



All aboard and
right on track
Leighton Kumagai's
New MetroRail City Project

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Full steam ahead

Leighton Kumagai’s New MetroRail City Project is the largest infrastructure construction in Perth

Kumagai Gumi have been specialising in constructing tunnels since 1898 with a portfolio that includes completed projects across Asia, Australia, the Middle East, and the USA. Australian construction company Leighton Contractors have worked on major projects across the continent, and have been involved in some of the largest developments in WA and Perth, including the duplication and widening of the Narrows Bridge and widening of the Mt Henry Bridge.

Leighton Kumagai was formed in June 2003 specifically to work on the New MetroRail City infrastructure project. The scale of the project, which includes two new stations, William Street and the Esplanade, and railway lines, as well as connections to the existing railway and other infrastructure changes, meant that when works commenced on New MetroRail City Project in 2004 it was one of the largest infrastructure construction in Perth.

The nature of the construction meant that Leighton Kumagai and it’s sub contractors found it necessary to explore innovative solutions to issues raised by the project. The construction of the New MetroRail City Project was the first occasion that a soft ground, large diameter bored tunnel had been constructed in the Perth CBD, and there were several major areas that posed particular challenges to construction.

The project necessitated the manufacture of a purpose built tunnel boring machine by Mitsubishi Heavy Industries in Japan, which was specifically designed to drill a tunnel that was the correct diameter for the subsequent railway line and tailored for the unique nature of the soil beneath the Perth CBD. Moreover, the ground beneath William Street potentially had steel ground anchors from previous constructions buried within it, so the tunnel boring machine was fitted with high-tech detectors so that it would locate any anchors along the alignment and give advanced warning to the tunnellers.

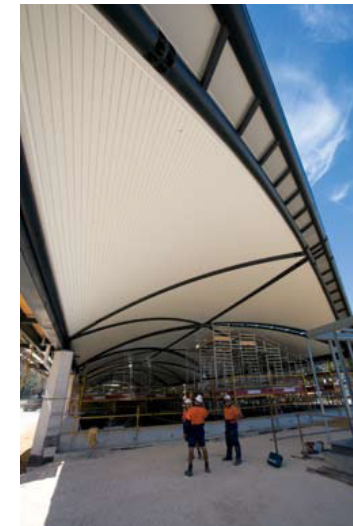
To enable the new stations and tunnels to link to existing railway lines the tunnel boring machine had to be able to achieve an exceptionally tight radius and at times with comparatively little cover above. This necessitated exceptionally careful boring, and extensive planning both prior to and during construction. In addition, the busy streets of the CBD necessitated the William Street Station was constructed underground and it lies below buildings, including one building that is heritage listed. This meant that the survey teams on the surface needed to collaborate with the tunnelers underground, whom needed to be responsive to any changes on the surface to minimise the overall movement of the ground and buildings. This necessitated that the project team use innovative solutions such as compensation grouting, in order to maintain the surface structures and reduce settlement.



A Deep Soil Mixing Method was also required for the paleo-channel conditions found at the reclaimed land at the river foreshore in order to insure the stability of the ground for construction. Compensation Grouting Method was applied to prevent any settlement the buildings just above the bored tunnels.

Working in the busy CBD and close to existing rail infrastructure meant that impact hammers could not be readily used for piling without causing shut downs at the Perth Rail Yard and on various roads. Leighton Kumagai introduced a Giken Silent Piler designed specifically for urban use. The Silent Piler enables sheet piling to be installed via a hydraulic push method, which causes no disturbance.

Through using new technologies and embracing innovative techniques of construction, as well as drawing on the expertise of their staff and specialist knowledge of the sub contractors, Leighton Kumagai have been able to complete the construction of the MetroRail City with minimal disturbance to the city, and despite the often difficult nature of the soil. This commitment has positioned Leighton and Kumagai at the forefront of the construction industry with a solid record in large-scale infrastructure developments. The companies have already worked together on other projects, such as the Eagle Nest Tunnel (Hong Kong) and the Wanchai East & North Point Trunk Sewer (Hong Kong).



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Keeping everything on track

How do you drive a 700m railway under a major city centre, build two underground stations and design approach structures that cross deep riverine silts without damaging surrounding buildings or endangering the public? Maunsell, renowned worldwide for its tunnelling and transport structures, mobilised a specialised team of engineers from around the organisation to successfully mitigate these risks to design Perth's largest infrastructure project since the 1960s.

