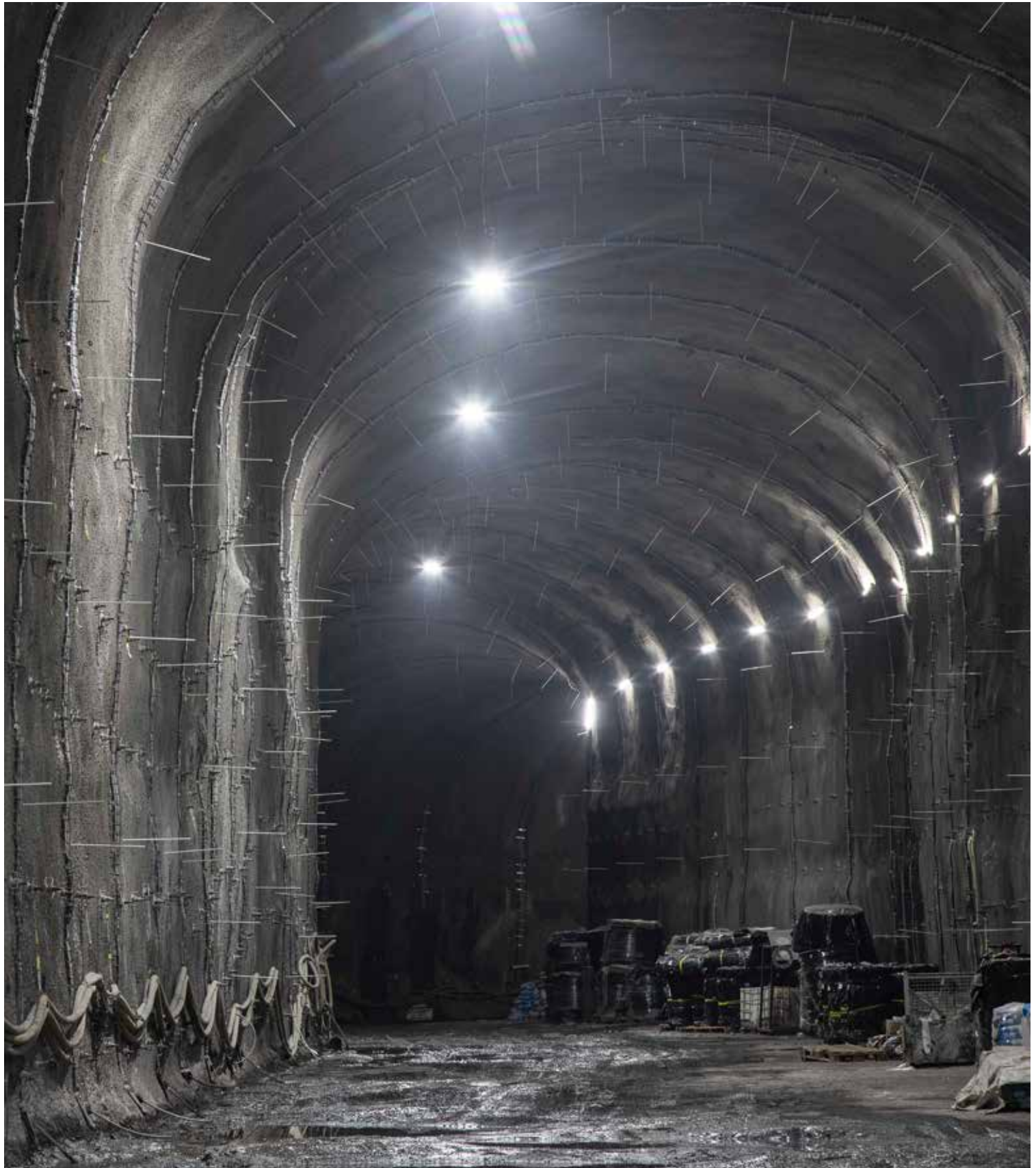


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**Cover photo:**

Photo is by Tom Roper : Depth Pins prior to secondary shotcrete lining, Australia.

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# President's forward

Firstly, I must congratulate, thank, and acknowledge the 2020+1 conference committee who held the very successful ATS conference in Melbourne in May 2021. The committee provided a great mix of technical presentations, exhibitors, networking and social activities. As it turned out, the postponement to May was a stroke of genius, as we found the window between lockdowns and border closures.

Since the conference, ATS has continued to provide members with online and, when possible, in-person technical sessions. For upcoming sessions, please refer to our website. The website ([www.ats.org.au](http://www.ats.org.au)) has been refreshed and is now becoming a vibrant and up-to-date place to go. Please put it on your list of bookmarks. On the website you can find news, events and information for members.



Our Women in Tunnelling group is now active and we have created a diversity protocol (it's on the website). The ATS is turning 50 next year and we have set up a committee to get some activities and celebrations for this event. Please get involved.

**Harry Asche,**  
**President**  
**Australasian Tunnelling Society**

## From the Chair NZTS

# Kia Ora Koutou

As I write this we are still in a lockdown due to the Delta variant as we catch-up on vaccination. Firstly I would like to acknowledge the continued progress of NZ tunnelling projects and the commitment of tunnelling teams, especially those expatriates subject to higher levels of stress and disruption due to prolonged absence from their families.

It doesn't seem that long ago that the NZTS assembled our lean (and mean) voluntary resources to provide a virtual HUB to support the ATS 2020+1 conference at Eden Park. It was great to get together as a tunnelling community for a couple of days and the interaction with Australia and our local events all worked extremely well judging by the response from our attendees. Congratulations to the ATS2020+1 organising committee and thanks to all the sponsors.

We look forward to the ITA tunnelling week in September with presentations from CRL and CI and hope to make those available on our website to those that can't make those late night sessions.

This edition has been compiled by David Lees from publicly available information and so we are grateful. Behind the scenes we know that planning is underway for tunnels that will support regulatory reform in the water sector, the energy sector and that support the electrification of transport – we hope to report more on them in upcoming editions.

Kia kaha

**Bill Newns**  
**Chair New Zealand Tunnelling Society**

## EDITOR'S NOTE

I am really grateful to all those people who have participated in this Journal. In particular I would like to thank Lauren Bordin who has provided me with excellent support, but also those members who have provided write ups of the Tunnelling Conference and other ATS meetings. Its great to be able to share this with all our members who could not attend.

Remember this is your journal – yes as Bill notes most of what is presented here has been collected from other public sources – if you are working on a project which you would like to present in the journal and has the client's approval I would most welcome your contribution.

**David Lees**  
**ATS Editor**

# Cross River Rail

On the Cross River Rail Project the excavation of the TBM tunnels reached their first big milestones with the breakthrough of the TBMs Else and Merle in Roma Street Station cavern. On the other end of the 5.4km long twin tunnels the roadheaders are preparing to break through within the next few weeks at Boggo Road.

Mathieson Stosic and Winson Hao Ye are two tunnel engineers who have been involved in site establishment at Woolloongabba Station and later in the excavation of the roadheader and TBM twin tunnels:

Since commencing on the project in September 2019 with the first breaking of ground at Woolloongabba, Mathieson has been involved in the delivery of a range of tunnelling work scopes. These include bulk earthworks, site establishment, decline construction, blasting, logistics, station box excavation, construction of two underground caverns, launch stubs for the TBM “Else” and “Merle”, twin mined tunnels 0.9km in length and mined cross passages.

In these roles and as part of the delivery team, Mathieson works to ensure the safe, timely and cost-effective delivery of each scope of work on the ground. Mathieson has achieved record quality assurance documentation close out volumes for the CRR Project, as well as contributing to the mined tunnel teams successful program milestone achievements.

Mathieson also works closely with many internal and external parties across the CRR Project in the delivery function such as tunnellers, supervisors,



**Breakthrough at Roma Street Station cavern.**

support staff, designers, independent certifiers, client representatives, subcontractors and suppliers who all play vital roles in ensuring the delivery of the CRR Project.

At the start of the project Winson supported the geotechnical investigations within the Brisbane CBD, organising the works for the boreholes whose data was required for design and construction in this crucial area. During site establishment Winson was involved in the FRP works for the TBM infrastructure and the excavation and retention of the retaining walls of the station box in Woolloongabba where the two double-shield TBMs were assembled (before they started their 4.2km long journey under the Brisbane River and the CBD towards the Northern Portal).

As shift engineer of TBM Else during TBM operation, Winson is assisting the project engineers and managers to supervise TBM shift activities and managing safety issues as well as all aspects of quality control with the TBM tunnel, which are essential in order to



**Mathieson at the face after one of the first cuts at Woolloongabba.**

deliver the tunnel on time and within the budget. Winson’s work as shift engineer on TBM Else references the latest drawings, specification and operation parameters for TBM excavation ensuring that these are followed in accordance with the permit to tunnel (PTT). The PTT involves the weekly review of the current ground conditions, monitoring data and special surface features. Winson is responsible for the installation of the segmental lining, ensuring the steering of the TBM meets the designed tunnel alignment, ensuring the

sufficient volume of annulus grouting as part of the quality control and documentation. He was also involved in the probe drilling for water ingress during the river crossing. TBM Else was the first of the two TBMs to break through at Roma Street station and is now getting ready for the remaining 1.2km to the Northern Portal to break through later this year.

Having grown up in Brisbane, Mathieson and Winson are passionate about the successful delivery of the CRR Project and the outcomes that it will bring for the city.



# Snowy 2.0 starts

Tunnelling at Snowy 2.0 has begun in earnest, with the first 200m of the main access tunnel having been excavated by one of Snowy Hydro's three TBMs working on the largest renewable energy project in Australia.

The TBM - named Lady Eileen Hudson after an important Snowy Scheme ambassador and the wife of inaugural Scheme Commissioner Sir William Hudson - has advanced its hard-rock, single-shield cutterhead into the portal face at Lobs Hole in the Snowy Mountains.

This is the start of a journey that will lead it 2.7km to where a cavern will be excavated to house the power station for the pumped-storage hydro scheme. Located nearly one kilometre below ground, the cavern, which will be excavated by the drill-and-blast method, is to house six reversible Francis pump-turbines capable of generating 2000 megawatts of power.

Built by CREG, the 137m long TBM is lining the walls of the 11m tunnel with precast concrete segments made at a purpose-built factory at nearby Polo Flat in Cooma.

There are nine seven-tonne segments for each tunnel ring, to be transported to the site by a fleet of trucks each specially fitted with three, custom-made trailers designed to manoeuvre safely the winding mountain roads. Operating round the clock, the factory employs many local people, and has the first manufacturing line carousel in full production with a second carousel being commissioned.

Once it has completed its main access tunnel drive, the TBM will be dismantled and reassembled at a portal near Talbingo Reservoir where it will excavate the tailrace tunnel. The total amount of tunnelling it will complete is 7.8km.

Snowy 2.0, which is being developed for project owner Snowy Hydro by Future Generation, a joint-venture led by Webuild with Australian partner Clough and Lane Construction, a U.S. subsidiary of Webuild, will link the existing Talbingo Reservoir with



Tantangara Reservoir through a network of 27km of tunnels.

Snowy 2.0 will expand Snowy Hydro's network of hydropower stations to support Australia's transition to a low-carbon emissions future. It will provide dispatchable, on-demand generating capacity to the National Electricity Market and provide 350,000 megawatt hours of large-scale storage (or enough power to run for a week without recharge pumping).

The second Snowy 2.0 TBM - named Kirsten after Australian astrophysicist Kirsten Banks - is being assembled at Lobs Hole to excavate the Emergency, Cable and Ventilation Tunnel (ECVT). Key machine components including the front shield, the bottom piece of the middle shield as well as the main drive have already been installed in the TBM cradle at the portal. The top middle shield and the tail shield will be done in the coming weeks. Workers are putting together the first two trailing gantries, while the segment erector is being set up.

Built by Herrenknecht, it is the most innovative of the three TBMs because it will be able to excavate at steep angles.

The first section of tunnel will be at a decline of up to a 9% (five degrees) for the ECVT, about 3km down to the cavern. The hard-rock single-shield TBM will then excavate on an incline of up to 47% (25 degrees) for the 1.6km Inclined Pressure Shaft. Its final stretch will be excavating 2km of the flatter headrace tunnel to meet the third TBM.

The third and last TBM, named Florence in honour of Florence Violet McKenzie, Australia's first electrical engineer, is arriving at Tantangara piece by piece by truck from Port Kembla in New South Wales. Located at the eastern end of the Snowy 2.0 project, the Herrenknecht machine will be responsible for 16km of the headrace tunnel. It is a dual mode TBM that can be operated in hard rock or slurry mode to capture hazardous mineral fibres and excavate through the Long Plain Fault.

The TBM assembly cradle at Tantangara - the top storage reservoir for Snowy 2.0 - is nearly complete, with assembly of the TBM due to begin in coming weeks. Work is also being done on the concrete batch plant, water treatment plant and workers camp.

# Melbourne Metro

The Metro Tunnel, previously known as the Melbourne Metro Rail Project or Melbourne Metro 1, has reported significant progress. Its twin 9km tunnels have moved closer to completion, switching the project's focus on to its five new underground stations. In May, Alice, the TBM to finish work on the metro's twin tunnels, broke through at Town Hall Station after successfully digging 12m under the Yarra River bed and around 7m below the Burnley Tunnel, and the last TBM Meg completed the final leg of the 9km tunnels from Kensington to South Yarra. The TBMs have dug as deep as 40m below ground (underneath the northern end of Swanston Street) and tunnelled through basalt rock, gravel, silt and clay.

After starting work in August 2019, the TBMs tunnelled an average of 90m a week, with TBM Alice recording the best rate of 195m in a single week. TBM Meg arrived at the Town Hall Station site 25m under Swanston and Collins Streets, following Millie, Joan and Alice, which broke through at the station throughout May 2021. TBMs Joan and Meg dug their final 670m under Swanston Street from the State Library Station site over March, April and May 2021. TBMs Millie and Alice began tunnelling in December 2020 to complete the final 1.8km leg, located under St Kilda Road and the Yarra River.

The Metro Tunnel will have two CBD stations: Town Hall Station at the southern end of Swanston Street; and State Library Station at the northern end of Swanston Street.

These two new CBD stations will allow Metro



Tunnel passengers to connect to City Loop services via underground pedestrian links at Flinders Street and Melbourne Central stations.

At 19m wide, the Town Hall and State Library station platforms will be among the widest underground metro platforms in the world, ensuring plenty of space for the thousands of passengers who will use them every day.

After the completion of

TBM tunnelling, Arden Station is taking shape with the platforms being constructed and the Laurens Street station entrance ground floor slab poured. The twin tunnels are now being fitted out with base slabs and steel brackets to house high voltage power cords.

Arden Station will be the centrepiece of a new precinct, which is expected to be home to around 34,000 jobs and

15,000 residents by 2050.

The first concrete pour to build the station's platforms has taken place. The station will have a direct link to the city's airport by 2029 and be within walking distance of the North Melbourne Recreation Centre, Arden Street Oval and the route 57 tram, creating a transport hub.

The Victorian government has unveiled updated designs for Arden Station in North Melbourne, part of the Metro Tunnel station project, collaboratively designed by Hassell, Weston Williamson and Rogers Stirk Harbour and Partners.

Updates to the design included in the new Development Plan contain the provision of a series of public grassed areas interspersed with tree planting, and improved station access with repositioned entry gates and the reorientation of entry ramps on Laurens Street. The entrance will now feature 15 soaring brick arches, down from the planned 16. These are being built off-site and will be delivered to the station and installed over the coming months.

While the previous Development Plan had the





ground level raising locally around the skylight, the design for ground level is now relatively flat, allowing for the skylights to appear raised.

The government said that work is well advanced on the station, with platform construction beginning in March, continuing alongside the installation of the over-track exhaust system and tunnel floor slab.

“Arden Station was where we launched our first tunnel boring machine almost two years ago, and with tunnelling now complete we’ll see the station take shape in coming months and years,” said transport minister Jacinta Allan.

Tunnel entrances at South Yarra and Kensington are now complete and connected to the main tunnels. Construction is well underway on 26 cross passages.

Work is ramping up on the project’s five new underground stations, with the final stages of excavation underway and work continuing to build walls, roof structures, entrances and platforms. Once the station structures are well advanced, crews will fit them out with electrical, mechanical and ventilation systems, as well as the next-generation signalling and train control technology needed for future high capacity

metro trains to be used on the line.

Once the tunnels and stations are fully fitted out, a long period of testing will ensure that the systems are integrated and talking to each other so that the newest part of Melbourne’s rail network can be operated safely and reliably.

The Metro Tunnel project is on track to be completed by 2025. When operational it will create capacity for more than half a million extra passengers a week during peak times across Melbourne’s train network.

