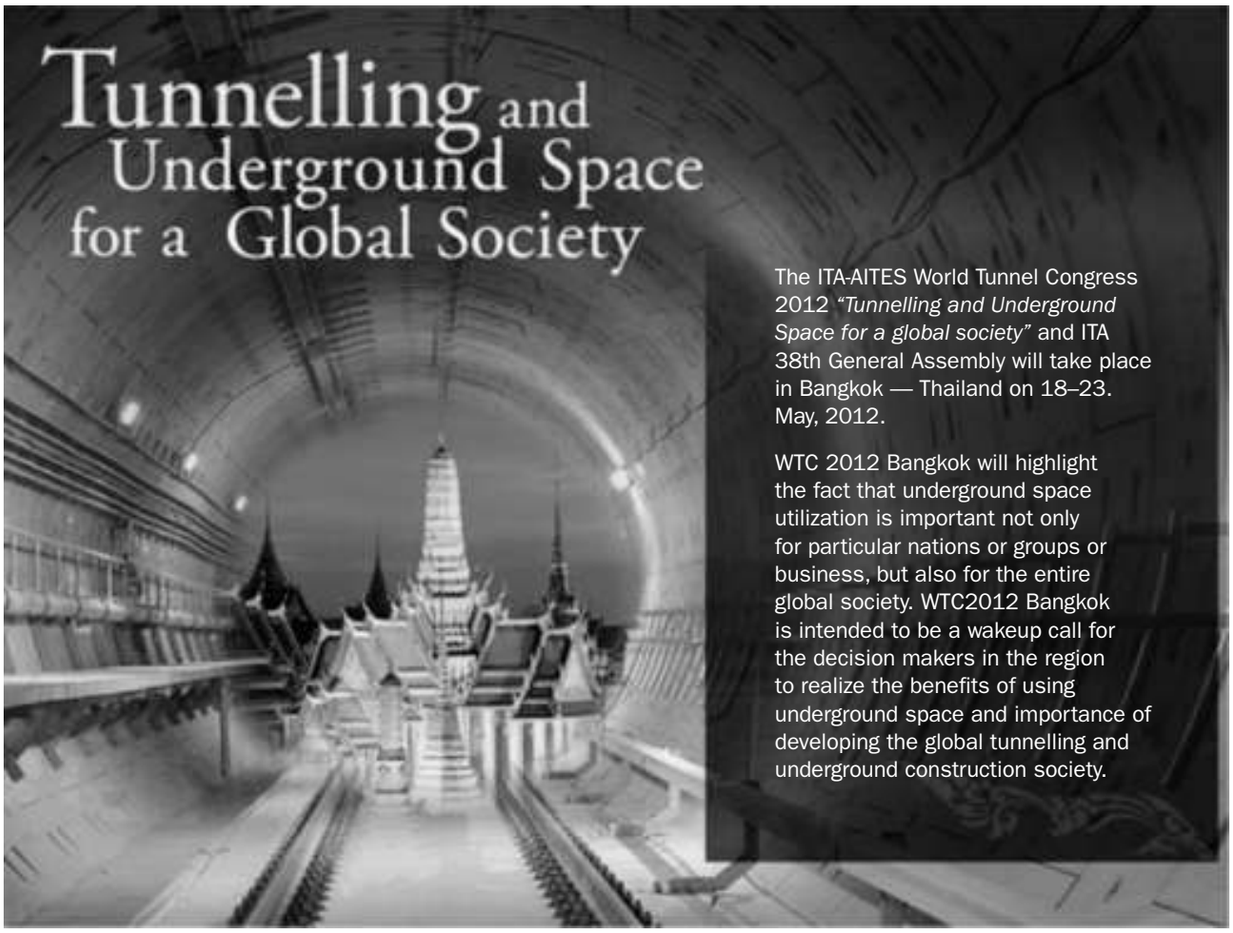
Eligible for the award are those works that are specifically aimed at safety and security of underground facilities in operation, preferably reflecting the interdisciplinarity