As the lead designers for the AUSS\$350-million New MetroRail City project, Maunsell's team of engineers and drafters applied world's best practice principles to overcome the technical challenges

for this complex project. The new 2.3 kilometre railway was delivered within a tight schedule, and includes two underground stations, a bored tunnel, cut and cover tunnels, and a new underpass below the Mitchell Freeway.

According to Maunsell's Senior Project Engineer, Mr Barry Moore, the team faced some unusual challenges.

"Working on New MetroRail City project presented some unique problems. The 1,400m of tunnels, consisting of two 6m diameter tubes, were the first to be driven in Perth, with the sandy clay beneath the city centre requiring extreme care with tunnelling activity. There were concerns that the surrounding buildings would shift and become damaged," he said.

"One major challenge included the heritage listed buildings surrounding the construction site. Part of the William Street Underground station lay directly beneath the iconic 100 year old Wellington Building.

"This necessitated exceptional skill to underpin the historic building. Our engineers returned to 'first principles' to develop strategies to support the building and construct the station below."

According to Moore, reclaimed land also presented many challenges for Maunsell's team of specialists. Railway alignments must adhere to stringent tolerances, so that any so called 'made ground' does not create problems with lateral movement or vertical settlement. Much of the Swan River Foreshore, where the Esplanade Station is located, is 'made ground'.

"A century ago the river was about 150 metres wider, and therefore the design of the railway and its associated piled and heavily reinforced structures was an exceptionally complex task," he said.

Maunsell tendered for this major project in 2003, and commenced engineering design for the structures, rail works, civil works, and road works the following year. Design Manager, Stephen Gibson, had the job of bringing together and coordinating an experienced team of design engineers.

"We had the added advantage of being able to access staff from around the world. We pulled our resources from across Australia, from AECOM company Faber Maunsell in London, as well as from our network of AECOM companies in the Middle East, Bangkok and Manila. We eventually ended up with a team of seventy designers," Mr Gibson said.

According to Mr Gibson, risk reviews were critical in successfully managing complex aspects of the project.

"One of the main tasks for the team was to identify risks that would affect the design of the tunnel, in order to devise a solution that would give our client the best possible outcome."

Maunsell's approach to resolving design, engineering and construction issues relied on fully integrated expertise, drawing the project team from a range of professional specialisations at local, national and international levels. This approach enabled Maunsell's team to deliver a state of the art infrastructure project for the people of Perth.

According to Mr Moore, Maunsell's internationally accredited project management standards provide continual support and client care in order to guarantee the company's high quality of work and service. In addition, Mr Moore said that Maunsell also extended its consultancy services following completion of the project. This attention to detail upheld a close working relationship with the Leighton Kumagai Joint Venture and Maunsell's other key clients.

In the past, Maunsell have been engaged as consulting and design engineers on projects that include Delhi and Bangkok's acclaimed metro schemes, the Copenhagen Metro and the London Underground, as well as the rail and civil design

for the 72km Perth to Mandurah railway scheme (also known as Package A). These major infrastructure projects relied on Maunsell's extensive tunnelling knowledge and technical capabilities.

Maunsell in Western Australia is experiencing incredible growth and change, all based on a reputation for project delivery and technical excellence.

With a strong commitment to excellence, international experience, and outstanding technical capability, Maunsell has successfully differentiated itself from industry competitors in Western Australia.

According to Mr Moore, Maunsell is now proud to include the successful completion of the New MetroRail City project among its long list of prestigious infrastructure developments in Western Australia.

Architecturally inspiring

HASSELL is one of the leading planning and design practices in Australasia. A broad and extensive knowledge base, widespread experience in large scale infrastructure projects, and an ability to provide sound leadership were key factors in their involvement on the Western Australian New MetroRail project. HASSELL is a multi-discipline practice, with extensive experience in public infrastructure projects, including airport, road and rail design. These large-scale projects are something of a company speciality with a plenitude of successfully completed ventures, including the Adelaide Airport, Epping to Chatswood rail link, Qantas Terminal Sydney and Parramatta Transport Interchange.