The work on the eastern entrance at South Yarra for the Metro Tunnel Project in Victoria, Australia, finished in March 2021 more than five months ahead of schedule and work associated with connecting the new structure with the project’s twin tunnels is currently underway.

The work on the eastern entrance consisted of broadening the current rail corridor, digging more than 31,000m<sup>3</sup> of rock and soil, and building a base slab, internal walls and roof slab. The old William Street Bridge was demolished to construct a new, longer single-span bridge. In addition, the current four rail tracks for the Frankston, Dandenong, Cranbourne and Pakenham lines were moved to



**Arden Station by Hassell, Weston Williamson and Rogers Stirk Harbour & Partners.**

create space for the new tracks to enter the tunnel. After the completion of the Melbourne Airport Rail, the trains will operate from Cranbourne and Pakenham via this tunnel entrance directly to the airport.

Work is currently progressing on an underground substation at South Yarra.

Anzac Station will bring train services to St Kilda for the first time and will allow commuters to be in the CBD in two minutes. It will eventually have direct services to Melbourne Airport. A tram super-stop will sit in the middle of the road and be able to connect passengers to the underground train station.

Anzac Station is planned to become a gateway to the Shrine of Remembrance,

Royal Botanic Garden and Albert Park.

All four of the Metro Tunnel’s TBMs are being retrieved from underground. The TBMs – named ‘Meg’, ‘Alice’, ‘Millie’ and ‘Joan’ – are being carefully dismantled before being transported back through the tunnels.

The machines are Herrenknecht Mixshields, running 120m long and featuring cutterheads with diameters of 7.2m.

Their removal follows 20 months of digging over a length of 9km, with Meg the last to arrive at the new Town Hall Station destination back in May.

The machines will be returned to the supplier and reassessed for potential reuse.



# Blue Mountains Tunnel

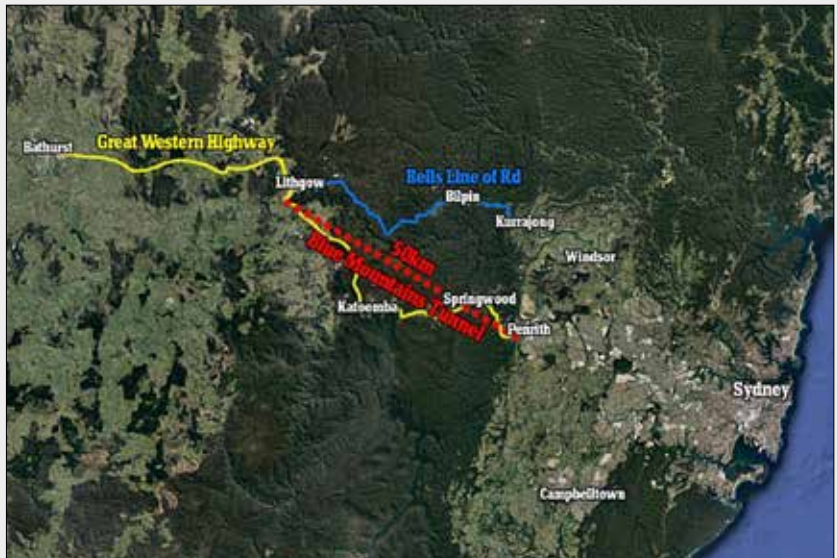
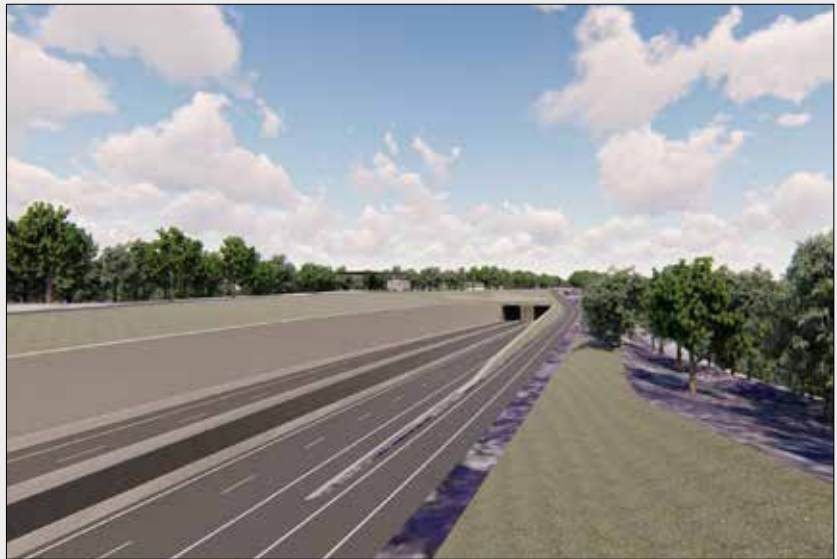
Ambitious plans to build a 50km tunnel under the Blue Mountains, that would have made it the 5th longest in the world, have been ruled out by bureaucrats for being too expensive. Instead, NSW government will construct two shorter tunnels of 4km and 4.5km.

The multi-billion-dollar tunnel would have bypassed the nearly 200-year-old Victoria Pass - a dual carriageway prone to heavy congestion during peak periods - on the range's western side.

NSW Minister for Regional Transport and Roads Paul Toole said plans would go ahead instead for the two shorter tunnels in the region at a cost of \$2.5bn. The two tunnels at Blackheath and Mount Victoria will form part of the Great Western Highway duplication project to reduce the notorious levels of traffic that run through the Blue Mountains.

Residents of Medlow Bath have called for the tunnel to be even longer, stretching from the popular tourist town of Katoomba to Hartley.

Victoria Pass was opened in 1832 after being built by convict labour but is well-known in recent years for being the site of traffic bottlenecks. Construction on the two separate tunnels is expected to start in 2022. The road between Katoomba and Lithgow will also be duplicated to create a four to five lane highway.



## North East Link

Spark consortium has been announced as the preferred bidder for Melbourne's much anticipated North East Link project, the largest Public Private Project (PPP) in Australia.

The Spark consortium includes WeBuild, GS Engineering and Construction, CPB Contractors, China Construction Oceania, Ventia, Capella Capital, John Laing Investments, DIF and Pacific Partnerships.

The North East Link Primary Package PPP provides three-lane twin tunnels that will finally close the missing link in Melbourne's freeway network. Up to 135,000 vehicles will use North East Link every day, reducing congestion in the north-east while maintaining local roads for local trips.

The \$7.9bn major works contract will be delivered as part of a PPP. The scope of the PPP includes the design of the entire North East Link corridor, including:

- extension of the M80 Ring Road at Plenty Road and the Greensborough Bypass at Plenty River Drive to the northern tunnel portal located near Blamey Road.
- approximately 6km of twin, three lane tunnel from the northern portal located at Blamey St, to a new southern portal located south of the Veneto Club in Bulleen.
- connection of the Eastern Freeway to North East Link, as well as major upgrades and modifications to the Eastern Freeway from Hoddle St to Springvale Rd.
- The long-term operation and maintenance of the entire North East Link corridor over a 25-year contract.

Construction has started with targeted completion by 2027. Once completed, the entire NEL corridor will be operated and maintained under a 25-year contract.



# Western Sydney Airport Metro Gets Green Light

The Sydney Metro – Western Sydney Airport project has reached a major milestone with planning approval having been granted by the New South Wales Government and major construction set to commence soon. The successful tunnel contractor will deliver 10km of twin Metro railway tunnels and the associated excavations of station boxes.

The entire 23km driverless metro will service western Sydney and the new Western Sydney International (Nancy-

Bird Walton) Airport, delivering major benefits for the region.

It is expected to transport up to 7,740 passengers each hour in each direction, while also taking about 110,000 vehicles off local roads every day, significantly reducing local traffic.

Community feedback has helped shape the project, including introducing measures to further reduce parking impacts on local communities and the relocation of a temporary bus

interchange.

It will take just five minutes to travel from the airport to the Aerotropolis, about 15 minutes from the airport to St Marys and 20 minutes from the Aerotropolis to St Marys – where customers can connect to the rest of Sydney’s rail network.

Early works started on Sydney Metro – Western Sydney Airport in December 2020. Major work will start in the coming months, with the tunnelling contract awarded by the end of the year and

TBMs in the ground by the end of 2023. The Australian and NSW governments are jointly delivering the 23km metro railway and six stations between St Marys and the Western Sydney Aerotropolis, including two stations at the airport.

Commonwealth Government approvals for Sydney Metro’s rail development work within the boundary of Western Sydney International Airport are expected in the coming months.

## Brisbane Metro



One of the tunnels dug for the Brisbane City Council’s \$1.2bn Metro project will not be finished in time for its “soft launch” and key upgrades to the Cultural Centre station, Victoria Bridge and Buranda Busway will also be incomplete. Full funding for the 60 articulated buses, and a pilot vehicle is not expected to make it onto existing city busways until at least early next year.

The Adelaide Street link, which will allow high-frequency buses to travel below the surface between the Victoria Bridge and King George Square busway, is now likely to take about 18 months, with an extra six months of additional work to finalise it. Construction on the tunnel is expected to start in late 2021, with completion due in May of 2024.

An above-ground Cultural Centre station upgrade is expected to be finished in early 2024 with work also expected to be ongoing along the Victoria Bridge and Buranda Busway, when buses begin entering service primarily on the Metro 1 route between Eight Mile Plains and Roma Street.

But the council will reheat its push for the Cultural Centre station to go underground following Brisbane’s 2032 Olympic successful bid.

## Track-laying under Sydney harbour

The 800m section of track in the northbound harbour tunnel is now complete while tracklaying on the southbound tunnel is expected to finish by July.

The NSW government’s flagship rail project will be composed of a line from Chatswood to the CBD, traversing under Sydney harbour, and then onto Sydenham and Bankstown.

More than 4000 tonnes of Australian steel had been used for 31km of tracks from Chatswood to Sydenham, including 200 tonnes under the harbour.

Internal documents have shown the cost of the Metro City and Southwest line, which is due to open in 2024, risks blowing out to as much as \$16.8bn.

The government originally budgeted the rail line to cost \$11.5bn to \$12.5bn.

New stations are being built at Crows Nest, North Sydney, Barangaroo, Martin Place, Pitt Street and Waterloo, along with new underground platforms at Central Station.



# Metro West

A \$1.96bn contract has been awarded to start tunnelling on Sydney's mega Metro West project. Construction work will begin immediately to deliver 11km of twin metro rail tunnels between Sydney Olympic Park and The Bays.

Mega TBMs will be in the ground before the end of next year, under the contract awarded to Acciona Construction Australia Pty Ltd and Ferrovial Construction (Australia) Pty Ltd Joint Venture.

The contract includes:

- Twin 11km metro railway tunnels from The Bays to Sydney Olympic Park.
- Excavation and civil works for five new stations at The Bays, Five Dock, Burwood North, North Strathfield and Sydney Olympic Park.
- Two double-shield, hard rock TBMs.
- A crossover cavern at Burwood North and one of the two precast concrete factories at Eastern Creek.
- More than 70,000 concrete segments to line the twin tunnels.
- Two access shafts at Burwood North and The Bays.
- A TBM launch site at The Bays Station and a TBM retrieval site at Sydney Olympic Park Station.

Completion of the tunnelling contract is expected in 2025.

Sydney Metro West will double rail capacity between Greater Sydney and the Sydney CBD, with customers able to get from Parramatta to the Sydney CBD in around 20 minutes on a fast, safe and reliable driverless metro train.

Sydney Metro West will create more than 10,000 direct new jobs and 70,000 indirect jobs, with many of these jobs generated by this major contract.

To build these tunnels a broad range of skills will be required including tunnellers, electricians, plumbers, carpenters, concrete workers, truck drivers, labourers and security guards.

Acciona Construction Australia Pty Ltd and Ferrovial Construction (Australia) Pty Ltd Joint Venture was awarded the first



of three major tunnelling contracts after a competitive tender process involving three shortlisted companies.

The remaining two tenderers John Holland, CPB Contractors and Ghella Australia Joint Venture (JHCPBG JV) and Gamuda and Laing O'Rourke Australia Joint Venture (GALC JV) will now bid for the Western Tunnelling Package, with the successful tenderer awarded a contract to build 9km of twin tunnels between Westmead and Sydney Olympic Park. This second major contract is expected to be

awarded by the end of this year.

Sydney Metro has also begun the process to appoint its third major tunnelling contractor for the Eastern Tunnelling. This contract for tunnelling between The Bays and Hunter Street in the Sydney CBD is expected to be awarded by late 2022.

Due to the massive scale of the Sydney Metro project, the final tunnelling contract value may vary due to ongoing fine-tuning and optimisation involving the other major contracts, for which tenders have yet to be received.

## New rail tunnels part of Infrastructure Victoria's 30-year plan

New rail tunnels part of Infrastructure Victoria's 30-year plan

Melbourne's future suburban rail loop will return at least \$1.10 on every dollar spent, the business and investment case for the multi-billion-dollar project shows. The train route will begin at Cheltenham and run underground to Box Hill and then across Melbourne's north to the Airport, and then south to Werribee — it will not be fully completed until 2053.

But the business case does not put a total projected cost of the entire project, raising questions about the accuracy of its cost-benefit analysis. The report says the first two sections will cost up to \$57bn.



The final section between Melbourne Airport and Werribee has no price tag.

The first section dubbed SRL East is expected to cost between \$30bn and \$34.5bn, with work to begin next year and be completed by 2035. It includes six new stations along an entirely underground route.



# Westgate tunnel

Melbourne's long-delayed West Gate Tunnel was originally scheduled to be completed in 2022. A new deal could spell the end of a long-running dispute over where to dump tonnes of contaminated soil from the troubled project.

Toll road operator Transurban, the state government's partner in the project, has confirmed that Hi-Quality in Bulla had been chosen to construct a purpose-built facility to collect, treat and dispose of the soil. Hi-Quality's tip, north of Melbourne Airport, was nominated by the tunnel's builders, CPB Contractors and John Holland, as the preferred site for the soil. Two other sites were also considered.

Hi-Quality estimates up to 200 jobs will be created during construction of the facility, while 50 workers will be hired to operate the soil site once it is completed in about six months.



"Transurban and its builder have had over four years to resolve this issue, and while we're pleased they have finally made a decision, they need to get on with setting up the site and getting the tunnel boring machines going," a state government spokeswoman said.

The \$6.7bn tunnel, which will be an alternative to the city's heavily congested West Gate Bridge, was originally scheduled to be completed in 2022.

But tunnelling was delayed in 2019 after soil contaminated with polyfluoroalkyl substances (PFAS) - dangerous chemicals that have been widely used in firefighting foam - were discovered at the construction site. Hundreds of workers on the project have lost their jobs because of the delay. Testing shows the levels of PFAS in the soil is expected to be low and at safe levels for the community and the environment.

Meanwhile Victorians with properties above the West Gate Tunnel are demanding compensation, in what could become a multi-million dollar test case for the state government. 90 Yarraville residents and commercial landowners have signed up to an action run by law firm Slater and Gordon, claiming the \$6.7bn tunnel will cause the value of their properties to drop.

## Early work begins on Western Harbour Tunnel

Tunnelling on early stages of the multibillion-dollar Western Harbour Tunnel has begun and excavators are now working to connect a vast spaghetti junction beneath Sydney's inner west with the future harbour crossing.

With more than 60 per cent of tunnelling complete on the Rozelle Interchange, excavation work has begun to connect the road junction to the harbour tunnel, according to the NSW government.

A three-storey underground junction, which varies in depth between 35 and 65m, the Rozelle Interchange will act as a linchpin for the WestConnex, and also provide the connection to a future Western Harbour Tunnel.

The state government has also confirmed planning approval has been granted for 10 hectares of parkland above the interchange.

NSW Transport Minister Andrew Constance said the parkland was being built on almost 10 hectares of formerly inaccessible industrial land.

It will feature sporting facilities, and walking and cycling tracks that will connect to Callan Park, the Bay Run and a



**An artist's impression of proposed parkland above the Rozelle Interchange.**

proposed public foreshore link at the Bays West. Mr Constance said the parkland was scheduled to be completed in 2023, along with the interchange.

Minister for Planning and Public Spaces Rob Stokes said the parklands will be a "green gem" in a network of existing and future public spaces and similar in size to Victoria Park near Sydney University.

However, some areas outside the scope of the landscape plan to develop the parkland, including parking and recreational facilities, have been referred to a working group made

up of government and council representatives, as well as community members.

While a link between Anzac Bridge and Iron Cove will be toll-free, motorists will be charged \$1.40 to enter the remainder of Rozelle Interchange, with a 50 cent per-kilometre distance-based toll on top of that.

The government anticipates 640,000 cubic metres of concrete and 32,000 tonnes of Australian steel will be used in construction.

More than 7.6M work hours have gone into the construction of the interchange, according to a NSW government spokeswoman.