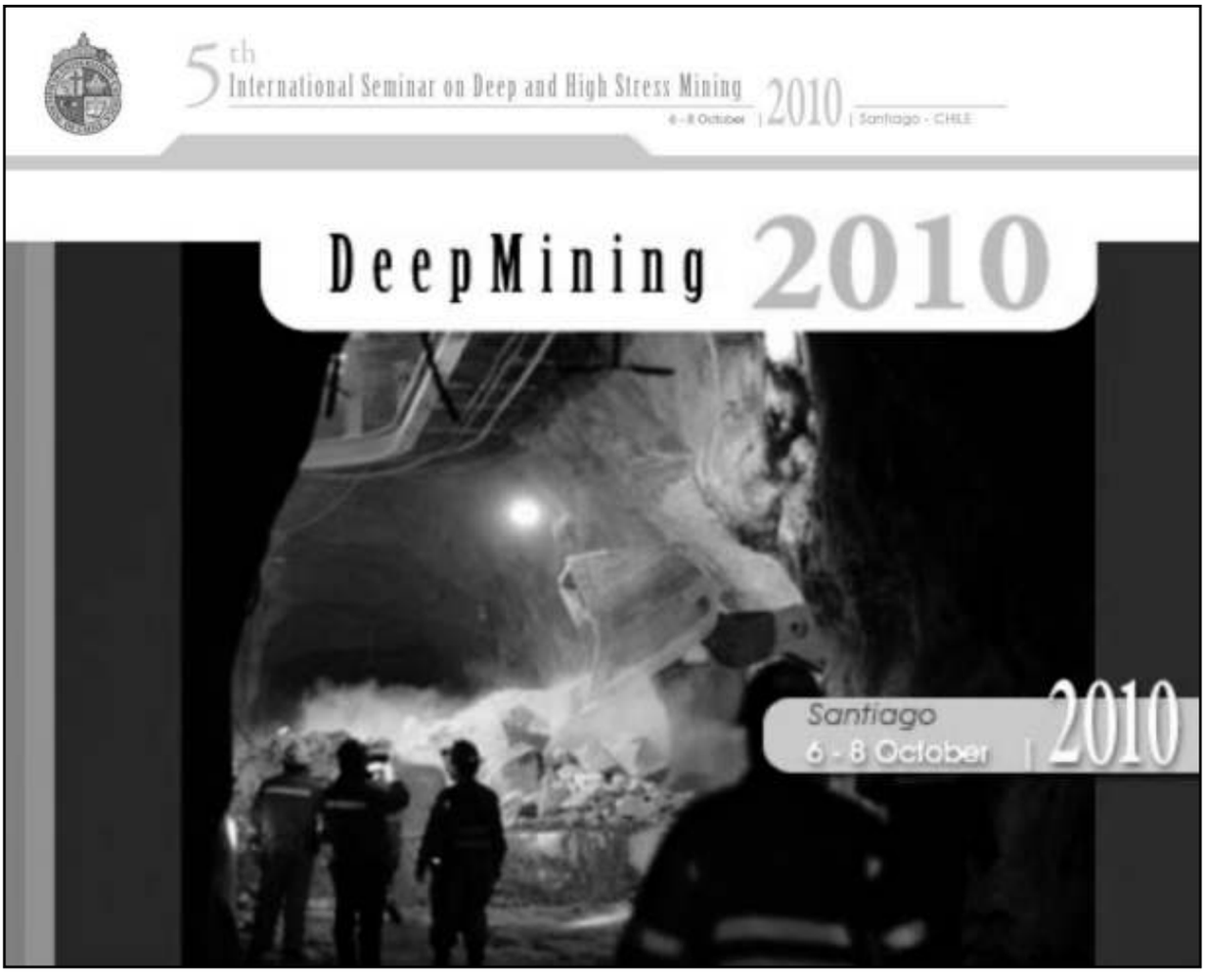
The steering board of the ITA COSUF has outlined the criteria to assess the work of nominated candidates for the ITA COSUF award. The work shall, among other criteria:

- describe new aspects in the area of safety and security in underground facilities
- be completed not more than two years before the time of the nomination
- be of outstanding quality, including clear and concise descriptions of the objectives, the scientific base, the work steps carried out, the results achieved and their relation to the current state of the art etc
- be significant and represent an unique contribution

Nominations for the ITA COSUF award may be deposited at the ITA COSUF steering board or at the ITA secretariat.