With a total cost of \$1.6 billion, the New MetroRail project aims to effectively double Transperth's rail network, establishing it as one of the largest transport infrastructure projects in Australia. When completed, an additional 163 kilometres of track is expected to reach four times the population that is currently serviced by the railway. The Perth city section of the project, 'Package F', provides extensive new track, tunnels, and two new underground platforms and stations.

Joint Venture (JV) developers, Leighton Contractors and Kumagai Gumi understood the significance and challenge that the city section provided to the overall project. Its impact on the largest population centre in WA, and the surrounding heritage listed buildings ensured that every aspect of the works and construction were sure to come under close scrutiny. The JV developer engaged HASSELL to design two new stations for the 'Package F' component - Esplanade and William Street Stations.

Drawing from their experience, a key intention of the HASSELL design was to emphasise a connection with the exterior environment while maximising the usage of interior space and natural light. The station design brings an architectural and humanistic value to a revitalised CBD. The stations intentionally express the engineering and construction methodology through the architecture. The architecture is not 'applied' to the structural enclosure, nor is the structure intended to be

hidden. The architecture, structure and services are intended to be integrated into a complete design. The stations embody a design philosophy that celebrates the boldness of the engineering and construction techniques. The architecture celebrates this engineering and gives the passenger a world class experience in rail travel.

The Esplanade and William Street Stations provided numerous challenges for the HASSELL team. Through collaborative consultation and communication with stakeholders and JV consultants, HASSELL effectively and efficiently planned the project, resulting in time and cost savings against original benchmarks. The William Street Station required the heritage listed Wellington Building to be retained, which New MetroRail states, 'is an outstanding engineering achievement.' The northern section of the station box was constructed from the top down directly below the Wellington Building utilising unique underpinning and pile-and-beam construction specifically developed for the heritage listed building.

The HASSELL contribution will greatly benefit the growing community of Perth. The Esplanade Station will link the Busport, the Perth Convention and Exhibition Centre, the Esplanade, the Central Business District and Swan River and foreshore, establishing an extended rail network. William Street Station provides accessible rail transport to a major retail centre of Perth which will benefit from the influx of more than 50,000 passengers travelling on the newly developed rail network.

The involvement of HASSELL on the New MetroRail project has demonstrated their expertise in providing practical solutions to challenging problems. But, perhaps of equal importance - HASSELL has demonstrated their overriding desire to create urban areas that are functional, aesthetically appealing, and entirely in keeping with their client's requirements.



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Artist's impression - Internal view at platform level - HASSELL Architects

RIGHT: Sapphire Clock Tower
New MetroRail, Perth
Concept visual-night

Timeless sculpture

Smith Sculptors are a family business with a forty year history, having worked throughout Europe and Asia, before finally locating in Perth in 1984. Smith Sculptors meticulously research, conceptualise and design all of their works, before subcontracting specialists in engineering and casting to help realise their work in the public realm. Previous work by the sculptors can be seen in the National Memorial for the Australian Army in Canberra, the Burswood Park Heritage Trail in Perth, the IDA Headquarters in Dublin, Eire, the HMAS Sydney Memorial in Western Australia and The Hong Kong University of Science & Technology.

Smith Sculptors have won awards and commendations for numerous projects, including the Centenary Medal in 2003, in recognition of 'service to the community through the arts and the creation of large scale public sculpture'.

Commissioned to produce a sculpture for the MetroRail project that is designed to mark the station at which the old and new railway lines meet, Smith Sculptors turned to numerous aspects of Western Australian history and culture for inspiration and spent eighteen months creating the visually stunning public art piece that is the aesthetic centre of the New MetroRail city development.

The fifteen metre high sculpture visually penetrates a skylight above the below ground station at Wellington Street, piercing the roof like a sapphire splinter. The massive splinter has a LED digital clock on each side, allowing travellers to monitor their train departures and arrivals. Controlled by a central computer, each of the three glass faces of the sculpture can transform, changing colour according to the programme, moreover each colour is linked to a harmonic tone that rings out to mark the hour, varying in

pitch according to the colour of the glass. On each facet there is, fused onto the glass, graphic images taken from microscopic photographs of the structure of sapphire crystal. The top of the sculpture features a laser which, as designer Charles Smith states, "is pointed at the centre of the universe".