Planning approval for the Western Harbour Tunnel and Warringah Freeway upgrade, which is expected to be completed in 2026, was granted earlier this year, with major construction set to begin later this year.

The Western Harbour Tunnel will be built in a trench on the harbour floor, and large prefabricated concrete tubes lowered into place from barges above.

# Inland Rail update

## - July 2021

Inland Rail is Australia's largest linear transport infrastructure project and will transform how we move goods around the nation, generating opportunities for our regions and our economy, now and well into the future.

The 1,700km freight rail line will connect Brisbane and Melbourne in less than 24 hours via regional Queensland, NSW and Victoria and is an enormous feat of engineering due to its size, scale and pure ambition.

Inland Rail is needed so Australia can keep pace with the freight demands of our growing population for everyday goods such as tinned food, drinks, white goods, fruit and vegetables.

At the peak of construction, Inland Rail will support more than 21,500 jobs and deliver an economic boost of more than \$18bn to Gross Domestic Product during construction and the first 50 years of operation.

Businesses across Australia are benefitting from Inland Rail's construction, with local materials and services sourced from all states and territories and more than 1,500 contracts awarded to more than 400 suppliers as at May 2021.

When fully operational from 2027, Inland Rail will enhance supply chain links between regional producers, manufacturers and businesses and national and global markets, reduce our reliance on road freight, and generate new opportunities for industries and our regions.

The ambition is taking shape with construction well underway.

The first of the 13 sections that comprise Inland Rail, the 103km Parkes to Narrabrie

section in central New South Wales, was commissioned in late September 2020 and is now operational.

Major construction on the Narrabrie to North Star Phase 1 section in NSW also started in November 2020 and solid progress is already being made.

More than 56km of old track stripped, 112km of old rail removed, more than 93,300 timber, steel and concrete sleepers removed, more than 220 culverts and 82 wingwalls installed and five bridges demolished. At May 2021, 335 people were working on the project (including 57 Indigenous people) and more than \$10.5M had been spent with 101 local suppliers.

In Queensland, the section from Gowrie near Toowoomba to Kagaru near Beaudesert, will be delivered under a Public Private Partnership (PPP). This 128km Gowrie to Kagaru section is the most technically complex of the entire Inland Rail Program.

The projects in this section are currently transitioning through Environmental Impact Statement (EIS) and



environmental approvals phases.

The Calvert to Kagaru and Helidon to Calvert projects have completed draft Environmental Impact Statement public display periods and the Gowrie to Helidon section's draft EIS is on public exhibition from 2 August to 25 October 2021.

Procurement for the PPP is running in parallel with the EIS and approvals phases. Three world class consortia were shortlisted for the Request for Proposals phase in 2020 which closed in June 2021.

Inland Rail is currently evaluating all proposals and

expects to complete the PPP procurement process and award this contract in 2022.

For each Inland Rail section, the mechanism for final approval of the detailed alignment will be the relevant planning approval instrument in each state.

Draft EISs have been completed for the Narrabrie to Katoomba, Katoomba to Helidon, Helidon to Calvert, Calvert to Kagaru and Helidon to Calvert projects. Sections in southern NSW and Victoria are progressing towards major reference design milestones too – all building momentum to deliver Inland Rail by 2027.



**This section features the construction of three tunnels including the 6.2km Toowoomba Range tunnel, as well as numerous viaducts (some over 50m high and 1.8km long), bridges and crossing loops to build a new dual gauge track traversing Toowoomba, the Lockyer Valley, Ipswich and the Scenic Rim.**



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# Constructing our future together

CPB Contractors is Australia's largest tunnelling contractor, delivering next generation projects that are reshaping the way cities move and better connecting people and communities.

Working across the roads, rail and utilities sectors for more than 50 years, we've undertaken some of the country's largest tunnelling projects, including the Sydney Harbour Tunnel, Brisbane Airport Link, Epping to Chatswood Rail Link and the WestConnex M4 East and M8.

Combining the construction track record and expertise formerly delivered by Thiess and Leighton Contractors, our team continues to provide vital, long-term infrastructure, including Sydney Metro City to South West, the WestConnex Rozelle Interchange projects, and Melbourne's West Gate Tunnel and Cross River Rail project in Queensland.

Cross River Rail, QLD



# McConnell Dowell gets creative on NZ storage pipeline

McConnell Dowell are closing in on completion of the St Marys Bay Area Water Quality Improvement project in Waitemata Harbour, Auckland. The complex project involves the construction of a new stormwater storage pipeline which will help provide a better life for people, birds and marine life in the region. The last tunnelling drive was completed at the end of 2020 with Hinehōaka, the project's microtunnel boring machine (MTBM), successfully completing more than 1km of microtunnelling in less than six months.

The 1,120m storage pipeline, which includes a marine outfall, was constructed in three separate tunnelling drives using pipe-jacking methods.

The new pipeline will reduce wastewater overflows to St Marys Bay and Masefield Beach by 95 per cent. The high flows after rain events will be stored in the new larger capacity pipeline and pumped back into the sewer network for treatment when there is capacity.

As well as reducing overflows, once complete the new marine outfall will discharge to a location far away from places where people swim.

Two shafts were constructed in council parkland at the bottom of the cliff face to accommodate each tunnelling drive and a third shaft needed to be constructed in the narrow streets around St Marys Bay. This shaft was carefully and cleverly designed to be able to retrieve the MTBM from a 3.8m diameter shaft, 25m below ground.



**The MTBM is retrieved at the London-New Street shaft**

Each tunnelling drive had its own unique challenges but one of the major challenges the project team faced was tunnelling very close to, and underneath, restored villas worth millions of dollars in one of Auckland's oldest suburbs. To mitigate stakeholder issues and concerns, the project set up a 'SiteHive' unit to collect data while the MTBM was operating. The unit continuously collected noise, dust and vibration monitoring readings from the worksite and this data helped proactively manage consent compliance, as well as record the impact of the operations. When noise reached predetermined levels a photo and sound recording were taken to capture the activity onsite. This constant monitoring meant the team could ensure construction activity operated within the consent conditions and any exceedances were investigated to see what could be done differently to ensure compliance in the immediate future.

Another technical feat on this project has been the design, construction and



**The London Street shaft under construction**

sinking of the marine outfall pipe. The outfall, constructed by McConnell Dowell's New Zealand marine team, had been cleverly built to withstand the 12-hour pipe-tow journey from Kaiaua, Firth of Thames to Auckland. What made this significant milestone a challenge was the on-water installation of the ballast blocks. Although on-water installations have been done before, the Creative Construction™ difference on this project had been the design and construction of the custom-made frame attached

to the side of the barge. This meant there was less pipe bending during the installation, while ensuring sufficient space on the barge to store the 70 ballast blocks and the crane that was carrying out the operation. Once the ballast blocks were installed, the 460m HDPE pipe was floated around from its temporary mooring off Westhaven Marina to its final position adjacent to Masefield Beach.

Although the sinking of the pipe was an effortless seven-hour procedure, the accuracy of the sinking was mainly due to the measurements taken by site engineers two days prior.

Starting from 3am, the team started measuring the pipe every hour for two days to see how it expanded and contracted in different temperatures and they noted the pipe dimensions that were recorded at the beginning of the day were different at the end of the day. By using these calculations, they could give a close-to-perfect hypothesis of where the pipe would land at completion of the sinking. As a result of these studies, there was only a slight discrepancy of 50mm off the predicted landing.

Health and wellbeing has also been a huge focus on this project, as all three tunnelling drives were carried out by the team working in shifts over a 24-hour, five days per week work period. To educate the team around mental health, McConnell Dowell invited Mates in Construction, a program aimed at improving mental wellness and reducing suicide in the construction industry, to run sessions onsite with the crew.

# Auckland City Rail Link

May 7th marked a milestone for Tāmaki Makaurau with the launch of the TBM at New Zealand’s largest infrastructure project, the \$4.4bn City Rail Link. The German-designed Chinese-built machine, named Dame Whina Cooper, was launched at the project’s Mt Eden site. The TBM is named after Māori rights champion, Kahurangi Dame Whina Cooper.

The machine will be operated by

the Link Alliance: New Zealand and international design and construction companies building the stations, tunnels and rail systems. The first 50m of tunnel at Mt Eden has already been mined to give room for the front sections of the enormous 130m-long machine that will excavate 1.6km under the Central Motorway Junction and Karangahape Rd into central Auckland to connect with the CRL tunnels already built from the Britomart Station.

The TBM will complete her first tunnel towards the end of the year, then be trucked back to Mt Eden in sections and prepared for its second tunnel drive next year.

The project, paid for by the Government and Auckland Council, aims to make the city’s rail network more efficient: trains will be able to run more often, faster and carry more people.



## ‘Long tunnel’ in the mix for Let’s Get Wellington Moving rethink

As if a second Mt Victoria tunnel in Wellington wasn’t controversial enough, there’s now mention of a “long tunnel” in alternative versions of the city’s \$6.4bn transport plan.

Let’s Get Wellington Moving (LGWM) is behind schedule, over-budget, and currently being picked apart. Interim work on the business cases for mass rapid transit and a second Mt Vic tunnel highlighted the cost blowout and found the project could be reshaped to deliver better outcomes.

So as of February this year officials were working on two different recommended programmes of investment and seven approaches for delivery. Among these various options in documents released under the Official Information Act there is mention of a “long tunnel” between the Terrace Tunnel and Kilbirnie.

The long tunnel is part of four transport network options being considered by LGWM, the \$6.4bn transport and urban development programme

focused on the area between Wellington Airport and the Ngauranga Gorge.

The Property Group, a consultancy firm, proposed a “long tunnel” – through Newtown, Mt Cook, and Te Aro – saying it would open up the most new space for housing and urban development. It would give the potential for more than 39,000 new

dwellings and almost 1.3 M square-metres of commercial floor space.

The option also included a new Mt Victoria walking and cycling tunnel, adjacent to the existing tunnel; light rail between Wellington Railway Station and Island Bay; and another form of rapid transit to Miramar and the airport.





# Central Interceptor

Watercare's Central Interceptor tunnel is set to be the biggest wastewater project in New Zealand history. On 30 July, TBM 'Hiwa te Rangi' (roughly translated, 'vigorous growth', a promise of a prosperous season) set off on her 14.7km journey under Auckland city. The TBM began cutting at the bottom of the 40m launch shaft and will travel north to its ultimate destination in Grey Lynn.

The name for the TBM was chosen by students who attend school along the route. Hiwa te Rangi, according to Māori legend, is one of the Matariki stars to which Māori would send their dreams or aspirations for the new year.

The Central Interceptor is an NZD\$1.2bn (AUD \$1.14b) wastewater tunnel, which, once completed, will be New Zealand's longest bored tunnel. Providing both storage and conveyance, it will hold 226,000m<sup>3</sup> of water and provide significant environmental benefits to the area.

Historically, heavy rain has overwhelmed the network, creating overflow into neighbouring streams. The Central Interceptor will reduce overflows into waterways and harbours, improving water quality and ensuring clean, safe



**Domenica, a Micro TBM lifts the first pipe into the shaft at Watercare's Central Interceptor project site at May Rd, Mt Roskill**

beaches. The tunnel has been designed to operate for 100 years. The Central Interceptor will run underground from Western Springs, near the Auckland Zoo, to the Māngere Wastewater Treatment Plant.

In June a micro-Tunnel Boring Machine (mTBM) called 'Domenica' started digging and laying the first pipe for the Central Interceptor wastewater tunnel project. The 12m long mTBM laid the first three metre section of the 2.1m diameter pipe at the May Rd, Mount Roskill site on 4 June. Another 328 pipe sections will follow over the next four months to create the first of two link sewers, which will branch off the main Central Interceptor Tunnel.

The first link sewer to be completed will travel from May Rd to Miranda Reserve in Avondale. The second will start near the Mt Albert War Memorial and travel 1.5km to the Ōrākei sewer main.

Domenica is named after Italian relatives of Ghella, one of the partners in the Ghella Abergeldie Joint Venture, which is delivering the project. She was manufactured in Germany and refurbished in Thailand.

The project is being delivered by the Ghella Abergeldie Joint Venture (GAJV) and will comprise nearly 20km of tunnels, more than 17 shafts, a major pump station and significant wastewater management and network infrastructure works.

The project is scheduled for completion in 2025.

## Shijingshan tunnel disaster

The Shijingshan tunnel flooded whilst under construction in China in July 2021. The rescue effort at Shijingshan tunnel involved divers, remote-controlled submarines and other high-tech equipment. But unfortunately the 14 miners could not be saved.

The Shijingshan tunnel is a section of an expressway under construction that passes beneath a reservoir in the Guangdong province city that lies close to Hong Kong and Macao.

Rescue work was hampered at times by carbon monoxide fumes from machinery being used in the tunnel as part of the operation. While the cause remains unclear, reports said an abnormal noise was heard and bits of material started falling off one side of the two-tube tunnel. An evacuation was ordered as water rushed in, but the 14 who died were unable to escape in time. The construction project appeared to have had safety problems for some time. In March, two workers died in another part of the tunnel.

## China launches largest self-built mix-shield TBM

China's largest domestically made shield tunneling machine "Jinxu" was officially launched in Changsha, Southwest Hunan Province on Saturday, attracting widespread attention online with not only its massive size but also its "panda" paint.

The machine has a diameter of 12.79m and weighs 3,000 tons. It will be used in the construction of Jinxiu Tunnel, an essential component of the highspeed railway from Chengdu to Zigong in Southwest China's Sichuan Province, which is known for being a home to pandas.

The machine will tackle complex conditions in the Jinxiu Tunnel, underneath a busy area of Chengdu.





## Two more JIMT/TERRATEC EPBMs to Taoyuan MRT Green Line

On behalf of JIM Technology (JIMT), TERRATEC has announced the delivery of two of the four, 6.24m diameter EPBMs that will be used by FUTSU-OBAYASHI-CEC JV for its underground works contract on Taoyuan MRT Green Line Contract GC03, in Taoyuan city of Taiwan for the Department of Rapid Transit Systems, Taoyuan.

Japanese contractor, Obayashi Corporation has purchased a total of four EPBMs from JIMT for Contract GC03. These first two 6.24m diameter EPBMs have completed their Factory Acceptance Test (FAT). The remaining two 8.38m diameter EPBMs will be delivered next year.

Earlier in April, a 6.24m diameter EPBM was delivered to BES-DAIHO-OKUMURA JV for its underground works contract on Taoyuan MRT Green Line Contract GC02. A total of two 6.24m diameter EPBMs will be delivered for this contract.

Both TBMs were produced in the TERRATEC factory, with key components

coming from Japan. The performance and quality have been evaluated as equal to those made in Japan by Obayashi Corporation, the Japanese contractor. In addition, the TERRATEC factory complies with the requirements of Japan's Official Development Assistance (ODA) policy that Japanese technologies and/or equipment are substantially utilized.

Taoyuan MRT Green Line is a rapid transit line of the Taoyuan Metro which consists of 6 lines. The MRT Green Line has a total of 21 stations (10 underground stations and 11 stereoscopic stations), with a total length of 27.8km. Contract GC03 includes 3 underground stations with two drives of 2.3km of up & down tunnels. The main drive is planned from the launch shaft and both TBMs will excavate from North end to Daxing West Road Intersection Station (G10) through Taoyuan P. Arts Center Station (G11) & Nankan Bus Station (G12). Work will start in October 2021.

The versatile EPBM has robust spoke type with outer ring cutterheads designed

to work effectively in the geology which includes sandstone and boulder that is expected on this contract. It is designed to smoothly discharge large boulders through the ribbon-type screw conveyor. As the TBM progresses, they will install 1,200mm wide by 250mm thick reinforced concrete lining rings, which consist of five segments plus a key. Muck cars will be used.

Taoyuan MRT Green Line is anticipated to complete in 2025. The City government plans to connect the Taoyuan Airport Line, the MRT Green Line, the Green Line to Zhongli, the MRT Brown Line, the Sanying Extension Line to extend the Bade section, and the underground Taoyuan Railway to form a ring-shaped track system. Through connecting the six lines, the City MRT system will provide a mass, fast and convenient travel service for the overall urban redevelopment.

Since 2018, TERRATEC is a member of JIMT Group which is the company created by three Japanese industrial giants: IHI Corporation, Mitsubishi Heavy Industries and JFE Engineering Corp. to merge their TBM divisions, thus combining their technology and experience of over 4,000 TBMs delivered since 1939 of every type and size up to 16 metre in diameter, for both Japan and Overseas projects.



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# Mumbai Metro

In Spring 2021, the second of two 6.65m diameter Robbins Crossover XRE TBMs made its third and final breakthrough for India's Mumbai Metro Line 3. The first machine made its final breakthrough for the project in late April. The tunnel drives were a triumph for joint venture contractor Larsen & Toubro and the Shanghai Tunnel Engineering Company (L&T – STEC), as the crew and equipment overcame unpredictable terrain, high-pressure water ingress, and government-imposed lockdown orders during the Covid-19 pandemic.