You may find more on ITA COSUF on www.ita-aites.org




5th International Seminar on Deep and High Stress Mining
6 - 8 October | 2010 | Santiago - CHILE
DeepMining 2010
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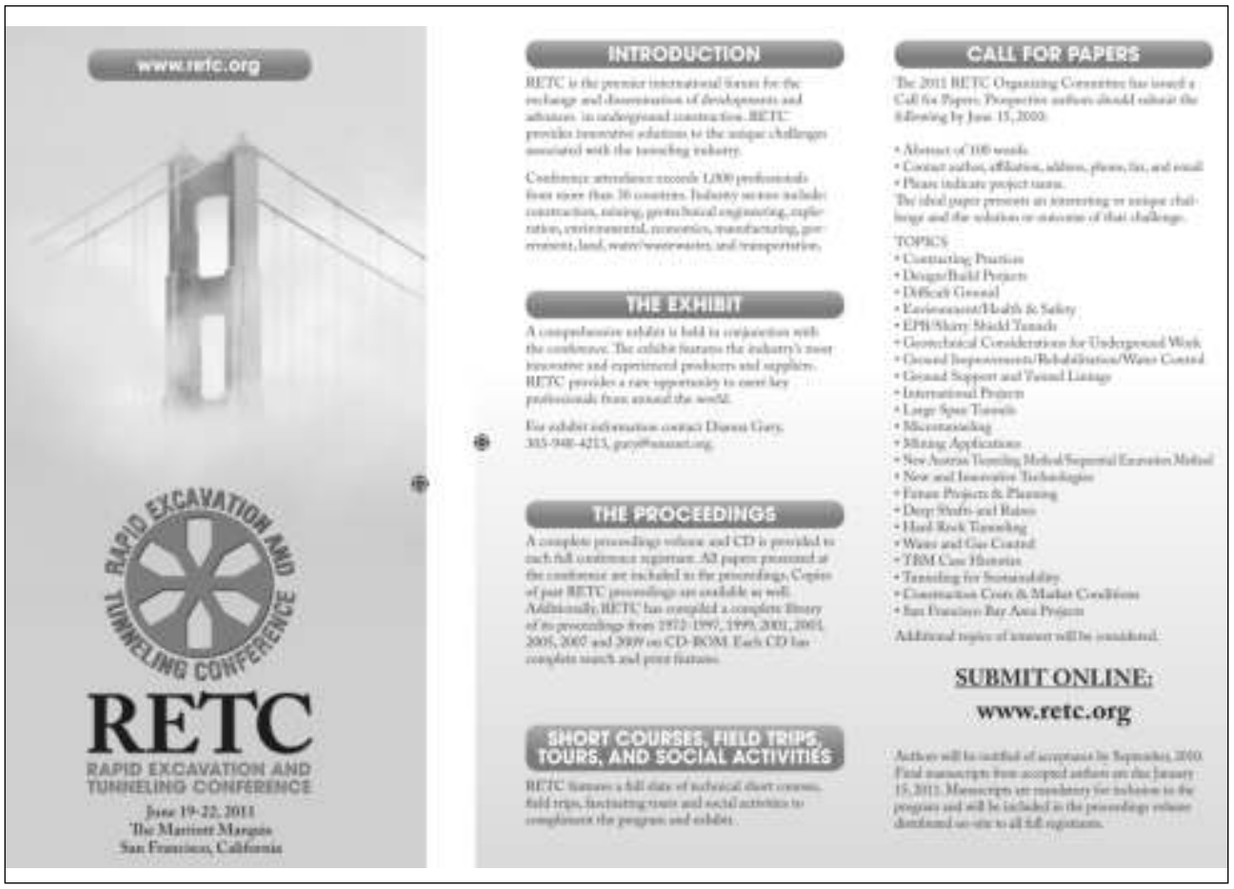
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June 19-22, 2011
The Marriott Marquis
San Francisco, California
INTRODUCTION
RETC is the premier international forum for the exchange and dissemination of developments and advances in underground construction. RETC provides innovative solutions to the unique challenges associated with the tunneling industry.
Conference attendance records 1,000 professionals from more than 30 countries. Industry sectors include: construction, mining, geotechnical engineering, exploration, environmental, economics, manufacturing, government, land, water/wastewater, and transportation.
THE EXHIBIT
A comprehensive exhibit is held in conjunction with the conference. The exhibit features the industry's most innovative and experienced producers and suppliers. RETC provides a rare opportunity to meet key professionals from around the world.
For exhibit information contact Dianna Gary, 303-948-4213, gary@smenet.org.
THE PROCEEDINGS
A complete proceedings volume and CD is provided to each full conference registrant. All papers presented at the conference are included in the proceedings. Copies of past RETC proceedings are available as well. Additionally, RETC has compiled a complete library of its proceedings from 1972-1997, 1999, 2001, 2003, 2005, 2007 and 2009 on CD-ROM. Each CD has complete search and print features.
SHORT COURSES, FIELD TRIPS, TOURS, AND SOCIAL ACTIVITIES
RETC features a full slate of technical short courses, field trips, fascinating tours and social activities to complement the program and exhibit.
CALL FOR PAPERS
The 2011 RETC Organizing Committee has issued a Call for Papers. Prospective authors should submit the following by June 15, 2010:
• Abstract of 100 words
• Contact author, affiliation, address, phone, fax, and email
• Please indicate project name.
The ideal paper presents an interesting or unique challenge and the solution or outcome of that challenge.
TOPICS
• Contracting Practices
• Design/Build Projects
• Difficult Ground
• Environment/Health & Safety
• EPB/Shitty Shield Tunnels
• Geotechnical Considerations for Underground Work
• Ground Improvements/Rehabilitation/Water Control
• Ground Support and Tunnel Linings
• International Projects
• Large Span Tunnels
• Microtunneling
• Mining Applications
• New Austrian Tunneling Method/Sequential Excavation Method
• New and Innovative Technologies
• Future Projects & Planning
• Deep Shafts and Raises
• Hard Rock Tunneling
• Water and Gas Control
• TBM Case Histories
• Tunneling for Sustainability
• Construction Costs & Market Conditions
• San Francisco Bay Area Projects
Additional topics of interest will be considered.
SUBMIT ONLINE:
www.retc.org
Authors will be notified of acceptance by September, 2010. Final manuscripts from accepted authors are due January 15, 2011. Manuscripts are mandatory for inclusion in the program and will be included in the proceedings volume distributed on-site to all full registrants.