The entire sculpture is inspired by notions of travel, time, clocks, and local scientific developments. As Charles Smith explains the University of Western Australia is recognized by the United Nations as having the most accurate atomic clock in the world. Created from a sapphire crystal that, Charles suggests, is a perfect sphere, the clock is accurate to one-10 billionth of a second thanks to the precise atomic resonance of the sapphire that is kept just above absolute zero and bombarded with microwaves. The time displayed on the clocks in the station is linked to the time measured at the University physics department, and thus represents the most accurate clock in the world. The sculpture thus recognises the importance of the scientific achievement of the University of Western Australia, the role of time in a successful train network, and is also designed to appear aesthetically satisfying to the travellers who see it. Moreover, the entire work is located so as to be a celebration of ingenuity, design, and architecture.

With such an exceptional vision for a public sculpture, both visually impressive, and practical for travellers, there is little doubt that Smith Sculptors have achieved something unique that complements the impressive development of the new MetroRail line and will be seen for years to come not just as the signature sculpture that defines the project, but as an aesthetic mark that will effect all who see it while travelling through Perth.



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Memorial to HMAS Sydney, Geraldton, WA.
Photo by permission of the Geraldton Guardian



Circle of Time, Hong Kong University of
Science and Technology



Citizen of the Year Commemorative Fountain,
Perth



National Memorial to the Australian Army,
Anzac Parade, Canberra



Craig Adamson and Stuart Allan, SKM and Ian Deck, SMEC

Streamline design

As part of the largest infrastructure development in Perth, the New MetroRail City project needed extensive design and engineering management. As a joint venture, two of our leading firms, Sinclair Knight Merz (SKM) and SMEC (Snowy Mountains Engineering Corporation) completed the engineering review and verification of the design packages.

The key aspect to the strategies employed by SKM and SMEC was to streamline the design process. The team challenged the traditional, often cumbersome methodology used in this area by adopting a system that effectively created a paper trail and narrative within a design document. In essence this would turn a one-hundred-page portfolio into a two-page drawing. This was largely thanks to a data hierarchy that prioritised efficiency while maintaining quality assurance to recognized standards. This enabled the team to

better understand the decision-making processes that informed the designs and act on these, free from unnecessary debate and discussion.

Through adapting this innovative methodology, the companies were able to streamline the process, working in this way enabled the project to proceed apace and allowed SKM and SMEC to rigorously manage all aspects of the design verification process.

Drawing on skill resources from across the globe, the companies utilised telephone conferencing and virtual meetings, aided by new technologies such as WiSE, SKM's Worldwide Information Sharing Environment. This enabled those employed on the project to work upon documents in the remote digital environment, enabling a greater ease of collaboration and streamlining communication.

For specific areas of work, SKM and SMEC relied on their established relationships with specialist companies located in Perth. Recognising the lo-

cal knowledge that these companies could bring to the project, companies such as Daniel Lloyd Acoustics, Sage Consulting and Halcrow Pacific all contributed to the design verification of the New MetroRail City project. This commitment to Western Australia enabled SKM and SMEC to not only draw upon local skills and recognise the talent within their own community, but also effectively helped to raise the profile of such specialists in the construction industry in Western Australia.

Collaborating on the New MetroRail City project allowed both companies to explore the advantages of working together. The joint venture team was perfectly positioned to deal with the challenges posed by such a large-scale project.

The experience has been beneficial, with both SKM and SMEC talking of working collaboratively on similar projects in Western Australia together should the situation arise in the future.

SKM and SMEC are both ranked in the top one hundred design firms by the Engineering News

Record. Both companies are employee owned, and both boast an international position thanks to a combination of organic growth in addition to mergers and acquisitions.

SKM and SMEC have offices across the world, commanding a vast array of intellectual assets and specialist skills, putting both companies at the forefront of their industry. SKM specialises in providing leading edge project delivery skills, along with technical consulting engineering design, feasibility, planning and construction management serves across infrastructure, power and industry, building and property, resources and water and environment markets. SMEC works across numerous specialist areas including major infrastructure development, engineering, physical hydraulic modelling, urban planning, and tunnels and underground space, amongst other areas. It is of no surprise that SKM and SMEC boast portfolios detailing successfully completed projects both in Australia and internationally.