The two custom-built machines were selected to bore parallel 2.9km tunnels between the Cuffe Parade station and CST stations, breaking through into several station sites along the way. "It is the first time in India that Dual Mode, Crossover type TBMs equipped with a horizontal screw conveyor and high torque/high speed (two-speed) cutterhead drives were used. Overall, the performance of the Crossover TBMs was found satisfactory and we are in the process of shifting these TBMs for the L&T Chennai Metro project," said Mr. Palwinder Singh, Head – Tunnel Construction for the L&T – STEC JV.

In another first for India, the Crossover TBMs employed a unique technique in a 554m long section from Hutatma Chowk to CST stations. They were used in the benching of the NATM Platform tunnel through basalt rock (removal of the bottom section of rock remaining in the station after conventionally removing the top section). "This requires fine control on the operational parameters of the TBM because only 25% of the cutterhead is excavating the rock mass, while the remaining 75% of the cutterhead has no contact with rock or soil. In addition, the TBM was relaunched without using a reaction frame, instead taking reaction from half segments erected during the benching of the NATM Platform Tunnel. These innovative concepts were accomplished for the first time in India at Mumbai Metro Line-3, Package 1, and I therefore have many reasons to feel proud on the completion of tunnelling," said Singh.

L&T – STEC made impressive

progress throughout tunneling despite the many exacting circumstances surrounding the scope of work. Above ground, the joint venture not only had to navigate the restrictions of working within an urban environment, such as limited work hours and the slow removal of muck due to minimal space and traffic, but also faced concern for major structures such as the Mittal Towers and the historic Bhikha Behram Well located along the tunneling route. The Crossover TBMs excavated with only 15 to 20m of cover separating them from these important structures, which had to be instrumented to monitor vibrations, movements, and potential settlement.

It was only limited by the rate of muck removal and we could have finished the tunnels much faster," said Singh.

L&T engineers were highly involved in the specifications and designs of the machines and worked closely with Robbins to prepare for the challenges the project presented. While L&T had extensive tunneling experience, tunneling with a Crossover machine was entirely new to them. To remedy this, Robbins provided a team of key personnel to train L&T in all aspects of the machines' design and operation. "Working with Robbins field service was more than satisfactory. Even during the Covid-19 pandemic times, Robbins



Underground, L&T – STEC faced a complex geological mix of fresh greyish basalt, soft volcanic tuffs, shale, and breccias—consolidated rocks of angular fragments of disintegrated volcanic rock. One of the biggest concerns, however, came from the tunnels' proximity to the coastline of the Arabian Sea. During one point, TBM 1 was only 25m from the coastline, with the invert level of the tunnel running approximately 22m below mean sea level. As anticipated with circumstances such as these, the Crossovers faced a significant amount of groundwater with up to 300 liters/min during their excavation.

Despite these obstacles, the TBMs were still able to maintain impressive rates. TBM 2 even completed one push in a swift 14 minutes. "In fact, the boring rate of the Crossover TBMs was never an issue for us.

field service was available 24 hours a day, 7 days a week. What else can one expect?" said Singh

Each milestone reached on this project is another step closer toward significantly improving the lives of Mumbai residents. As the financial capital of India and one of the most populated cities in the world, Mumbai is faced with an excessive amount of road traffic. It currently takes up to two hours to drive the 25km distance from Cuffe Parade to the airport—the same trip on the finished metro will take a mere 50 minutes. The completion of Mumbai Metro Line 3, which is expected in 2025, will not only save residents transit time, but is expected to initially decrease road traffic in the area by 35%, reducing daily fuel consumption by 460,000 liters.



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## First tunnel breakthrough for Malaysia-China mega rail project



**Workers assembling in front of the Paka Tunnel mouth, which is part of the East Coast Rail Link project, in Terengganu**

The East Coast Rail Link (ECRL), Malaysia's mega rail project, jointly constructed with China Communications Construction Company (CCCC), has seen the first tunnel breakthrough in Terengganu.

The ECRL runs from Malaysia's largest transport hub in Port Klang and travels across the peninsula to Kelantan, which is expected to greatly enhance connectivity. It is expected to bring more balanced growth to the country by linking its less-developed region on the east coast to the economic heartland on the west coast upon its completion in 2026.

The works at more than 300 locations will commence by year-end involving earthworks, bridge construction as well as tunnelling, which will drive the construction of the ECRL into its peak period.

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## Singapore Cross Island Line Phase 1

Singapore's Land Transport Authority (LTA) has awarded the S\$356M (£190M) contract for design and construction of a section of the Cross Island Line Phase 1 (CRL1).

A joint venture of Taisei Corporation and China State Construction Engineering will build the bored tunnel between the Aviation Park and Loyang stations.

Construction works for the 3.2km tunnel is expected to start in the second quarter of this year. For the first time, LTA will use a large-diameter TBM to construct a single tunnel with two tracks in it. Passenger services on CRL1 are slated to begin in 2030.

Taisei Corporation is currently involved in the construction of Marina Bay station and tunnels for the Thomson-East Coast Line while China State Construction Engineering is working on the construction of Keppel and Cantonment stations for Circle Line 6, as well as tunnels for the North East Line Extension.

The CRL - Singapore's eighth MRT line - will, at 50km, be the longest fully underground line on the network. It will serve existing and future developments in the eastern, western, and north-eastern corridors, linking major hubs such as Jurong Lake District, Punggol Digital District and Changi region. Almost half of its stations will be interchanges with other train lines. It will be constructed in three phases. CRL1 is 29km long and comprises 12 stations from Aviation Park to Bright Hill. Studies on the details of subsequent CRL phases are ongoing.

## Zojila tunnel re-awarded for 3rd time

The strategic Zojila Tunnel project in Kashmir which was re-awarded for a third time is facing another big hurdle barely 10 months after work orders were issued raising questions whether the tunnel will ever see the light of day.

The NHIDCL, a subsidiary of the highways ministry, which is executing the project, has written to the ministry to transfer the project to the ministry as it was finding it "difficult" to handle the challenging project.

Sources said the ministry is not keen to take back the project from the agency which was set up particularly to take up works in the hill states and north-eastern region. The NHIDCL made the request citing the death of an executive director who was an expert in tunnel engineering. It has also said that the authority engineer or independent consultant for the 14km tunnel project which includes a connecting road has also been suspended and it was trying to re-award the consultancy work.

Official documents show that NHIDCL wrote the letter to highways ministry barely a week after it put the company building the tunnel, Megha Engineering and Infrastructure Ltd (MEIL), in the 'negative list' alleging inefficiency and non-compliance of contractual provision.

Inclusion of the company in the negative list bars it from bidding for projects for one year. The NHIDCL's notice to the company mentions that the pace of work by the company is slow given the upcoming milestone of 10% progress to be achieved by October 1 this year.

"This is a strategic project and has to be completed in time, by September 2026 as per contract. Any delay will only increase burden on government exchequer and delay in bringing relief to people living in Leh and Ladakh, who remain cut off from the rest of the country for six months," said a source raising concern over the current state of affairs.

TOI has learnt that the MEIL had raised the issue of penalty and of putting it in 'negative list' with the highways ministry. The ministry had asked the NHIDCL to review its decision and subsequently the agency had taken it out of the 'negative list'. However, within hours it took a U-turn and put the company back under the list.

Sources in the highway building industry said imposing any penalty before the due date of first milestone and flip-flop over putting the company under negative list doesn't send a good signal to the sector, which has delivered even during Covid.

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# Final Breakthrough on Bangkok Orange Line Contract E3

Completion of the 3.3km MRT Orange Line (East section) project at Hua Mak Station has been celebrated following the final breakthrough of a TERRATEC 6.39m diameter EPBM driven by contractor Italian-Thai Development PCL (ITD) on one of three underground civil works contracts for the first 23km-long (East Section) phase of the Mass Rapid Transit Authority of Thailand's (MRTA) Orange Line Project.

The Eastbound tunnel breakthrough on Contract E3 was achieved way ahead of schedule. Contract E3, which was awarded to ITD in May 2017, totals over 6km of TBM driven tunnel and three underground stations, extending from Khlong Ban Ma to Hua Mak. After completing the Westbound tunnel on Jan. 20, 2020 with the best month ever in Thailand with progress of 663.4m, the EPBM began mining eastwards from the Khlong Ban Ma station box on April 26, 2020, and quickly got up to speed following its initial drive. By mid-June 2020, the TBM was achieving the best rates of 33 rings per day (46.2m/day – another best every advance rate per day) and had already undertaken its first intermediate breakthrough.

In March 2020, The Westbound tunnel breakthrough on Contract E3 took place a full month ahead of schedule. The Eastbound tunnel breakthrough on Contract E3 has been achieved 118 days ahead of schedule.

The TERRATEC S70 TBM was designed to tackle the variable soft ground geology of the city – which ranges from soft and medium to stiff and very stiff clays, with lenses of dense sand and the potential for high-pressure groundwater inflows – as well as the need to mine through numerous diaphragm wall shafts and potentially, concrete piles.

In order to handle these challenging conditions, the TBM's soft ground cutterhead features a spoke style and the addition of back-loading knife bits to assist the break-in and break-out of the shafts. In addition, the machine is fitted with an active bentonite face support injection system and double-gated screw, to ensure face stability and mitigate settlement

during excavation in areas of flowing sands and high groundwater pressure.

As the machine progresses along the alignment, it has been installing a precast concrete segmental lining consisting of five x 1400mm wide Universal style segments plus key, with an internal diameter of 5.7m.

In total, TBM tunnelling operations for ITD's Orange Line (East) contract has lasted two years.

Bangkok's new Orange Line will

eventually total about 35.9km with 26.2km aligned underground with 22 underground stations and another 9km and seven stations on elevated structures. The line is scheduled to open in March 2024. When completes, the Orange Line will provide a vital transportation link from Bangkok's city centre to districts in the east, reducing traffic congestion and paving the way for improved accessibility, economic growth and new residential and commercial opportunities along the alignment.

## Bangalore Metro

For the first time, the Bangalore Metro Rail Corporation Limited (BMRCL) has deployed an indigenously assembled TBM for Namma Metro work. The unnamed TBM has been deployed at Rashtriya Military School station and will burrow its way towards Langford station.

The length of the tunnel is around 650m. The machine is manufactured by Herrenknecht and assembled in Chennai. It is the first machine to be used by BMRCL which has been assembled in India.

After completing one tunnel between RMS and Langford, the machine will be brought back to RMS and re-launched for the second tunnel.

Under Phase II of Namma Metro project, the BMRCL is building an underground line from Dairy Circle to Nagawara (13.9km), which is part of the 21km line from Nagawara to Kalena Agrahara. For this, BMRCL will construct the underground line in four packages.

The BMRCL has already deployed four TBMs. One machine, Urja, commenced burrowing work in August 2020 from Cantonment station towards Shivajinagar. So far, it has covered a distance of over 328m. Another machine, Vindya, was launched in October last year, and has covered a distance of 279m.

The third machine, Avani, is boring a tunnel from Shivajinagar to Rashtriya Military School, and has covered 281m. Another machine 'Lavi' has been deployed and will start tunnelling work shortly.

Under Phase II, a total of nine machines will carry out tunnelling work to cover a stretch of 14km. Two machines, Tunga and Bhadra, will arrive from Chennai in a month and will be deployed between Dairy Circle and Langford.

The final two machines will arrive at a later stage and will be deployed for work between Pottery Town and Nagawara.







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# LTA Awards CRL1 Ang Mo Kio Station And Tunnels

Singapore's Land Transport Authority (LTA) has awarded the civil contract for the design and construction of Ang Mo Kio station and tunnels under the first phase of the Cross Island Line (CRL1) to Gammon Construction and Engineering Pte. Ltd – Bachy Soletanche Singapore Pte. Ltd. Joint Venture. Valued at \$644 million, the contract will also cover addition and alteration (A&A) works to the existing Ang Mo Kio station along the North-South Line (NSL). When completed, Ang Mo Kio station will be an interchange between CRL and NSL.

Construction works for the CRL1 Ang Mo Kio station are expected to start in the fourth quarter of this year, with passenger service slated for 2030.

CRL1 Ang Mo Kio station is an underground station located adjacent to the busy junction of Ang Mo Kio Ave 3 and Ang Mo Kio Ave 8. As it will be located

close to the NSL viaduct and surrounding structures, LTA and the contractor will closely monitor the project's progress and ensure that all works are carried out safely, with minimal impact to existing structures.

Deep excavation works for CRL1 Ang Mo Kio station will be carried out under challenging ground conditions, as the rock is typically weaker at the transition point between the Old Alluvium (predominantly soil-like material) to Bukit Timah Granite formation. This requires the use of specially-designed machinery to carry out the excavation works safely.

When completed, the station will have entrances that connect directly to different residential blocks, AMK Hub, Ang Mo Kio Integrated Transport Hub and Ang Mo Kio Town Garden East. Two of the new entrances will be connected to the station via underpasses across Ang Mo Kio Avenues 3 and 8. To ensure smooth traffic flow on the

roads, these underpasses will be constructed using a "pipe-roofing and mining" method, where a box structure made of pipes will support the ground while mining works are carried out beneath the surface of the road. This method minimises disturbance to the surrounding roads, buildings and underground services, as compared to the more traditional method of open cut excavation from the ground surface.

To minimise inconvenience to commuters, LTA will plan and coordinate closely with SMRT to carry out majority of the A&A works during non-operating hours. The CRL is Singapore's eighth MRT line and is fully underground. It will serve existing and future developments in the eastern, north-eastern and western corridors, linking major hubs such as Jurong Lake District, Punggol Digital District and Changi region. The CRL will have almost half of its stations as interchanges with other rail lines, making it easier and more convenient for commuters to travel across the rail network. CRL1 is 29km long and comprises 12 stations from Aviation Park to Bright Hill.

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# SRT marks Thailand's longest tunnel breakthrough

A TBM working on the country's longest rail tunnel at Ban Hin Lab, in Saraburi's Muak Lek district, has reported its first breakthrough. The breakthrough meant the 5.2km section officially became the country's longest tunnel, comfortably beating the 1.3km Khun Tan tunnel - part of the Northern rail route located on the border of Lampang and Lamphun.

The Ban Hin Lab is the first out of four tunnels which will form the dual-track rail route between Saraburi and Nakhon Ratchasima, also known as Korat.

SRT governor, Nirut Maneephan, said the breakthrough marked a milestone for the dual-track project carried out by Italian-Thai Development Plc and the Rail Tunnelling Co, which is a prominent feature in the rail transport infrastructure



**Engineers and technicians celebrate the breakthrough of the country's longest rail tunnel at Ban Hin Lab, in Saraburi's Muak Lek district**

development plan for 2015-2022.

Upon completion, the dual-track upgrade will bring the Northeast closer to the rest of the country as more trains, including high-speed services, will be able to run more frequently and carry more passengers and freight to the upper Northeast.

While three more tunnels will be constructed along the

main Northeast line, four new tunnels will be built on the Den Chai-Chiang Rai-Chiang Kong branch line.

The branch route spanning 323km will go through Phrae, Phayao, Lampang and Chiang Rai, where it will run to the 2nd Chiang Saen port, before terminating at the border bridge which crosses to Laos.

The four tunnels on the Den Chai-Chiang Khong route

comprise two to be built in Phrae with a combined length of 7.5km, a third near the Phayao University and a fourth at Doi Luang in Chiang Rai.

In April, the SRT announced it expected to name the contractors for the Den Chai-Chiang Khong and the 355km section between Ban Phai and Nakhon Phanom in the northeast route next month. Electronic bidding will be held to select the contractors to work on the sections.

Six companies or consortiums are expected to take part in the e-bidding, said Suranadet Thupawitrot, the SRT's chief engineer for constructions and special projects.

The Den Chai-Chiang Khong project is valued at 72.9bn baht, while the Ban Phai-Nakhon Phanom is worth 55.4bn baht, he said. The Den Chai-Chiang Khong project is further broken down into three construction contracts.



# ATS2020+1 Australasian Tunnelling Conference – a roaring success!



After nearly two years of planning, including postponement from November 2020, the 17th Australasian Tunnelling Conference (ATS2020+1) was held in Melbourne, Australia, between 10th and 13th of May 2021, at the Melbourne Convention and Exhibition Centre. The theme for the conference was ‘Innovating the next 50 years’, being recognition of all the great tunnelling work that had been carried out in Australia and New Zealand in the ensuing 50 years and looking forward to the next 50 years, due to the significant pipeline of tunnelling work.

The Australian Tunnelling Society National Executive Committee appointed Rob Muley as the conference organising committee chair and Richard Buckingham, the ATS Victorian Chapter Chair and ATS Vice-President at the helm to ensure the ATS was appropriately represented.