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:: About ACUUS

ACUUS is an international non-governmental association actively promoting partnerships amongst all experts who design, analyse and decide upon the use of our cities' underground space. ACUUS promotes also the awareness of the private sector, governments at all levels and the general public on the specific issues related to the sustainable use of the urban underground. Read more about ACUUS at www.acuus.qc.ca.

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2010 is the end of China's "11th Five Year Plan", during which the Chinese railway system tremendously developed. The modernisation of passenger transportation and freight transportation were going forward together, the new lines construction and existing lines reconstruction brought out the best in each other. In additional, technology and equipment related with the locomotive & rolling stock were improved. Since the 16th National Congress of the Communist Party of China, China's railway has obtained great achievement.

According to the national development and reform commission, the total investment in railway is 700 billion RMB in 2010 and for the 12th Five Year Plan the number will be 3000 billion. To build **integrated network** forhigh-speed railway and heavy haul lines, obtain the advanced level of equipment for locomotive & rolling stock, achieve the **integrated** Informatization for transportation organization, passenger and freight transport marketing and operation management, China's ministry of railway will realize basic railway modernization before 2020 with the aim of finishing "long-term railway network plan" and building up a moderately prosperous society.

"Rail Transit" of HnZ Industry Media, together with **China Civil Engineering** Society will hold China Rail Congress in November 2010 in Beijing. Themed "Driving into safe and green neo-era" with 4 forums **Construction and Maintenance, Locomotive and Rolling stock, Railway Informatization, Railway Power System** and **Electrification System**, combined with the Chinese macro market information and the international railway construction scheme, this congress is going to be the largest, the most authoritative and influential rail industry event in Asia. What's more, The "6th China International Rail Transit Technology Exhibition", the largest railway exhibition in Asia will be concurrently held, then the "win-win" union of congress and exhibition is bound to be an amazing event in the rail industry where thoughts exchanged, problem solved, deal concluded and partners made.

14th Australasian Tunnelling Conference 2011

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The race is on!

- **Over 100 abstracts received!**
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- Keen interest from the industry suggests a multitude of suppliers, constructors and designers will exhibit at the event.

The Conference Organising Committee is working hard to meet the raised expectations of a fuller, more meaningful conference to mark the start of the Second Decade of the 21st Century and to set a standard for the 2014 ITS Conference in Sydney.

We have the highest of expectations insight for all presenters and excitedly begin the countdown! We encourage all tunnelers, infrastructure owners and developers, and users to mark their diaries for 8-10 March 2011 in Auckland and contribute. We look forward to welcoming you and facilitating a network fiesta with ample exposure to the state-of-art of developing the underground.