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Choosing the right path

Founded in Hong Kong in 1997 by Australian surveyors, Auspat Land Survey are specialists in providing surveys for infrastructure construction. The company's portfolio includes roads, railways, bridges and buildings. They maintain a high profile in the surveying industry across Asia and the Pacific and are considering expansion to the Middle East in the future.

In Australia, the company's 30 highly skilled and experienced employees have worked on major infrastructure developments in most states, including structures and pavements on the Western Sydney Orbital and Mitcham-Frankston Eastlink Project and recently commenced the Gateway Bridge Duplication in Brisbane. As spokesperson Mitch Dickson points out, the company are currently focusing much of their work in Australia partly as a result of the country's current construction boom.

For the New MetroRail City project the company provided surveys for the tunnel boring and slab-track rail laying processes. In order to achieve the exceptionally high tolerances of the extremely

tight radius curves necessary to manoeuvre under the streets of Perth in such a high profile project, Auspat used the latest in surveying technologies.

For the tunnel boring process the boring machine was guided by the Japanese software programme Robotec. Manufactured by Enzan, this programme used the continuous reading of known points installed on the tunnel boring machine head and immediately fed the data back to the onboard computer in the tunnel boring machines control room and to the monitoring room in the surface level offices. This enabled the operator to steer the machine accordingly, and to ensure the tunnel was bored within the tolerances of the small radius design parameters.

For the track laying process a similar process was used. With the tracks initially positioned to set out lines, a Leica GPR1000 Rail Trolley and Leica 1201 Total Station was subsequently used to monitor and adjust the position of the rail. The trolley and total station used radio modems to communicate measurements and the onboard software calculated the deviation to track align-

ment. So accurate were the calculations that the design parameters could be adjusted to 1mm in both the horizontal and vertical fields.

The successful completion of the MetroRail City development is yet another achievement for Auspat Land Survey Australia P/L and enables the company to further establish their pole position in the industry.

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Making tracks

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Founded in 1992, Pacific Rail Engineering's staff of fifty have worked across Australia on numerous projects, providing track components, maintenance of rolling stock and manufacturing turnouts. In Western Australia the company have already fulfilled contracts for MetroRail, having previously worked on the Perth to Mandula line.

Awarded the contract for New MetroRail City in November 2005, Pacific Rail Engineering were called upon to design and manufacture six turnouts to form three crossovers. The company's eighteen strong dedicated team were called upon to design and manufacture the crossovers, and pre-assemble them for inspection prior to installation, which was undertaken by a third company.

While steel turnouts are normally positioned on a concrete bearer, for the New MetroRail project Pacific Rail Engineering had to utilise resilient eggs, specially designed egg shaped pads that absorb noise and vibration. Through the employment of this technology noise and vibration pollution are reduced, an important factor when constructing

train lines below the crowded CBD. Moreover, as company spokesman Neil Balbirnie suggests this may be the first time such techniques have been used in Western Australia. The ability to integrate emergent technological developments into large-scale urban developments, as well as experience in providing a quality assured service, has helped position Pacific Rail Engineering at the forefront of their trade.

Our experience extends from emergency building of crossings to large turnkey projects to designing special trackwork configurations in all gauges and track profiles.

Amongst current projects Pacific Rail Engineering are currently working on in Sydney, include supply of turnouts using the weldable cast manganese crossing and the friction buffer stops, all of which is part of the Clearings Project to revitalise the city's rail network and ease congestion.



Narrows Bridge



Mount Henry Bridge

Durability by design

The appointment of an independent Durability Consultant has become a requirement on many major projects in order to ensure that the highest level of expertise is brought to bear on analysing the suitability of specific construction materials and techniques proposed. Durability Consultancy for the New MetroRail project was provided by BCRC.

Employing a team of international experts, BCRC ensures durability assessment models reflect the cutting edge of the industry. One example of this commitment to cutting edge practice is that BCRC were incorporating the CIRIA UK February 2007 report C660 into crack width analysis months prior to its publication.

BCRC offer durability assessments across most construction materials, including concrete, timber, steel and brick, amongst others. BCRC durability assessments on the New MetroRail project included galvanic corrosion rates of screw piles, pile corrosion due to sulphate reducing bacteria, and the effects of marine mud on locating pile plug termination.