Rob isn’t one to do things by halves, and from the start, Rob set the crossbar at lofty heights where no conference committee had ever gone before. Rob brought together a diverse committee of industry leaders to ensure the conference lassoed the smarts in the industry, from the YOLO attitude of Gerard Quigg to the orchestration of scheduling extraordinaire Andrew Kindred.

Rob wanted the conference to be engaging and relevant to all, from the designers to the contractors, academics

to the capitalists, male to female, infrastructure tunnellers to miners, and the Australian old guard through to the overseas tunnel constructors entering the market. The tunnelling industry has come of age and the world has realised that Australia is the place in the world with a strong pipeline of exciting large tunnel projects for many years to come. Rob didn’t just want engineers on the organising committee; he also enlisted the soft skills of a marketing professional and the event organiser of the best event he’d ever been to, and Elle Events didn’t disappoint.

Given the groundswell of excitement in the industry, when the call was put out for

speakers in late 2019, there was a flood. Despite Andrew Kindred’s schedule of morning keynote followed by three parallel streams, the conference papers were four times oversubscribed. Volunteers from all around Australia and New Zealand gave their time to review the papers and helped chase up some outstanding papers and ensure there was a broad range of topics covered. The technical and special streams covered in the conference were:

- Innovative construction
- Future proofing through project development and delivery
- Environmental assessment, stakeholder engagement and community impact and placemaking
- Major projects—case studies
- Challenges for ground support and permanent lining
- World best practice in health, safety, risk, training and education
- Growth of digital engineering, instrumentation and tunnel data systems
- Improvements in tunnel ventilation and fire life safety
- Sustainable tunnel operations, maintenance and rehabilitation
- Tunnelling in Australia—the last 50 years
- Young Members—the future of our industry

Similarly, when the call went out for keynote speakers, key people from major projects around Australia were surprisingly





willing to brave Melbourne in mid-May.

The conference opened on the Tuesday morning with a Welcome to Country from Wurundjeri Woi Wurrung Elder Ringo Terrick, who discussed relationships with contactors on tunnelling projects. Ringo was supported by Uncle Trevor and the Yarra Yarra Dancers with traditional song, dance and storytelling, as well as a contemporary dance piece, which left the assembled delegates spellbound.

The Tuesday morning keynote presentation was filled with engaging presentations from interstate project leaders, as well as from local champions of the tunnelling industry, such as Corey Hannett, Director General at the helm of all of the tunnelling delivery authorities, and The Hon. Jacinta Allan, the current Minister for Transport Infrastructure and Minister for Melbourne's exciting upcoming mega-tunnelling project, the Suburban Rail Loop.

With speakers secured, there was a 'captain's call' that, everyone had had enough of the pandemic, it was to be a wholly face-to-face conference and this would be an exhibition like no other, or bust. No-one was going to be subject to papers on Zoom or Teams. A separate venue was hired in New Zealand and a specialist radio videographer engaged for a non-fish eye experience, because international borders weren't expected to open. Therefore, in parallel with the main conference in Melbourne, a New Zealand hub was set up in Auckland where 100+ New Zealand based delegates gathered in a venue and tuned into a live broadcast of the conference from Melbourne, and they also presented via the same broadcast link to the delegates assembled in Melbourne.

With the score written, the organising committee went around finding displays

and sponsors. The committee wanted a much larger trade exhibition to give the ATS's valued supporters an opportunity to really display their wares and capabilities. The large event space secured at the conference venue allowed a range of plant and equipment to be displayed, including impressive dust extractors, drilling rigs, shotcrete rig and a bright yellow front end loader.



The additional space also allowed some fantastic booths and displays to be set up, including a pool table, a virtual reality suite, several coffee carts, chill-out zones and jars of sweets! The breaks between the technical session were taken in the expo hall, where excellent catering was provided for the morning and afternoon tea, as well as lunch. Breaking in the expo area afforded delegates the opportunity to mingle, catch up and meet the exhibitors and their excellent and often quite imaginative booths and displays. Feedback from the exhibitors and delegates alike was very positive, and people certainly relished the opportunity to rekindle friendships and associations during the breaks.

However, with the calibre of the speakers and the prospects in the industry, it wasn't a hard sell. Most sponsorships were taken up, and others invented to suit market demands and all the 100+ exhibition booths filled, with our pre-pandemic targets met. Conference delegate sales initially trickled in and were mainly from Melbourne, but in the few weeks prior and with the borders remaining open, confidence grew, and Rob's vision realised and there ended up being well over 500 delegates. The event organiser also established a conference app, so that the program was on delegates phones and papers could be downloaded by delegates and easily scaled for all attendees.

As well as the three-day conference, the organising committee held two workshops on the Monday prior to the conference, being the 10th of May. At past conferences a workshop event has also been held, often with a tunnel design focus, and they have always proven to be popular. For the ATS2020+1 conference the organising committee was able to link up with the recently opened Victorian Tunnelling Centre (VTC) and the recently opened Victoria University (VU) Fire Testing Facility. Holding two workshops, one at each facility, allowed the ATS to provide a hands-on workshop experience and also was a great way to showcase these exciting new facilities. Both workshops were a great success, they were well received by their respective attendees and were a great start to the conference week. The conference was also followed by tours of the Melbourne Metro project on the Friday.

Keen to use the opportunity of the conference to encourage graduates and young engineers to help address the shortfall in the tunnelling industry, the organising committee put a call out to





universities, more than a year ahead of the conference, to do research on tunnelling. Four universities presented their posters on their research at the conference and were rewarded with a free conference ticket. On the first day of the conference there was also an afternoon technical stream for ATS Young Members, with discounted tickets for under 35s just for the afternoon and evening. After the first day of the conference there were networking drinks in the exhibition space and a Young Members event held at a spectacular location on the river, directly outside the conference venue.

The Young Members evening was opened to Young Members and the young-at-heart, so delegates rolled out of the conference to the networking drinks in the exhibition space and then kicked on to the Young Members event at The General Assembly at South Wharf. The young members of the committee recognised that this evening should be about networking and not a place for stuffy speeches.

The following morning, start of day two, there was a sold-out Women in Tunnelling Breakfast, hosted by ATS committee member Nadine Makin. At the breakfast, Dr Collette Burke, the inaugural Chief Engineer of Victoria and Susana Fueyo, the Executive Director of Adelaide's upcoming \$9B+ North South Corridor project, discussed some of the challenges facing the tunnelling industry given the current level of work and the strong pipeline of future projects.

Wednesday was another full day of technical presentations and networking, followed by a short break to get changed, or not, ready for the Conference Gala Dinner, a short walk along the river at the magnificent Crown Palladium. There the conference delegates caught up for an evening full of socialising, music,

comedy and recognition awards. The Allen Neyland Tunnelling Achievement Award was awarded to industry stalwart Tony Peach, who unfortunately was unable to attend the event, and the inaugural Women In Tunnelling Outstanding Achievement Award was presented to a thoroughly deserving Diane Mather. To top it all off, the Melbourne evening was uncharacteristically mild for the walk home at the end of a very long day.

The morning of the final day kicked off with a Sponsors and Exhibitors Breakfast, then a keynote presentation and a morning of three technical streams. The conference closing presentation was a debate chaired by Richard Buckingham on an issue close to the heart of any construction project, titled appropriately, quoting William Shakespeare, 'let's kill all the lawyers'. The debaters were conference committee chair Rob Muley, whose work inevitably includes bearing the brunt of lawyers, Partner at Construction Law Firm Corrs Ben Davidson and the tunnelling industry's favourite barrister and passionate advocate and FIDIC 'Emerald' Book for tunnelling projects Prof. Arnold Dix. This was a lively debate with some excellent and considered questions raised by the delegates and was a great way to round out the three days.

The conference closed mid-afternoon and the exhibitors bumped out.

The captain's call was the right one. The industry experienced what it really needed, a face-to-face conference, and a welcome reprieve from the year that was. The conference was full of memorable moments, but a highlight for many was the Wednesday morning session titled 'Tunnelling the last 50 years', where Doug Maconochie, Anthony Bennett, Chris Tattersall, Philip Pells and Charles MacDonald were assembled and presented the best of our industry.

The trade exhibition space and technical presentations and the associated events were buzzing with people who were really looking forward to a face-to-face event. The conference was certainly one of, if not the, best conference ever. The ATS 2020+1 Australasian Tunnelling Conference closed with the organising committee on stage at the end of the conference getting a round of applause for an event executed to perfection after two years of hard work!

Now the baton has been handed from the ATS to the NZTS to host the next Australasian Tunnelling Conference to be held in Auckland in November 2023, which we are looking forward to.



# QLD Chapter Report

3<sup>rd</sup> Qtr 2021  
Diane Mather

| Activity  | Outcome/Report  |
|---|---|
| Group Committee Members (including office bearers)                                    | <b>2021 QLD ATS Committee</b><br>*Chair – Diane Mather<br>*National Chair: Dr Harry Asche<br>*Vice Chair: Andrew Ridout<br>Secretary: Scott Keniston<br>Treasurer: Brendan Henry<br>Shotcrete Society Representative* Jurij Karlovšek<br>Young Member chair *Brodie Aitcheson,<br>Young Member Representatives – Monique Quirk, Jiwoo Ahn (webmaster), Alena Conrads<br>Committee Member: Alan Robertson<br>Committee Member: Jeremy Kruger<br>Committee Member: Anthony Harding – CPD Co ordinator<br>Committee Member: Annalena Baier<br>Committee Member: Morteza Ghamgosar<br>*National Treasurer: Geoff Archer<br>*ATS National Austroads Representative – Tony Peglas<br><i>*denotes role on National executive</i> |
| Next Election (elections to be discussed with EA Project Officer):                    | November 2022 unless nominated earlier.   |
| Activities Achieved Since Last Meeting:   | March Technical Session Directional Drilling for Tunnel Investigation Tunnelling Heroes Young Members Networking Session May<br>June Technical Session 2 Young members showcase<br>July ATS Technical Session Systems Assurance<br>All technical sessions face to face and online – on EA demand available for ATS members<br>QLD Committee Meeting 21st May 2021   |
| Report on Voice of Industry (include who has been allocated tasks and progress made): | Scott Keniston to develop draft proposal document and circulate for review. The voice of industry work has started, and the letter to platinum sponsors has gone out.<br>Close out follow up calls to each of them.<br>Meeting with TfNSW to be rescheduled (due to lack of response)   |
| Report on Inclusion (include who has been allocated tasks and progress made):         | Diane Mather developed proposal document, circulated for review. Policy document accepted/endorsed by EA.<br>To upload to ATS website   |
| Other:  | Members concern regarding CPEng/ NER registration of Engineering Geologists, Mining Engineers and other non civil college disciplines<br>Austroads updated for ATS journal provided by Tony Peglas<br>Participation in STEM activities for International Women in Engineering Day 23rd June 2021<br>Presentation to Concrete Institute Australia on Queensland Tunnelling Projects  |

# Women in Tunnelling

Jan 2021 to July 2021  
Nadine Makin

| Activity  | Outcome/Report  |
|---|---|
| Group Committee Members (including office bearers)                                      | Nadine Makin (Nadine.Makin@aurecongroup.com)<br>Agnes Varo (Agnes.Varo@aurecongroup.com)<br>Diane Mather (DMather@artc.com.au)<br>Alena Conrads (alena.conrads@cbgujv.com.au)<br>Annalena Baier (annalena.baier@bcsaustralia.com) |
| Next Election (elections to be discussed with EA Project Officer):                      | N/A   |
| Activities Achieved Since Last Meeting:   | Committee formed<br>Committee created, assessed, and awarded the inaugural Women in Tunnelling award for outstanding achievement  |
| Report on Women in Tunnelling (include who has been allocated tasks and progress made): | Need to formally elect chair of committee<br>Feedback at the conference was to have ongoing WIT networking between conferences committee to explore further opportunities for these   |



# VIC Chapter Report

May to July 2021

Richard Buckingham – Chair Victorian ATS

| Activity  | Outcome/Report   |
|---|--|
| Group Committee Members (including office bearers)  | <p><b>Current ATS VIC Committee with roles – elected November 2020</b><br/>           Chair: Richard Buckingham<br/>           Deputy Chair: Stephen Barrett<br/>           Hon Secretary: Anthony Bennett<br/>           Hon Treasurer: Bruce Grant<br/>           Young Member Rep: Gerard Quigg<br/>           Events Coordinator: Jay Lee<br/>           Committee Member: Gerry Bertakis<br/>           Committee Member: John Main<br/>           Committee Member: Nadin Makin<br/>           Committee Member: Josh Barry<br/>           Committee Member: Rachael McCarrison<br/>           Committee Member: David Grist<br/>           Committee Member: Chris Swaine</p> <p><b>Committee members departed in recent months</b><br/>           Committee Member: Toby Shutler (moved to NSW)<br/>           Committee Member: Siddharth Patel (moved to WA)</p>   |
| Next Election (elections to be discussed with EA Project Officer):                              | End October 2021   |
| Activities Achieved Since Last Meeting:   | <p><b>ATS2020+1 Australasian Tunnelling Conference</b><br/>           The conference was hosted successfully between 11th and 13th May, with two one day workshops of the 10th</p> <p>Given the challenges of the preceding year or so we were very fortunate to be able to hold a live face to face event in Melbourne where we were able to gather over 500 delegates, 70 trade exhibitors and 43 sponsors.<br/>           94 technical papers were presented, and 18 keynote speakers spoke about key projects and the state of the industry.</p> <p>Given that less than two weeks later Melbourne was plunged into another hard lockdown the organising committee was extremely pleased that we were able to pull it off.</p> <p><b>Technical Sessions held in Vic – None</b></p> <p><b>Vic Chapter Committee Meetings</b><br/>           Meeting held 30th June</p>  |
| Report on Victorian Tunnelling Centre (include who has been allocated tasks and progress made): | <p><b>VTCIAG (VTC Industry Advisory Group)</b><br/>           Meets every two months<br/>           Last meeting 22 June 2021<br/>           Next meeting 31 August 2021<br/>           Committee of industry representatives including from ATS<br/>           • Richard Buckingham • Ed Taylor • Tony Bennett • Arnold Dix</p> <p><b>Recent Progress</b><br/>           Very successful pre conference workshop held 10th May with excellent feedback from attendees and good exposure of the VTC to the industry and the ATS Exco</p> <p>The VTC has now produced several resources for tunnel inductions which have had the involvement of a number of key industry people in their development. Other resources are being developed (see item 4.4 in attached minutes).</p> <p>VTC has secured the Snowy 2.0 project as a client and is assisting with developing their tunnel training induction material and will be hosting tunnel inductions at the VTC facility for Snowy 2.0 staff – this was due to be held 20th July but had to be postponed due border restrictions as the Snowy staff were going to be to be bussed into Victoria.</p> <p>VTC is in discussion with several Higher Education establishments to promote engineering to students with a tunnel training course – seems positive.</p> <p>VTC also tendering a project to the National Careers Institute to promote tunnelling careers to certain groups.<br/>           • Primary school (grade 5 6)<br/>           • Secondary school (yr 8 10)<br/>           • Job seekers / job changers</p> <p>Note, the VTC's approach and planned interaction with the universities is likely to aid the ATS's own attempts to approach universities, this point was noted in the committee meeting.</p> <p>See attached minutes for further details on VTC activities.</p> |
| Report on University Courses (include who has been allocated tasks and progress made):          | No direct progress made with universities from the Vic Chapter, will raise again at next chapter meeting later this month  |