Keynote Presentations

- **Professor Giovanni Barla, Turin Polytechnic University** never fails to infuse his audience with his enthusiasm and love for underground soil/rock mechanics and we look forward to his address.
- **Alan Morris, Project Manager for the XRL Tunnels , Mass Transport Railway Corporation, Hong Kong** will provide an overview of tunnelling in Asia while also outlining his views on where our industry finds itself in terms of technical developments.
- **Professor Arnold Dicks**, Chairman of the ITA Contractual Practices Group and Australian delegate to PIARC in tunnel ventilation, safety and environment will address operational issues in particular in vehicular tunnels.

Sponsorship

Showcase your business at the Conference by sponsoring the event. The sponsorship package contains a variety of levels and should you wish to discuss any of the levels, develop a package to suit your budget, or if you have any enquiries, please do not hesitate to contact event management.

Trade Exhibition

A Trade Exhibition will be held in association with the event. The exhibition will provide an excellent opportunity for companies to display their products and services to the participants.

Tours

Start or finish your Conference experience with scheduled tours of the Auckland region. Tours will include Conference related sites and tours of indulgence.

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An opportunity for immersion into European thinking and approaches with Giovanni Barla, Turin Polytechnic University.

Event Management: The AusIMM

For further information including sponsorship and exhibition opportunities, please contact:
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ATS Tunnel Database

NEW SOUTH WALES

Project:	Sydney CBD Metro		
Client: SMA	**Designer** PB/Arup	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Sydney CBD West Metro will initially run from Central to Rozelle and eventually to the north west	**Current status:**	Cancelled

Project:	City Relief Line		
Client: SMA	**Designer** PB/Arup	**Contractor:**	**Supervising Engineer:**
Scope of work:	5km priority tunnel is proposed to be constructed from Eveleigh to Wynyard, separating western services from inner city trains	**Current status:**	Transport NSW is starting alignment and design studies for the project and will investigate a number of alignment and construction options

Project:	Burrow Road Tunnel		
Client: Enery Australia	**Designer** Demlakian Consulting Engineers	**Contractor:** Abergeldie Complex Infrastructure	**Supervising Engineer:**
Scope of work:	87m long and 2800mm diameter tunnel is approximately 5m below Burrows Road in Alexandria, Sydney	**Current status:**	Excavation complete. Finishing works underway

Project:	Mardi-Mangrove pipeline		
Client: Gosford City and Wyong Shire Councils	**Designer**	**Contractor:** John Holland	**Supervising Engineer:**
Scope of work:	Two pipelines, including 1.9 kilometre section from Wyong River to Mardi Dam, which will be microtunnelled	**Current status:**	Construction commenced to be completed June 2011

Project:	Central Coast Rail Upgrade		
Client: RIC	**Designer** Connell Wagner (Concept) — complete	**Contractor:**	**Supervising Engineer:**
Scope of work:	Hornsby to Hawkesbury. 11.5km twin 8m dia. Rail tunnels.	**Current status:**	EIS complete.

Project:	F3 to M2 Road Tunnel		
Client: RTA and Federal DOTARS	**Designer** SKM (preliminary design)	**Contractor:**	**Supervising Engineer:**
Scope of work:	8km road tunnel to connect the southern end of the F3 Freeway with the M2 Tollroad	**Current status:**	Preferred corridor selected. Preparing the Terms of Reference for development of a concept proposal Construction timetable for the project is yet to be established.

Project:	M5 East tunnel widening		
Client: RTA	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	Provision of additional four new lanes in a tunnel(s) next to the existing the M5 East tunnel	**Current status:**	Proposed

Project:	M4 East Link		
Client: RTA	**Designer** Connell Wagner	**Contractor:**	**Supervising Engineer:**
Scope of work:	5.5km long, privately funded, road tunnel to connect the eastern end of the M4 Motorway with the CityWest Link.	**Current status:**	On hold awaiting funding

Project:	F6 Transport Corridor		
Client:	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	20-kilometre motorway from the Sutherland Shire to the city Tunnelled section between Port Hacking Road at Sylvania and Loftus	**Current status:**	Economic Impact Study complete

Project:	Bells Line of Road		
Client: RTA	**Designer** Maunsell.	**Contractor:**	**Supervising Engineer:**
Scope of work:	1.2km tunnel to remove 13% grade near Kurrajong	**Current status:**	On Hold