The New MetroRail development also provided the BCRC team with some exceptional challenges, which led the company to draw upon its international resources. The Wellington Street Station diaphragm walls are under 15m of water pressure, with high levels of sulphates and chlorides in places. With no standards, either Australian or international, on these walls the company had to provide an analysis to insure best practice based on the expertise, experience and research of their international team.

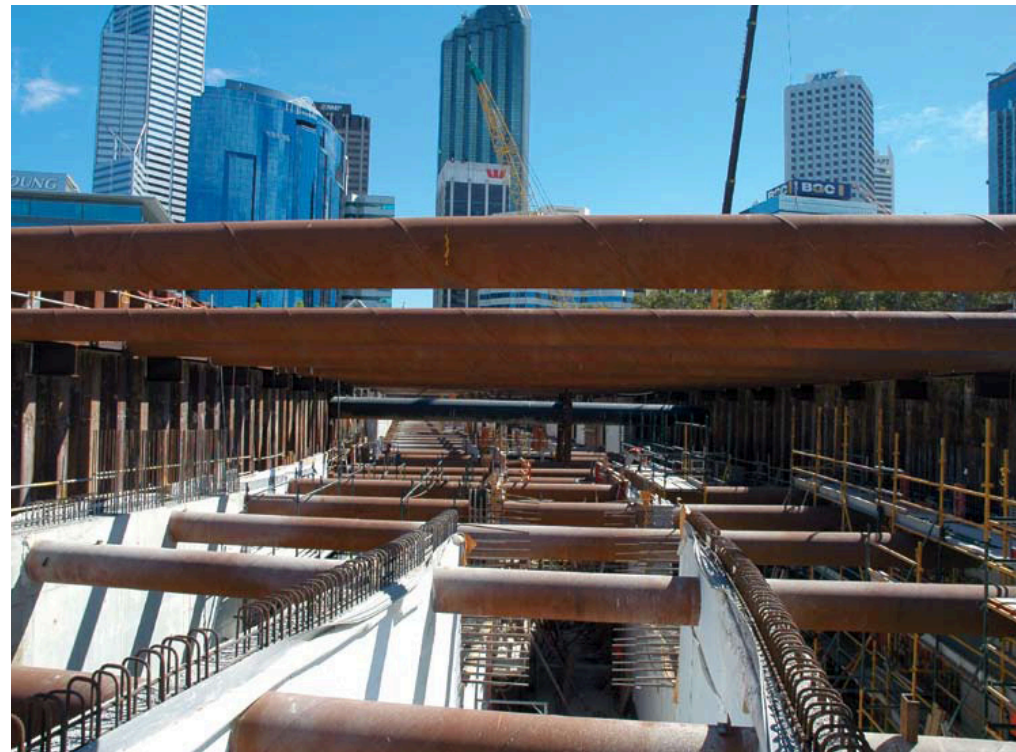
For the tunnels BCRC had to examine the potential for water penetration in the concrete lining. Again drawing on their international approach the company applied recent research findings from the Netherlands on chloride migration through concrete, to resolve chloride build up on the inside face of linings.

With clearly established international links, BCRC have been able to consult across Australia on various projects including the Gold Coast Desalination Plant, Melbourne's NSP 2 Sewer Tunnels, and the Albury Wodonga Bypass

amongst others. With offices in Sydney, Perth, Townsville and Kalgoorlie the company are well positioned to support the infrastructure boom across the country.

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Surveying with Insight

Since 2003 the small, dedicated team at Insight Survey have specialised in providing surveys for both large and small-scale construction of civil works. For the New MetroRail City project the company provided construction control, undertook construction set out and data recording during the construction process. Insight also provided position checking using CAD to map the design elements prior to set out and produced 3D visualisations for the two vents over the tunnel at the foreshore. In addition Insight Survey worked with the design engineers on the cut and cover roof panels.