# ATS Young Members

Q2 2021  
Brodie Aitchison

| Activity   | Outcome/Report   |                     |                          |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
|--|--|---------------------|--------------------------|------------------------|-----------|-------------|-------------------------|-----|-----|---------------|-----|------------------------------|-----|--------|-------|-----|----------------------------|-----|-------|----------------|--------------|--|-----|---------|------------------|-----------------|---------------------|-----|-----------|--------------------------|--|-------------------------------|-----|-------------|--------------------------|--|--|----|-----|--------------|-----|--|----|-----|--------------|-----|--------------------|----------|-----|--------|--|---------------------------|----------|-----|--------|--|---------------------------------------|----------|-----|--------|------------------------|
| Group Committee Members (including office bearers)   | <b>ATSym committee:</b><br>QLD<br>• Monique Quirk • Alena Conrads • Jiwoo Ahn • Luke Foyster • Brodie Aitchison<br>NSW<br>• Katerina Monemvasioti • Aaron Lippett • Antony Limasouza<br>VIC<br>• Gerard Quigg • Renee Shi (New committee member)<br>WA<br>• Jiang Aizezi   |                     |                          |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Next Election (elections to be discussed with EA Project Officer):                           | No elections planned   |                     |                          |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Activities Achieved Since Last Meeting:  | ATS 2020+1 conference – Young members technical session (11/5/21)<br>ATS 2020+1 conference – Young members networking event (11/5/21)<br>ATS QLD Young members technical session (10/6/21)<br>ATS QLD Networking event – Tunnelling Heroes (20/5/21)<br>Website content and updates to members section<br>Survey completed to obtain feedback for ATS Tunnel Design Guideline and commencement of planning for lunchtime series on the design guide.<br>Provided articles and content to David Lees for the A&NZ Journal Provided articles and content for Breakthrough Magazine<br>ITA young members steering committee nomination – Alena Conrads  |                     |                          |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Report on ATS Website (include who has been allocated tasks and progress made):              | ATS young members are supporting updates to the website by working with Lauren Bordin. Items completed include:<br>• Members section: Method to retrieve password now added to avoid members not having access to the members section.<br>• Minutes from ITAym added to members section.<br>• Opinions Tab added: Voice of industry<br>• News Tab added<br><br>Tasks to be completed include:<br>• Commenting to be allowed on opinion pieces and news articles<br>• Tunnel projects section to be revamped<br>• Website redesign – current platform is outdated   |                     |                          |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Other:   | <b>Planned activities:</b><br>Table 1 Summary of planned ATSym activities<br><table><tr><th>Young member events</th><th>State</th><th>Date</th><th>Organiser</th><th>Sponsorship</th></tr><tr><td>Young members breakfast</td><td>QLD</td><td>TBC</td><td>Monique/Jiwoo</td><td>TBC</td></tr><tr><td>CRR young members site visit</td><td>QLD</td><td>4/9/21</td><td>Alena</td><td>n/a</td></tr><tr><td>ATS Tunnel D&amp;C Shortcourse</td><td>NSW</td><td>11/21</td><td>Aaron/Katerina</td><td>Multiple TBC</td></tr><tr><td>Knowledge transfer program – project based</td><td>NSW</td><td>Ongoing</td><td>Katerina/ Antony</td><td>Sponsorship N/A</td></tr><tr><td>YP networking event</td><td>NSW</td><td>TBC (PC)*</td><td>Aaron / Katerina/ Antony</td><td></td></tr><tr><td>UNSW University guest lecture</td><td>NSW</td><td>10/21 (PC*)</td><td>Aaron / Katerina/ Antony</td><td></td></tr><tr><td>ATS tunnelling presso, uni tour (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan)</td><td>WA</td><td>TBC</td><td>Jiang Aizezi</td><td>TBC</td></tr><tr><td>Pipejacking/Microtunnelling uni road show (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan)</td><td>WA</td><td>TBC</td><td>Jiang Aizezi</td><td>TBC</td></tr><tr><td>David Sugden Award</td><td>National</td><td>TBC</td><td>Brodie</td><td></td></tr><tr><td>Tunnel Design guide rev 2</td><td>National</td><td>TBC</td><td>Brodie</td><td></td></tr><tr><td>Tunnel Design Guide lunch time series</td><td>National</td><td>TBC</td><td>Brodie</td><td>Organising in progress</td></tr></table> | Young member events | State                    | Date                   | Organiser | Sponsorship | Young members breakfast | QLD | TBC | Monique/Jiwoo | TBC | CRR young members site visit | QLD | 4/9/21 | Alena | n/a | ATS Tunnel D&C Shortcourse | NSW | 11/21 | Aaron/Katerina | Multiple TBC | Knowledge transfer program – project based | NSW | Ongoing | Katerina/ Antony | Sponsorship N/A | YP networking event | NSW | TBC (PC)* | Aaron / Katerina/ Antony |  | UNSW University guest lecture | NSW | 10/21 (PC*) | Aaron / Katerina/ Antony |  | ATS tunnelling presso, uni tour (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan) | WA | TBC | Jiang Aizezi | TBC | Pipejacking/Microtunnelling uni road show (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan) | WA | TBC | Jiang Aizezi | TBC | David Sugden Award | National | TBC | Brodie |  | Tunnel Design guide rev 2 | National | TBC | Brodie |  | Tunnel Design Guide lunch time series | National | TBC | Brodie | Organising in progress |
| Young member events  | State  | Date                | Organiser                | Sponsorship            |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Young members breakfast  | QLD  | TBC                 | Monique/Jiwoo            | TBC                    |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| CRR young members site visit   | QLD  | 4/9/21              | Alena                    | n/a                    |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| ATS Tunnel D&C Shortcourse   | NSW  | 11/21               | Aaron/Katerina           | Multiple TBC           |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Knowledge transfer program – project based   | NSW  | Ongoing             | Katerina/ Antony         | Sponsorship N/A        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| YP networking event  | NSW  | TBC (PC)*           | Aaron / Katerina/ Antony |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| UNSW University guest lecture  | NSW  | 10/21 (PC*)         | Aaron / Katerina/ Antony |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| ATS tunnelling presso, uni tour (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan)           | WA   | TBC                 | Jiang Aizezi             | TBC                    |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Pipejacking/Microtunnelling uni road show (UWA, Curtin, Notre Dame, Murdoch and Edith Cowan) | WA   | TBC                 | Jiang Aizezi             | TBC                    |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| David Sugden Award   | National   | TBC                 | Brodie                   |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Tunnel Design guide rev 2  | National   | TBC                 | Brodie                   |                        |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |
| Tunnel Design Guide lunch time series  | National   | TBC                 | Brodie                   | Organising in progress |           |             |                         |     |     |               |     |                              |     |        |       |     |                            |     |       |                |              |  |     |         |                  |                 |                     |     |           |                          |  |                               |     |             |                          |  |  |    |     |              |     |  |    |     |              |     |                    |          |     |        |  |                           |          |     |        |  |                                       |          |     |        |                        |

\* (PC) = Pending COVID Restrictions

\* (PC) = Pending COVID Restrictions



# AUSS (Shotcrete Society)

Jan – Jul 2021  
Dr Jurij Karlovsek

| Activity   | Outcome/Report   |
|--|--|
| Group Committee Members (including office bearers)   | <b>ATSym committee:</b> <ul style="list-style-type: none"> <li>• Des Vlietstra &lt;desv@barchip.com&gt;;</li> <li>• Tony Cooper &lt;TCooper@barchip.com&gt;; TREASURER</li> <li>• Stefan Bernard &lt;s.bernard@tse.net.au&gt;; CHAIR</li> <li>• David Hocking &lt;david.hocking@boral.com.au&gt;;</li> <li>• John Kennedy &lt;john.kennedy@kh-geotech.com.au&gt;;</li> <li>• Kan Seah &lt;Kan.Seah@jetcrete.com.au&gt;;</li> <li>• Ryan Salter &lt;ryan.salter@mbcc-group.com&gt;;</li> <li>• Jurij Karlovsek &lt;j.karlovsek@uq.edu.au&gt;</li> </ul>   |
| Next Election (elections to be discussed with EA Project Officer):                         | November 2021  |
| Activities Achieved Since Last Meeting:  | <p><b>Website update (Research assistant conducted a literature review and support with update)</b></p> <p><b>Shotcrete Guide announced at CIA (Available at CIA website)</b></p> <p>The final version of the guidelines had been accepted by the Concrete Institute of Australia (CIA). There have been some difficulties with the document due to its large file size. To accommodate this, CIA have created several versions of the document to purchase: high res, low res and hard copy. A digital copy has also been sent to the International Tunnelling Association (ITA). The Chair expressed a need to coordinate documents like this globally, so they aren't in contradiction with each other, and a global guide can be set. It was noted that the CIA held a webinar on 12 November from the guidelines and EA are also interested in holding a webinar. The Committee discussed ways of creating awareness and creating content from the guidelines.</p> <p><b>ITA Working Group 12 (Shotcrete)</b></p> <p>The Chair provided an update on ITA Working Group 12. Their two documents on permanent concrete linings have been completed. The next project is to look at the in-service performance of shotcrete, which previously hasn't been written down and overall, there is a poor level of awareness on shotcrete's performance in different environments. The ATS have also taken hold of this and is reaching out to organisations to gather data on the performance of shotcrete. The Chair will investigate who within the industry they can reach out to obtain this information.</p> <p><b>No scheduled upcoming workshops / courses (not interested in online delivery)</b></p> <p><b>Securing sponsorship for sustainable operation of AuSS</b></p>  |
| Report on Research & Development (include who has been allocated tasks and progress made): | <p><b>The following topics have been proposed by the AuSS executive committee to put forward to ATS executive committee's Research and Development task report:</b></p> <p>Research priorities for tunnelling, and issues related to the shrinkage of shotcrete come out near the top of the list for most people. So, the specific issues are:</p> <ol style="list-style-type: none"> <li>1. Mix design to limit shrinkage (Increased porosity in the applied shotcrete, due to accelerated shotcrete having a stiffer structure at a time major chemical reactions are taking place, implies increased shrinkage (relative to shotcrete cast specimens without accelerator allowing more fluid compaction dynamics). One would logically assume this resultant exacerbated level of shrinkage should be able to be measured. It is doubtful however given the further complication in separating autogenous and drying shrinkage when considering the effect of accelerators on early strength development that absolutes may not be routinely and repeatedly measured which would obstruct reporting a confident absolute value.)</li> <li>2. Employing a mechanism and method which could routinely establish comparative values of supplied and/ verses applied, or post accelerator added, shotcrete. Fibres that can effectively control shrinkage</li> <li>3. Methods of measuring shrinkage in the field</li> <li>4. Numerical modelling of shrinkage</li> <li>5. Durability:             <ol style="list-style-type: none"> <li>a. Accounting for the effect of shrinkage on in-plane stiffness and restraint</li> <li>b. Effect of shrinkage cracks on load resistance of a lining</li> <li>c. Effect of shrinkage cracks of durability</li> </ol> </li> <li>6. Commercially-oriented questions:             <ol style="list-style-type: none"> <li>a. Modelling of double-layered linings,</li> <li>b. Thickness control,</li> <li>c. Spraying issues.</li> </ol> </li> <li>7. Crystalline waterproofing admixtures in shotcrete in conjunction with macro pp fibres. Crystalline water proofers are very suited to the typical water cement ratios of shotcrete mixes. It is important to control crack width in the shotcrete to be within the limits of what a crystalline water proofer can heal. A study on crack control with PP fibres would of benefit to the industry.</li> <li>8. Composite shell linings - reducing total material consumption, the sustainability topic</li> <li>9. Early age strength with the use of SCM's- reducing cement content; a great topic but such reductions come with potential negative impacts on strength, pumpability and rebound.</li> </ol> |

# Austrroads road tunnels project update

Austrroads' Road Tunnels Task Force is responsible for providing practical guidance on all aspects of tunnel planning, design, construction, operation and maintenance. The group has representatives from Australia and New Zealand transport agencies, the Australasian Tunnelling Society and Australasian Tunnel Operators Group.

The Task Force members are overseeing six projects, and another two are planned to begin later in the year. The upcoming 2021-22 projects focus on aesthetic designs to improve customer experience and road tunnel wall panels.

Project **ART6334** will define a process for designing, testing and delivering aesthetic features. The process will ultimately be applied to new and existing road tunnels in Australia and New Zealand.

Research has found that drivers demonstrate different behaviours in tunnels compared to surface routes. In tunnels, drivers concentrate more, are more anxious, tend to stay in the same lane and kept greater distance from other vehicles. The project will review recent Australasian projects to identify best practice aesthetic approaches that respond to these behaviours.

Project **ART6335** will examine the performance of wall panels in tunnels. Tunnel wall panels are produced from a variety of materials and incorporate different types of support structures. They are typically specified using performance-based requirements however it is not clear which product provides the best life-cycle outcome. This project will identify how well different wall panels perform and which products provide a cost saving to tunnel operators throughout their life cycle.

These additions to the Task Force's existing project portfolio help strengthen Austrroads' capacity to ensure consistency for road users and the application of best practice principles to the management and performance of transport infrastructure.

**ART6243** is investigating ways to improve the sustainability of tunnel construction, operation and maintenance and will update Austrroads' Guide to Road Tunnels. It is due to be completed in late 2022.

**ART6233** will develop signage to reduce the impact of over-dimensioned and dangerous goods vehicles on both the infrastructure and Workplace Health and Safety (WHS). The signage designs and guidelines for their placement will be included as an update to the Austrroads' Guide to Road Tunnels Part 2: Planning, Design and Commissioning in late 2021.

**ART6153** is developing an online database allow Austrroads, road agencies and tunnel operators to efficiently store and access fire incident safety data. A prototype is complete but final development is on-hold pending the implementation of a project to modernise Austrroads' ICT architecture.

**ART6122** will develop a standardised method to assess risks associated with routing dangerous goods through tunnels. Consultation with stakeholders is due to begin in late July 2021.

**ART6137** is examining the use of the perceptual countermeasures to reduce crash risks in tunnels. Perceptual countermeasures

are low-cost treatments, such as painted lines, which encourage drivers to reduce travel speeds. The research report is likely to be available at the end of the year.

The COVID-19 pandemic continues to delay the delivery of **ART6011**. This project will provide designers with new ways to assess driver experience in medium-to-long road tunnels. Some road tunnels require additional design features to ensure driver safety, including long tunnels with multiple exits and way-finding options which may be confusing, and long sections of tunnel without distinctive features may lead to driver fatigue, boredom and distraction. The project is using new methods to assess human factors in driving and is expected to establish the driver simulator as a safety-assured way to assess changes in long sections of tunnel.

The simulator was used in the largest worldwide survey of tunnel users to examine driver behaviour and the results informed designs used in Sydney's NorthConnex motorway tunnel which opened to traffic in October 2020. The tunnel lighting recently won the Award of Excellence from the International Association of Lighting Designers (IALD) at its 38th annual awards held in June.



**NorthConnex star-light feature.**  
Source: Transport for NSW



**NorthConnex blue forest lighting feature.**  
Source: Transport for NSW



# Victorian Tunnelling Centre

Tony Peglas



The day before the official first day of the ATS2020+1 conference, delegates had the opportunity to attend a Fundamentals of Safe Tunnel Construction pre-conference workshop, held at the new Victorian Tunnelling Centre (VTC).

The VTC is located at Holmesglen Institute's Drummond Street campus in Chadstone, where it offers specialist training to workers in the construction and operation of a variety of tunnels including rail, road and utilities. The \$16 million VCT was co-funded by North East Link, Rail Projects Victoria and West Gate Tunnel and is run by Holmesglen Institute. The institute will offer both existing and new courses at the tunnelling centre, including Certificate and Diploma qualifications as well as safety-based training for working underground.

Completed at the end of 2020, the centre has been modelled on London's Tunnelling and Underground Construction Academy and the setup of the facility is truly impressive. This Australian-first tunnelling training centre is training thousands of workers and will

be key in building Victoria's workforce and development of skilled workers working on the Victorian Government's major pipeline of works including North East Link, Suburban Rail Loop, Metro Tunnel and the West Gate Tunnel.

Upon arrival and following a briefing on what to expect for the day, the delegates were split into groups to rotate through the workshop activities. First up was the mined tunnel experience, where we were taken to the full-height replica mined tunnel (three lanes



wide). You can't get any more tunnel experience than Harry Lyle (Tunnelling Solutions) and we were very fortunate to be able to listen to Harry's stories from past tunnelling projects, particularly in relation to safety of the workforce. There is also a purpose built 20 seat refuge

chamber located in the tunnel which allows for onsite training in the event of an emergency situation.

The next activity was in relation to Tunnel Boring Machine (TBM) tunnelling. Visible from the Monash



Freeway, the VTC has a TBM cutterhead standing 7.2 metres tall and weighing in at 100 tonnes – a prominent and impressive addition to the facility.

The cutterhead is identical to those used for the Metro Tunnel under Melbourne's CBD. The delegates were able to climb inside and through the cutterhead, which will be used to train the next generation of tunnel construction workers, primarily to prepare workers and trainees for tunnel works in servicing techniques such as removal and replacement of

disc cutters and cutting knives, and excavation chamber access and monitoring. There is also a full-size replica of a segmentally lined tunnel constructed using segments from the Metro Tunnel project.

The final session involved a series of learnings on Safety-in-Design, project risk and the confronting and important issue of silica dust control by Kate Cole (Sydney Metro) based on the work of the NSW Air Quality Working Group. We also got to experience some of the augmented and virtual reality experiences available, including underground safety simulations and training, simulation of working in a TBM environment and getting a first-hand experience on machine operations.

It was a great start to the ATS2020+1 conference and exciting opportunity to undertake the safety workshop at the new VTC. It was clear the use of immersive and dynamic training methods to upskill the local workforce will go a long way in ensuring Victorians are ready to lead the way in tunnelling operations and underground construction techniques.

# Tony Peach

It is only fitting the most recent recipient of the Allen Neyland Tunnelling Achievement Award used to work with the man the award is named after.

In fact, 2021 winner Tony Peach has worked with many greats of the tunnelling industry and he has now joined some of the best as a recipient of the illustrious triennial award.