Project:	Busby's Bore Project		
Client: Clean Up Australia	**Designer** KBR	**Contractor:**	**Supervising Engineer:**
Scope of work:	Connection to Busby's Bore and underground water storage in disused St James Railway Tunnel	**Current status:**	Concept design

Project:	Murrurundi Freight Rail Tunnel		
Client: ARTC	**Designer** TBA	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Freight rail tunnel through the Liverpool Ranges at Murrurundi	**Current status:**	Under consideration

Project:	South Sydney Freight Line		
Client: ARTC	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	• 30km single track running parallel to the Main South line between Sefton railway station and Macarthur railway station • Cut and Cover tunnel at Sefton. required to carry the SSFL underneath the existing Bankstown Line • underground proposal though Cabramatta Railway Station.	**Current status:**	Tenders currently being reviewed

Project:	City East Cable Tunnel		
Client: EnergyAustralia	**Designer** AECOM	**Contractor:**	**Managing Contractor**
Scope of work:	3.2 km TBM tunnel from Surry Hills to Sydney CBD including connections to existing and proposed substations	**Current status:**	Detailed Design

QUEENSLAND

Project:	Airport Link & Northern Busway		
Client: Queensland Government	**Designer** PB Arup	**Contractor:** Thiess/John Holland JV	**Supervising Engineer:**
Scope of work:	$4.3B PPP project. Construction of road tunnels and a busway including Australia's longest road tunnel at 6.7km long	**Current Status:**	First TBM 'Rocksy' commenced in August and has completed over 100m of eastbound tunnel. Second TBM 'Sandy' on site and to commence westbound tunnel soon.

Project:	Northern Link		
Client: Brisbane City Council	**Designer** SKM Connell Wagner JV (Reference Design)	**Contractor:**	**Supervising Engineer:**
Scope of work:	2 x 4km road tunnels from Towong to Milton	**Current Status:**	Construction expected to start in December

Project:	Toowoomba Bypass		
Client: Queensland Main Roads	**Designer**	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	42km road costing $1B+ will include 735 m twin tube tunnel at top of Great Dividing Range	**Current status:**	Pilot tunnel completed. Project on hold awaiting funding.

Project:	Cross River Rail		
Client: DoT&MR	**Designer** TBA	**Contractor:**	**Supervising Engineer:**
Scope of work:	A 19km proposed corridor would include a tunnel under the Brisbane River and new stations, running from Salisbury, in Brisbane's south, to Wooloowin, in the north, via Woolloongabba, the CBD and Bowen Hills	**Current status:**	Feasibility study is continuing

Project:	Inner Orbital Tunnel		
Client: Queensland Main Roads	**Designer**	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	8km road tunnel between Toowong and EvertonPark	**Current status:**	Planning complete and included in the Western Brisbane Transport Strategy

Project:	Stafford Road Tunnel		
Client: Queensland Main Roads	**Designer**	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Urban motorway tunnel under Stafford Road to connect the proposed North West Transport Corridor and Inner Orbital with Airport Link	**Current status:**	Planning complete and included in the Western Brisbane Transport Strategy

Project:	Kingsford Smith Tunnel		
Client: Queensland Main Roads	**Designer**	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Tunnel to link traffic from the Gateway Motorway and Australia Trade Coast to the Inner City Bypass	**Current status:**	Proposed. Early design options to be developed before Christmas 2010

WESTERN AUSTRALIA

Project:	Perth Airport Rail Link		
Client: Public Transport Authority	**Designer** AECOM (study)	**Contractor:** N/A	**Supervising Engineer:** N/A
Scope of work:	Twin track electrified passenger heavy rail route from Midland Line near Bayswater Station to a new possible terminal station at High Wycombe. Route to service growing Office and Industrial Park with underground station near current Domestic Terminal. Tunnel options extend under main airport runway to new underground station at International Terminal, continuing eastwards under future runway to High Wycombe (total track length up to 10km, approx half in cut and cover and bored tunnel).	**Current status:**	Pre-feasibility Study including preferred route identification and preliminary costing, report submitted.