Along with Neyland, Peach has worked with David Sugden, Frank Watson, Stan White, Mike Willie and Bob Cooper during his career spanning more than six decades.

"I genuinely am quite humbled because some of the prior recipients were, and are, doyens in our industry and I looked at the list of who had received the awards and I was pleasantly surprised at how many of them I had personally worked with," Mr Peach said. "I was stunned that I was awarded this prestigious trophy and I'm very proud to be thought of alongside some of these people. Dave Sugden and I worked together for many years. When I first started working at the Hydro (Formally the Tasmanian Hydro Electricity Commission) he was the "Plant Engineer", and I worked with him right until he died 11 or 12 years ago."

The Tasmanian Hydro Electrical Commission proved to be a strategic place for fostering the next generation of key personnel in the industry.

"I started as a cadet engineer at the Tasmanian Hydro Electricity Commission, today it's abbreviated to Hydro, and of the prior recipients of the award a gentleman by the name of Allen Neyland used to work at the Hydro. Frank Watson used to work at the Hydro, Dave Sugden used to work at



the Hydro, Tony Peach used to work at the Hydro," Mr Peach said with a grin.

"So the Tasmania Hydro obviously was a breeding ground for the underground construction industry in Australia. I was awarded a cadetship as a mechanical engineer at the Tasmanian Hydro Electricity Commission and I was employed there for about six years before I moved on. During the time I was a cadet the commission had imported a Robbins tunnel boring machine and I was lucky enough to be in the office that had to make modifications to that machine and I became hooked. After my cadetship indenture was completed at the Hydro, The Robbins Company



offered me a job in Australia and I was with them for 11 years. The JARVA Company, a competitor to Robbins in the USA offered me a senior position and I and my family relocated to Ohio for 11 years."

Mr Peach said the USA had a plethora of projects during his tenure, and he was fortunate to

become involved in many of them, creating some fantastic opportunities.

"The USA is not averse to going underground whereas in Australia we only have one twelfth of the population so there were at least 12 times the amount of projects going on at the time so it was a lot easier to become involved in the industry and there were several specialist contractors who were not averse to trialing new ideas," he said. "As suppliers we'd come up with an idea that we might be able to manufacture a machine that would perform better, but to invest in multiple million dollar machines that are one offs was very expensive. However, if you identified a contractor that



believed in you, you could work with them. We did some quite interesting things."

Mr Peach noted the Tunnel and Reservoir Plan in Chicago as one of the most interesting projects he worked on while living in the USA.

"Chicago suffered from the problem of when they had heavy rains in the summer-time the storm water would overflow into the sewers, the sewers would overflow and the sewer would then flood into Lake Michigan and I was involved in the Atlas Copco-Jarva company at the time and there were multiple machines in the 11 or 12 metre diameter range and that was a massive project, very interesting," he

said. Returning to Australia, Mr Peach founded Terratec, a company he successfully ran for 25 years. Highlights included the company claiming the world record for outright metres per month by a TBM system during the completion of the Katoomba sewerage tunnels project; conceiving the Graham Farmer freeway's serpentine bunker conveyor to assist with spoil removal in Perth; and being part of the team that modified the TBM that successfully excavated the Melbourne Underground rail loop.

He maintains that reliability is the key to a good machine for contractors. "I discovered that after starting our own company, what the contractors needed was a machine to get from point A to point B. Even most of the competition today is pushing more horsepower to try and get there more quickly which makes some sense but the machines are becoming less and less reliable. We discovered you were far better off building a machine that was ultra-reliable. We used to take a lot of time and effort and energy to try and make the machinery near bullet proof and it couldn't be damaged by anyone going into the tunnel and could get to the other end in the shortest possible time, not the fastest possible time."

Mr Peach also served on the International Tunnelling Association's working group for mechanised tunnelling and contributed to the solution to free the Beaconsfield miners trapped underground in 2006.

With an illustrious career and experience around the world to draw from, Mr Peach continues to share his knowledge and consult part-time.

"I've thoroughly enjoyed every minute of my career, it's big boy's toys and as a mechanical engineer you couldn't have had any more enjoyment," he said.



# Fire Testing Workshop

The Fire Testing Workshop was held at the Victoria University (VU) Werribee Campus on the 10th of May 2021, the day preceding the ATS2020+1 Australasian Tunnelling Conference. This workshop was presented by Associate Professor Dr Maurice Guerrieri, a structural engineer who specialises in concrete spalling, and who is the manager of the fire testing facility.

More than 30 participants from client, academia, construction and consultancy backgrounds attended the workshop. The workshop was a great success, and a lot of positive feedback was received from the attendees. The workshop was a great advertisement for the VU Fire Testing Facility and highlighted the availability of such a facility to the Australian Tunnelling Industry.

The workshop demonstrated a unique large-scale structural fire test furnace capable of testing structures under combined structural and fire loading. The furnace is designed to accommodate a range of fire conditions, such as those found in tunnel fire scenarios. The furnace has the capability to test full-

scale tunnel segments with an applied vertical load in any configuration up to 250 tonnes, and horizontal loading up to 100 tonnes. This state-of-the-art fire testing facility is unique in this country, and Victoria University is now Australia's prime structural fire-testing laboratory able to test every fire curve in the world to the highest international standard. It is the only facility in Australia with the capability to test full-scale structurally loaded concrete tunnel segments under fire conditions.

During the workshop, the participants witnessed the full process of the concrete segment fire test, where four concrete segments of different grade were tested at the same time. The participants observed the behaviour of the concrete segment inside the furnace chamber via a 4k real time camera, and spalling and melting of concrete was observed during the test. Seeing the concrete segments melting under the extreme heat provided a rare opportunity for the practitioners to have a close look at this highly specialised test, which is a key element of tunnel lining segment design. Participants were also able to observe water "sweating"



from the side of the concrete segment not exposed to the extreme heat of the test. The fire curve of each concrete segment was observed via the real time monitoring system established next to the furnace.

Fire testing of concrete segments is a highly specialised and critical test

for tunnel lining segment design. The pre-conference workshop presented the full process of the fire test to the participants and provided them with the opportunity to receive first-hand experience on fire testing, which would hopefully be of great benefit in their work.



## BRTS Bamford Rock Testing Services

Since the development of the Internet in the mid-1990s, many reports and papers are readily available to peruse and download in pdf format. Before then, the only alternative to obtaining "hard-copy" publications was to get them on microfilm or microfiche. During his decades as an academic at the University of Melbourne, Dr Bill Bamford accumulated an extensive library on his specialties of tunnelling and rock engineering, in both hard copy and microfiche format. He has recently had his microfiche collection, containing much significant material written during the second half of the 20<sup>th</sup> century, scanned into pdf format, and is willing to make this historical and irreplaceable information freely available to his tunnelling and rock mechanics colleagues.

Dr Bill Bamford has been involved with tunnelling and rock mechanics since the 1950s. He was employed on the Snowy Mountains Scheme as an engineering geologist from 1958, later lectured in rock mechanics at the University of Melbourne, and founded Bamford Rock Testing Services in 2014.

He has long been an active member of the Australian Tunnelling Society (and its predecessor AUCTA), the Australian Geomechanics Society, and the International Society for Rock Mechanics & Rock Engineering.

At [www.bamfordrocks.com.au/archives](http://www.bamfordrocks.com.au/archives) you can find lists (by author) of theses, scanned microfiches and conference papers which are available for your perusal.

These are materials which are not available on the internet or in the readily accessible databases of any organisation. For example, have you ever wanted to read the 1969 U.S. Dept of Transportation report on "Design Of Tunnel Liners And Support Systems", by Deere, Peck, Monsees & Schmidt? Well, now you can!

We are happy for you to come into BRTS in North Melbourne to read the documents in our extensive rock library or scan them to take with you on a USB (no charge, but a chance to chat with Bill or have a coffee while you read).

Or, if you want any of the scanned microfiche documents (2<sup>nd</sup> sheet in .xls spreadsheet of our Library holdings), then email Jenny and she will send you a copy.

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## American Rock Mechanics Association (ARMA) - Monash Chapter

American Rock Mechanics Association (ARMA)-Monash Chapter has been initiated as the first International ARMA Student Chapter in June 2020, at the Department of Civil Engineering, Monash University, Australia. The main purpose of this Chapter is to create a community of students, researchers and industry professionals in which they can collaborate and share their interests and findings in relation to rock mechanics.

Over the last few years, there has been an increasing interest from both undergraduate and postgraduate students to be involved in the field of rock mechanics on different dimensions. Monash University is world renowned for its excellence in research and teaching in Civil Engineering particularly in the area of rock mechanics. Monash University has been recently ranked as the 15th best university in the world in mineral and mining engineering, and 23rd in civil and structural engineering according to the QS world university rankings. This achievement makes

Monash University a perfect spot to create the first ARMA Student Chapter in Australia.

Since the Chapter formation, five sub-committees have been established to form a unique platform for further research activities including the first ARMA photo contest to visually demonstrate the excitements of this field and have more talented students being involved in the future research initiatives. These five sub-committees are as follows:

- Tunnelling and Underground Spaces
- Geomechanics and Mining
- Petroleum and Geophysics
- Numerical Modelling
- AI and Big Data in Geomechanics

As our main interest lies within the rock mechanics area, we are always striving to initiate effective links and research network between the Chapter and local rock mechanics communities. Thereby, significant collaborations have been made through this unique platform including having industry professionals as guest

speakers within the Department of Civil Engineering, successfully promoting rock mechanics programs and activities nationally and globally, visiting rock mechanics projects and internship opportunities for the interested students who can potentially guarantee the bright future of this industry.

**Babak Khadivi**  
**BSc, MSc, PhD Candidate**  
**President of ARMA-Monash Student Chapter**



## Kidston Pumped Storage Hydro Project

Kidston Pumped Storage Hydro Project is the first pumped hydro project in Australia for 40 years.

The Project has been awarded by Genex Power to McConnell Dowell, John Holland Joint Venture. The project is supported by designers GHD and Mott MacDonald, with Andritz for the electro-mechanical works, working as one team.

The project commenced formally at the end of April 2021 and a ground breaking ceremony was held at the Kidston site in early June 2021 with parties from Genex Power, McConnell Dowell and John Holland in attendance, along with Senator Susan McDonald, Senator for Queensland.

The site re-purposes a disused gold mine that last operated 20 years ago and utilises the storage reservoirs between the Wises and Eldridge pits. The project involves a new dam, tunnels and an underground cavern to house the two turbines (2 x 125MW). Dispatchable energy is available through generation of electricity from running water from the upper reservoir (Wises) to the lower (Eldridge) through the turbines at times



of peak power demand and pumping back up during low demand. Power distribution connecting to the site will be provided via a new 275kV transmission line from Mt Fox, a distance of approximately 196km away.

Construction has commenced with site establishment activities including:

- Camp refurbishment and expansion;
- Airfield works;
- Site investigation works; and
- Initial dewatering of Eldridge pit into Wises pit.

Detailed design and planning works are advancing with focus on:

- Powerhouse cavern and tunnel designs;
- Turbine generator design and prototype modelling;
- Levee design and switchyard; and
- Transmission line designs.

The Construction Phase will create:

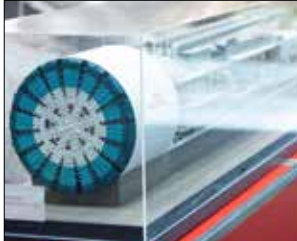
- 900 direct jobs during construction over 4 years;
- Estimate up to 1,000 indirect jobs during construction over 4 years;
- 20 direct jobs during operations; and
- Major employers McConnell Dowell John Holland Joint Venture, Powerlink (UGL), Beon and ISS.



# The Australian Tunnelling Society would like to thank all the contributions and support from our sponsors, which helped ensure a successful Australasian Tunnelling Conference 2020+1.

## Platinum sponsor

John Holland



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CREG

Herrenknecht

Silver sponsors

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Austunnel

BarChip

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GS E&C

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Sika

Robodrill



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Bamser - *Networking Welcome Event*



Mott MacDonald - *Young Members Networking Event*  
CPB Contractors - *Conference dinner*

## Additional conference sponsors

Rix Ground Engineering - *Technology hub*

PSM - *Program book, conference proceedings and lanyards*

Normet - *Water bottles*



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Sizense - *Conference bags*

Master Builders - *Lunches*

MultiGrout - *Conference supporter*

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WSP

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Bamser

Gamuda

Wurth

Jacobs

McMillen Jacobs Associates

Mainmark

Holmesglen

Geomotion

WSP

Hydroflux

## ATS/NZ Journal cover photo competition

A competition has been held for this issue of ATS/NZ Journal's cover photo, and the originally chosen winner was this one by Dr Eva Grasso, but unfortunately it was just not of a high enough resolution to be used on the cover.



So, we chose the photo seen on this issue's cover by Tom Roper: "Depth Pins prior to secondary shotcrete lining, Australia" which incidentally also won first place in the American Rock Mechanics Association photo contest – although this was not known when it was selected. However, many others were considered highly, and here are some of the runners up:



George Watfa: Jetfan, Australia



Photos of Martin Place fit out sent by Brian Marshall



Martin Place fit out



Martin Place fit out

## ATSym Report

July 2021 | Brodie Aitchison | ATSym representative

The ATSym committee is a team of enthusiastic tunnellers from across the country. Despite the difficulties with interstate borders and lockdowns 2021 has been a busy year thus far. ATSym activities that have taken place or are scheduled to take place in 2021 include:

- ATS2020+1 conference technical session (Tuesday 11th May at the Boat Shed)
- ATS2020+1 networking event (Tuesday 11th May at the MCEC)
- Tunnelling Heroes networking event (20th May at Milton Common)
- ATSym technical session (10th June)

*Presentation 1: Maintenance scheduling of cutting tools in soft ground mechanised tunnelling considering uncertainties in wear prediction*

*Presentation 2: Numerical modelling of the Sharaan Desert Resort*

- ATSym technical session – (September 15th 2021)  
*Soil Conditioning for EPB TBMs*
- Tunnel Design Guideline revision 2 planning (Q3/4 2021)
- Tunnel Design Guideline presentation series (Q3/4 2021)
- 2021 David Sugden Award (Closing September 30th 2021)
- Website content (Online training, Podcasts etc)
- ATSym site visits



ATSym Committee

## ATS 2020+1 Conference – Young Members Technical Session

The ATS young members held their own technical presentation time-slot at the ATS 2020+1 conference at the MCEC on the Tuesday afternoon (May 11th). The session comprised of four presentations on a variety of topics from segmental lining design through to large span caverns and soft ground pedestrian access tunnels. There were also many other young members presenting in technical streams throughout the conference which showcased the depth of young talent within the tunnelling industry. It was fantastic to see their presentations were well attended and there was some great feedback given on

the high calibre of our young engineers. The presenters at the young members Tuesday session included:

- Senthilnath G T - Design and construction of pedestrian access tunnels below existing operational metro tunnels.
- Renee Shi - SFRC segmental lining code of practice review of International Guidelines and application to Australian Standards.
- Aaron Lippett - Recent observations from the design and construction of large span tunnels in Sydney.
- Daniel Hamilton - Metro Tunnel - CBD South Station Cavern Construction.



ATSym technical session at the ATS 2020+1 Conference (L-R: Daniel Hamilton, Senthilnath G T, Renee Shi, Aaron Lippett, Brodie Aitchison, Gerard Quigg)

## Tunnelling Heroes networking event

The ATS young members hosted a networking event on May 20th in Brisbane at Milton Common. The event featured a Q&A session with 3 eminent tunnellers; Matt Lennon (Tunnel Construction Director), Ulrike Pelz (Project Design Director), and Adrian Smith (PSM Design Director) and provided an invaluable opportunity to ask questions and hear advice from the 3 very experienced tunnel engineers.



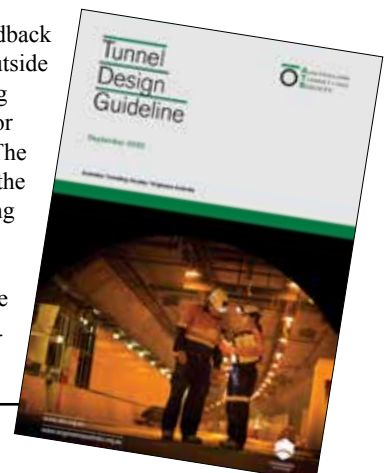
Left: Q&A Panellists (L-R: Adrian Smith, Matthew Lennon, Ulrike Pelz; Right: Young engineers)

## Revision 2 of the Tunnel Design Guideline to commence

The ATS Tunnel Design Guideline has been out for 1 year and the ATS young members are looking to build on the success of revision 1 of the document. A survey was sent out to all ATS members to obtain feedback on the document and to rally support to assist with revision 2. Thank you to everyone who has responded! Revision 2 of the Tunnel Design Guideline will be commencing soon.

The ATS has received good feedback from the tunnelling community outside Australia and will soon be opening up the Tunnel Design Guideline for purchase for non-ATS members. The intent of this is to promote use of the document with the wider tunnelling community.

If you would like to know more about the Tunnel Design Guideline please reach out to Brodie (brodie.aitchison@aurecongroup.com).





# ATS 2020+1 Conference - Young Members Networking Event

July 2021 | Brodie Aitchison | ATSym representative

The ATS young member event was held at The General Assembly, South Wharf. The event was sponsored by Mott MacDonald with more than 150 people in attendance. At the event, Brodie Aitchison was introduced as the new ATSym representative and gave a short overview of the programme for 2021. A main focus was to promote and raise awareness of the Tunnel Design Guide. The guide was completed in late 2020 and the work was led by the ATS young member representatives, with guidance and technical reviews from the executive committee. The guide is a publication of the most common methods used to design tunnels in Australia and was intended to be a local reference which our industry to call upon, particularly for



ATS young members event at ATS 2020+1 Conference

students and young engineers. Brodie issued a rallying call to young Engineers asking for them to step forward and get involved in their local tunnelling chapters in the coming months.

Recognition was also given to Joshua Barry who in 2020 was awarded the International Tunnelling Association's Young

Tunneller of the Year Award.

Josh was present on the evening and gave a short overview of his career to date.

Josh started his career at Aurecon as a student engineer in Melbourne, Australia, in 2007. It was a move to Hong Kong in 2011 where Josh really began to step up and take on challenges beyond

his experience level which really formed the base of his career and got him excited about developing his future in tunnelling. In 2016, Josh moved to Bangkok where he has gone on to create and lead Aurecon's first tunnel team in Thailand. Josh has recently moved back home to Melbourne, Australia where he is helping to nurture the next generation of tunnellers who want to follow in his footsteps. His key message to the young tunnellers in the room was to believe in yourself and to take new opportunities as they arise.

The evening continued with food, beverages, and lots of networking. It was great to get back together, meet old friends and make some new friends after a challenging 2020 in the industry.

## Young members technical session

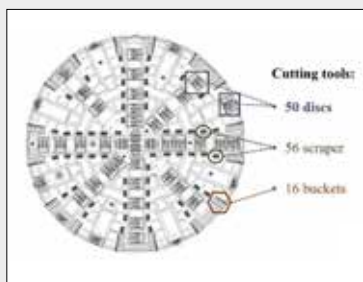
*The ATS young members hosted a technical session on June 10th in Brisbane which showcased 2 talented young engineers working in the tunnelling industry. It was a hybrid event with over 100 people online and 30 in person. The two speakers were Alena Conrads and Jiwoo Ahn.*

### Alena Conrads

Project Engineer, CPBGU JV, Cross River Rail, Wayss & Freytag

**Presentation:** Maintenance scheduling of cutting tools in soft ground mechanised tunnelling considering uncertainties in wear prediction

Alena completed her PHD at the Institute for Tunnelling and Construction Management at the Ruhr-University in Bochum, Germany, under the guidance of Prof. Thewes. Her research focused on process simulation of logistic and maintenance processes of mechanised tunnelling projects. She was also a key driver behind the founding of the German ITA young members chapter STUVE-YEP. Alena is now part of the tunnelling division of Wayss & Freytag and in October 2019 began work on the Cross River Rail project in Brisbane as a project engineer for the TBM tunnels.

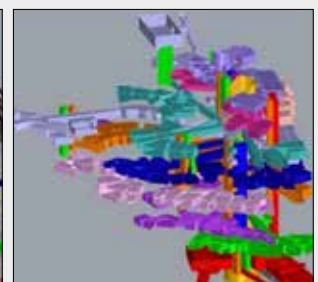
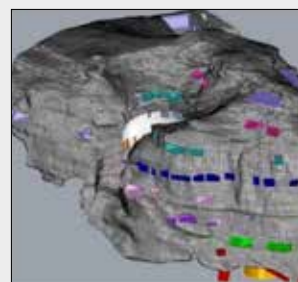


### Jiwoo Ahn

Geotechnical Engineer, PSM

**Presentation:** Numerical modelling of the Sharaan Desert Resort

Jiwoo is a Geotechnical Engineer at PSM and has been involved in a variety civil engineering and mining projects both locally and internationally. Jiwoo is currently working on the Cross River Rail Project where he is providing construction phase design services. His presentation focussed on the numerical modelling for a luxury hotel in Saudi Arabia – The Sharaan Desert Resort.



# Australian and New Zealand Tunnel Projects

| Region | Location       | Project  | Client                                     | Technical Advisor             | Designer                             | Contractor  |
|--------|----------------|--|--|-------------------------------|--------------------------------------|---|
| NSW    | Sydney         | NorthConnex  | RMS  | AECOM                         | Aurecon-SMEC JV                      | LendLease-Bouygues  |
| NSW    | Sydney         | WestConnex Stage 2 (New M5)  | Sydney Motorway Corporation                | AECOM                         | Aurecon-Jacobs                       | CPB-Samsung -Dragados JV  |
| NSW    | Sydney         | WestConnex Stage 3A (M4-M5 Link)   | Sydney Motorway Corporation                | AECOM                         | Aurecon-Jacobs                       | LendLease-Bouygues - Samsung JV   |
| NSW    | Sydney         | WestConnex Stage 3B (Rozelle Interchange)  | RMS  | AECOM                         | Arcadis/WSP JV-MJA-PSM               | John Holland-CPB  |
| NSW    | Sydney         | Sydney Metro City and South East TSE Contract                                    | TfNSW                                      |                               | Arcadis-MJA-PSM                      | John Holland/ CPB/ Ghella JV  |
| NSW    | Snowy Mtns     | Snowy 2.0  | Snowy Hydro                                | SMEC                          | Lombardi, Coffey, Tetra Tech.        | Salini-Clough-Lane JV   |
| NSW    | Sydney         | M6 Stage 1   | TfNSW                                      | Aurecon                       |                                      | CPB-Ghella JV   |
| NSW    | Sydney         | M6 Stage 2   | TfNSW                                      |                               |                                      |   |
| NSW    | Sydney         | Sydney Metro West - Olympic Park to The Bays                                     | TfNSW                                      | MottMacDonald                 |                                      | Acciona-Ferrovial JV  |
| NSW    | Sydney         | Sydney Metro West - Westmead to Olympic Park                                     | TfNSW                                      | MottMacDonald                 |                                      |   |
| NSW    | Sydney         | HarbourLink - Western Harbour Tunnel   | Tf NSW                                     | WSP/ARUP                      |                                      |   |
| NSW    | Sydney         | Sydney Metro - Western Sydney Airport - Station boxes and Tunnels Contract (SBT) | TfNSW                                      | Mott MacDonald                |                                      |   |
| NSW    | Sydney         | Western Harbour Tunnel   | TfNSW                                      | WSP/ARUP                      |                                      |   |
| NSW    | Sydney         | Beaches Link   | TfNSW                                      | WSP/ARUP                      |                                      |   |
| NSW    | Coffs Harbour  | Coffs Harbour Bypass   | TfNSW                                      | Arup/Aurecon                  |                                      |   |
| NSW    | Blue Mountains | Great Western Sydney Highway Upgrade - Katoomba to Lithgow                       | TfNSW                                      |                               |                                      |   |
| Qld    | Gold Coast     | Gold Coast Seaway  | Gold Coast Water                           |                               | WSP                                  | John Holland  |
| Qld    | Brisbane       | Cross River Rail   | Cross River Rail Delivery Authority        | ARUP                          | PSM-RBG-Hatch-Geodata                | CPB-Ghella-BAM  |
| Qld    | Brisbane       | Brisbane Metro   | Brisbane City Council                      | Jacobs                        |                                      | Acciona   |
| Qld    | Toowoomba      | Inland Rail - Kagaru to Gowrie PPP   | ARTC                                       | ARUP/SMEC                     |                                      |   |
| Qld    | Kidston        | Kidston Pumped Storage Hydro Project   | Genex Power                                |                               | GHD-Mott MacDonald JV                | John Holland  |
| Vic    | Melbourne      | Melbourne Metro Tunnel and Stations PPP  | MMRA                                       | Aurecon Jacobs Mott MacDonald | ARUP/Arcadis/WSP                     | Cross Yarra Partnership comprising Lendlease, John Holland, Bouygues and Capella Capital.   |
| Vic    | Melbourne      | West Gate Tunnel   | Transurban                                 | AECOM                         | Aurecon/Jacobs                       | John Holland/CPB Contractors JV   |
| Vic    | Melbourne      | North East Link  | VicRoads                                   | GHD                           |                                      | SPARK - WeBuild, GS Engineering and Construction, CPB Contractors, China Construction Oceania, Ventia, Capella Capital, John Laing Investments, DIF and Pacific Partnerships. |
| Vic    | Melbourne      | Hawthorn Main Sewer Siphon   | Melbourne Water                            |                               | KBR                                  | John Holland  |
| Vic    | Melbourne      | Maribyrnong River Main Sewer Augmentation  | Melbourne Water                            |                               |                                      |   |
| Vic    | Melbourne      | Hobson Bay May Sewer   | Melbourne Water                            | GHD                           |                                      |   |
| Vic    | Melbourne      | Melbourne Airport Rail Link  | Rail Projects Victoria                     | Aurecon Jacobs Mott MacDonald |                                      |   |
| Vic    | Melbourne      | Suburban Rail Loop   | Suburban Rail Loop Authority               | Aurecon Jacobs Mott MacDonald |                                      |   |
| SA     | Adelaide       | North South Corridor - River Torrens to Darlington.                              | Department of Infrastructure and Transport | WSP/GHD/WGA                   |                                      |   |
| WA     | Perth          | Forrestfield-Airport Link Project  | Public Transport Authority                 | Various                       | GHD, Geodata                         | Salini-Impregilo-NRW JV   |
| NZ     | Auckland       | City Rail Link Package 3   | Auckland Transport                         | Aurecon-Mott MacDonald        |                                      | Vinci-Downer  |
| NZ     | Auckland       | Central Interceptor Project  | WaterCare                                  | Jacobs/MJA/AECOM              | Arup/Beca                            | Ghella-Abergeldie JV  |
| NZ     | Wellington     | Wellington Northern Corridor   | NZ Transport Agency                        |                               | AECOM, Parsons Brinckerhoff and Beca |   |
| NZ     | Tauranga       | Tauranga Tunnel  | Local Govt                                 |                               |                                      |   |



| Scope of work   | Current status   |
|---|--|
| Spanning 9 km, NorthConnex will be the longest road tunnel project in Australia. Cost \$3B  | Construction completed - Tunnel operational.   |
| Provision of additional four new lanes in a driven tunnel next to the existing the M5 East tunnel   | Construction completed - Tunnel operational.   |
| Twin 8.5km road tunnels linking M4 East and M5 East Duplication and major underground interchange at Rozelle  | Contract awarded June 2018. Under construction for completion in 2023  |
| Underground interchange linking the M4-M5 Link to Anzac Bridge, Iron Cove Link and future Western Harbour Tunnel  | Contract awarded Dec 2018. Under construction for completion in 2023   |
| Underground rail Link from Chatswood to Sydnhenham via Central Station  | Contract awarded June 2017. Under construction for completion in 2021.   |
| 2,000 MW pumped storage hydro scheme  | Contract awarded to Salini-Clough-Lane JV  |
| 4 km of motorway tunnel from New M5 to Presidents Ave Kogarah   | Contract awarded. Under construction for completion in 2025.   |
| Motorway connection between the Sydney motorway network and the M1 Princes Motorway at Waterfall.   | Planning expected to commence in early 2022.   |
| 11 km of twin metro rail tunnels between Sydney Olympic Park and The Bays.  | Contract awarded. Under construction for completion in 2025.   |
| 9 km of twin metro rail tunnels between Westmead and Sydney Olympic Park.   | Under Tender. John Holland, CPB Contractors and Ghella Australia Joint Venture and Gamuda and Laing O'Rourke Australia Joint Venture. Award expected by end of 2021. |
| Road tunnel linking WestConnex with North Sydney (Military Road)  | EoI expected November 2020   |
| Metro rail link from St Marys to the new Western Sydney International Airport. Aproximately 10 km of tunnel with Stations and Shafts.   | Under Tender - Bouygues Construction Australia, John Holland Gamuda JV, Acciona Construction Australia. Contract Award expected by end of 2021.                      |
| The tunnel to connect the WestConnex Rozelle Interchange with the Warringah Freeway in North Sydney. Twin 6.5 km tunnels with immersed tube section.  | RFT expected in late 2021.   |
| Tunnel linking the Northern Beaches to the Warringah Freeway in North Sydney. Approximately 11 km of tunnels.   | EIS underway. Construction expected to start in 2023 and completed in 2028.  |
| 14 km bypass of the Coffs Harbour urban area, from Englands Road in the south to Sapphire in the north.   | EOI expected 2021.   |
| Upgrading the Great Western Highway between Katoomba and Lithgow. The Upgrade will reduce congestion, deliver safer, more efficient and reliable journeys for those travelling in, around and through the Blue Mountains, and better connect communities in the Central West.   | In planning.   |
| Recycled water outfall pipeline including DN2100 pipejack, 1400 m long  | Under construction for completion 2020.  |
| New north-south metro tunnels with connections running from Dutton Park in the south to Victoria Park in the north and new underground stations at Boggo Raod, Woollongabba, Albert Street and Roma Street.   | Under construction for completion 2024.  |
| Brisbane Metro is a 21 kilometre service connecting 18 stations along dedicated busways between Eight Mile Plains and Roma Street, and Royal Brisbane and Women's Hospital and University of Queensland with easy links between Metro, bus and train services. Includes a new underground bus station at the Cultural Centre and a tunnel along Adelaide Street | Awarded to Acciona   |
| 126 km rail link which includes three tunnels totalling 8.5 km in length.   | Under tender, announcement expected late 2021/early 2022.  |
| 250MW pumped hydro. The Kidston Pumped Storage Hydro Project will utilise the two existing mining pits (Wises and Eldridge) as the upper and lower reservoirs   | Under construction for completion 2024.  |
| New rail tunnel between Footscray and South Yarra with new stations in North Melbourne, Parkville, CBD (2) and St Kilda Road.   | Under construction for completion 2025.  |
| Proposed twin road tunnels (6km) and elevated road structures linking the Westgate Freeway at Williamstown Road with City Link  | Under construction for completion 2024.  |
| North East Link project will connect the Metropolitan ring road (M80) and Eastern Freeway (M3) completing a ring road around Melbourne which includes the Monash Freeway (M1). Two six-kilometre three lane tunnels, ventilation structures, green spaces, and 25 kilometres of new and upgraded walking and cycling tracks.                                    | Construction commenced, expected completion date 2027.   |
| DN2000 pipe jack under the Yarra River at Hawthorn.   | Under construction for completion 2023.  |
| Augmentation of the existing sewer with a 1.3 km pipeline which includes a 800 m DN1400 pipe jack.  | MWC panel tender submitted February 2021.  |
| Upgrade of existing Hobson Bay Main Sewer crossing of the Yarra River   | Tender submitted March 2021.   |
| Rail link to Melbourne Airport. Tunnel scope yet to be confirmed  | In planning  |
| 90 km long rail loop to connect outer suburbs of Melbourne. To be delivered in four stages.   | In planning for commencement in 2022   |
| Southern Package includes twin road runnels, each 4 km long. Northern Package includes twin road tunnels, each 2 km long.   | In planning  |
| 7.1 km twin-bored, concrete-lined and 6.2 m internal diameter tunnels extending from Guildford Road in Bayswater to Dundas Road in Forrestfield. Three stations; Airport West station will be located underground in the Brearley Avenue road reserve, between Second Street and Dunseith Drive, close to the current Domestic Airport precinct                 | Under construction for completion 2022.  |
| A 3.5 km loop linking Britomart with the current western line. Three new underground stations at Aotea Square, Newton and K' Road. Britomart to Downtown involves tunneling under the historic Central Post Office building which is now home to Britomart station. On the other side of Downtown up to Wyndham St will be cut and cover tunnels                | Under construction for completion 2024.  |
| New sewer tunnel approximately 14 km in length from central Auckland to Mangere Wastewater Treatment Plant  | Under construction   |
| Four lane expressway from Levin to Wellington Airport including duplication of Mt Victoria and Terrace tunnels  | Site investigation underway  |
| Three routes for a road tunnel through the Kaimai Ranges, linking Tauranga with the Waikato   | Currently being investigated by the NZ Transport Agency  |

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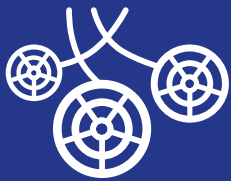
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