Project:	Southern Seawater Desalination Project — Subsea Pipejack tunnels		
Client: Southern Seawater Alliance	**Designer** An Alliance comprising Water Corporation, Technicas Reunidas, Valorizia Agua, AJ Lucas and Worley Parsons.	**Contractor:** Zueblin Australia	**Supervising Engineer:** N/A
Scope of work:	Two TBM pipejack tunnels approx 900m long under coastal sand dunes (approx 400m) and out to sea (500m). Two Herrenknecht slurry TBMs used with bored diameters 3.0m and 2.4m. Larger tunnel complete and TBM retrieved from below seabed. Smaller tunnel due for completion mid-September 2010 with retrieval from below seabed.	**Current status:**	Desalination plant is expected to be completed and operating by end 2011

Project:	The Hub Project		
Client: Public Transport Authority	**Designer** N/A	**Contractor:** N/A	**Supervising Engineer:** N/A
Scope of work:	Lowering twin Fremantle lines underground in cut and cover tunnel above existing Joondalup line bored tunnels west of Perth Central Station. Lowering of Wellington Street Bus Station underground with bus access ramp to west.	**Current status:**	Master Plan underway, present to Cabinet early 2010 for funding and programme commitments. Anticipate construction start early 2011. For more information go to www.tenders.wa.gov.au, Early Tender Advice , # 2010011.

Project:	Norhern suburbs sewer		
Client: Water Corporation	**Designer** N/A	**Contractor:** DM Civil	**Supervising Engineer:** N/A
Scope of work:	4.4 km section of sewer pipe through the suburbs of Woodvale, Kingsley, Madeley and Wanneroo,	**Current status:**	Sewer construction is expected to be completed by 2011

VICTORIA

Project:	Melbourne Metro		
Client: DoT	**Designer** TBA	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Stage 1 — new rail tunnel between Dynon in the west and St Kilda Road near Domain with new stations in North Melbourne, Parkville, and St Kilda Road. Satge 2 — linking Domain to the Caulfield corridor	**Current status:**	Stage 1 — expected to start construction in 2012 and be completed by 2018

Project:	East-West Tunnel		
Client: VicRoads	**Designer** TBA	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Potential tunnel under Carlton and Royal Park running from the Tullamarine Freeway to the Western Ring Rd	**Current status:**	Study planned

Project:	WestLink — Stage 1		
Client: LMA	**Designer** Aurecon/AECOM/GHD	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Road tunnel connecting Geelong Road/Sunshine Road in West Footscray to Dynon Road/Footscray road in the Port precinct .	**Current status:**	Community consultation and design work will take until at least 2011 which will determine the design of the tunnel access on the Maribyrnong River crossing.

Project:	Northern Sewer Project		
Client: Melbourne Water	**Designer** SKM/Jacobs	**Contractor:** JHG	**Supervising Engineer:**
Scope of work:	Stage 1 — 8km of 1.6m and 2.5m diameter sewer tunnels. Stage 2 — 4.5km and 1.8km diameter sewer tunnels	**Current status:**	Tunnel from Newlands Road, Coburg North to Carr Street, Coburg North complete. Bell Street West connection works complete. Construction of final tunnel is still progressing well with a breakthrough planned for late September at Carr Street. shaft. Project is ahead of its mid 2012 deadline

Project:	Hoddle Street Tunnel		
Client: Vic Roads	**Designer** GHD	**Contractor:** TBA	**Supervising Engineer:** TBA
Scope of work:	Tunnel would run from the Eastern Freeway to Wellington Parade, near the MCG.	**Current status:**	In planning. Two-year government consultation process

Project:	Wonthaggi Desaliantion Plant		
Client: Department of Sustainable Energy	**Designer** GHD	**Contractor:** Thiess Degremont	**Supervising Engineer:** TBA
Scope of work:	Desalination plant will include intake and outake tunnels offshore up to 2.5km long	**Current status:**	Construction commenced

Project:	Melbourne Main Sewer Replacement		
Client: Melbourne Water	**Designer**	**Contractor:** John Holland	**Supervising Engineer:**
Scope of work:	$220 million 2.3km 1.8m diameter new sewer includes six shafts 10-15m deep and 142m crossing of Yarra River	**Current status:**	First tunnel breakthrough has been achieved, Project completion in 2012

Project:	Sugarloaf Pipeline Project		
Client: Melbourne Water	**Designer** SKM/GHD	**Contractor:** John Holland	**Supervising Engineer:**
Scope of work:	70 kilometre pipeline linking the Goulburn River near Yea to the Sugarloaf Reservoir in Melbourne's northeast, including an 830 metre tunnel	**Current status:**	Complete.

Project:	Frankston Drainage Improvement Project		
Client: Melbourne Water	**Designer**	**Contractor:** Winslow Infrastructure	**Supervising Engineer:**
Scope of work:	1.5 kilometre 3 m OD tunnel with 2.5 m dia concrete stormwater pipeline from Monash University to Kananook Creek.	**Current status:**	Tunnelling complete

Project:	Regional Rail Link		
Client: DoT	**Designer** KBR/Arup	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Potential rail tunnels under Footscray as part of the broader Regional Rail Link project from Werribee South to Southern Cross Station via Tarneit	**Current status:**	Business case study in progress

Project:	North East Link		
Client: LMA	**Designer** TBA	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	Potential road tunnel from Greensborough to Bullen linking the Western Ring Road to the Easten freeway	**Current status:**	Not before 2018

SOUTH AUSTRALIA

Project:	Adelaide Desalination Plant		
Client: SA Water	**Designer**	**Contractor:** Winslow Infrastructure	**Supervising Engineer:**
Scope of work:	11.5 km pipeline from Port Stanvac to the Happy Valley water treatment storage facility including 6 tunnel bores ranging from 30 to 160m	**Current status:**	Tunnel works complete

NORTHERN TERRITORY

Project:	Darwin Water Main		
Client: Darwin City Council and the Department of Planning and Infrastructure	**Designer**	**Contractor:** Winslow Infrastructure	**Supervising Engineer:**
Scope of work:	Construction of several major water mains will take place in two stages. Stage 1 includes installing 1.2 km of 450mm steel pipe. Stage 2 includes the installation of 9 km of 450 mm steel water in Darwin's CBD.	**Current status:**	Stage 1 complete. Stage two underway and nearing completion

NEW ZEALAND

Project:	Rosedale waste water outfall		
Client: North Shore City Council	**Designer** Maunsell	**Contractor:** TBA	**Supervising Engineer:**
Scope of work:	2.6km of on shore tunnel and 2.7km of trenched marine pipeline.	**Current status:**	Complete

Project:	Homer Tunnel Upgrade		
Client:	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	2 Lane tunnel	**Current status:**	In planning

Project:	Victorai Park Tunnel		
Client: Transit NZ	**Designer** V Formation (Fletcher Construction, Beca Engineering, Higgins Contractors and Parsons and Brinckerhoff)	**Contractor:**	**Supervising Engineer:**
Scope of work:	440m long 2 Lane tunnel	**Current status:**	280m of the tunnel walls have been completed, A total of 439 of the required 1039 concrete piles have also been inserted at the base of the tunnel

Project:	Milford Dart Tunnel		
Client: Milford Dart Co.	**Designer** URS	**Contractor:**	**Supervising Engineer:**
Scope of work:	10.2 kms of 5m diameter tunnel for single lane bus route or rail	**Current status:**	In planning

Project:	North Bank Tunnel		
Client: Meridian Energy	**Designer** URS	**Contractor:**	**Supervising Engineer:**
Scope of work:	36kms of 12m diameter headrace tunnel & hydro power station	**Current status:**	

Project:	Britomart rail loop		
Client: Auckland Regional Transport Authority	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	3.5km tunnel beneath Albert St and including underground stations near Wellesley St and Karangahape Rd.	**Current status:**	Planning and conceptual design in progress

Project:	Wellington Northern Corridor		
Client: NZ Transport Agency Board	**Designer** AECOM, Parsons Brinckerhoff and Beca	**Contractor:**	**Supervising Engineer:**
Scope of work:	Four lane expressway from Levin to Wellington Airport including duplication of Mt Victoria and Terrace tunnels .	**Current status:**	In planning

Project:	Waitaki Hydro		
Client: Meridian Energy	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	34 km tunnel from Lake Waitaki to the Waitaki River at Stonewall	**Current status:**	Final approval received

Project:	Tauranga Tunnel		
Client: Local Govt	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:		**Current status:**	Proposal

Project:	Central Interceptor Project		
Client: Local Govt	**Designer** AECOM	**Contractor:**	**Supervising Engineer:**
Scope of work:	New sewer tunnel approximately 14 kilometres in length from central Auckland to Mangere Wastewater Treatment Plant	**Current status:**	Design in progress — construction to be completed by 2025

Project:	Nevis Tunnel		
Client: NZ Transport Agency	**Designer**	**Contractor:**	**Supervising Engineer:**
Scope of work:	Tunnel to replace a rockfall-prone stretch of highway at the Nevis Bluff, midway between Cromwell and Queenstown.	**Current status:**	Concept