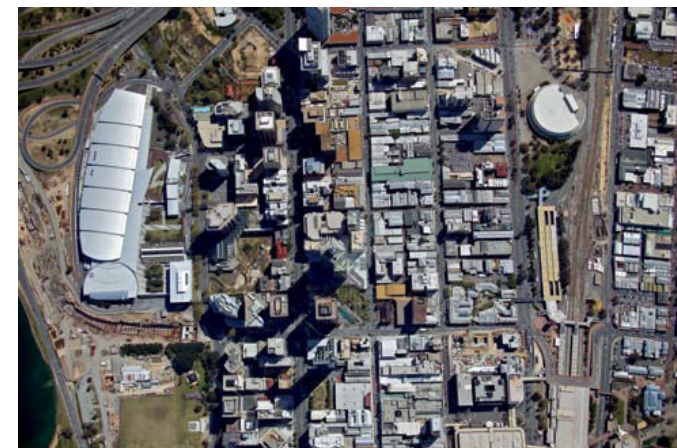
Insight Survey employed the Trimble 5600, with ACU Controller, so as to best record the necessary information for quality assurance. Through their use of the Trimble 5600 and its scanning feature, the existing road could be recorded to enable the design of the new bridge deck so that the new rail line could pass underneath the freeway without having to close the road and thus having little impact on the general public who could progress unhindered.

The Trimble 5600 was also deployed at the Esplanade Station, so that the ten metre high wall could be scanned with a 2X2 metre grid. This enabled Insight Survey to measure any movement or distortion that may have occurred due to the vast pressures created through the backfilling process.

The hardest challenge faced by Insight Survey was maintaining the control at the foreshore. The combination of reclaimed land and the vibration created by the ongoing works meant that the control would move, necessitating the control was updated regularly throughout the process and that the Insight Survey team rigorously manage their work in order to guarantee quality assurance.

The highly skilled Insight Survey staff and meticulous application of the latest technology meant that the surveying processes associated with the New MetroRail City project progressed unhindered, achieving guaranteed results.

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A well grounded company

A global organisation with three decades of experience, ERM is the largest all environmental consultancy in the world. Spanning across 40 countries with over 100 offices, ERM draws on a worldwide network of highly skilled and experienced employees.

ERM provides a variety of environmental services including environmental assessments, site decontamination and acid sulphate soil investigation and remediation, planning, designing and maintaining programs of corporate due diligence, landscape architecture, infrastructure and town planning. In addition the company also provide assessments into the impact socially, politically and on aspects of cultural heritage.

ERM works across numerous industries, not just providing environmental and social services to

the construction industry, but also advising the infrastructure, utilities, property, oil, gas and mining industries on the environmental, social and heritage aspects of planning, design, construction and decommissioning of developments.

New MetroRail is the largest public sector infrastructure development in Western Australia and the first time a bored tunnel has been constructed through Perth's CBD therefore the environmental impacts and the ramifications of construction had to be carefully assessed. ERM was called upon to provide advice on the assessment and management of acid sulphate soils and contaminated soils.

The project was faced with numerous challenges, including trying to minimise the effects of the construction of such a large project on the daily

workings of the city. ERM's team were faced with advising on management decisions without affecting the surrounding infrastructure or the construction schedule which put their expert knowledge to the test on the project.

One of the challenges of the project was assessing the nature of the soil to be removed during the construction of the tunnels. The nature and quality of the soil would affect the response to its disposal or reuse. Initial lab tests revealed that much of the soil was an acid sulphate soil; this meant that ERM had to devise a management response based on these results and advise on management options for soil removal and disposal. This task was made harder by the busy urban location of the construction site, which meant that space in which the soil could be stored or treated was at a minimum, in addition the project demanded the work be carried out at speed in order that the construction schedule be maintained. Soil was removed from the tunnel by a tunnel boring machine operating continuously and transported

by a conveyor belt to a muck pit, where the soil was removed for treatment and disposal.

ERM is at the forefront of its industry, and as such, is in an advantageous position to provide the advice and services required by the planning, infrastructure and construction industries to address the increasingly important environmental policy and green issues.

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Founded in 1997 Drillline Pty Ltd have a decade of experience in horizontal boring, directional drilling and pipecracking. In 2000, the company gained a license for CIPP (Cured in Place Pipeline Technology), which enabled Drillline to extend their services into pipeline rehabilitation, offering services that include CCTV surveying and Laser Profiling, jetwashing and root cutting to customers including the Water Corporation, local government and the mining industry. This service was extended in 2005 when Drillline acquired a Kingvac 9000 Vacuum Tanker, which enabled the company to offer educting, waste removal, vacuum excavation and trenching as well as a range of other services.

The Kingvac 9000 Vacuum Tanker is capable of vacuum extraction from a depth of more than thirty metres and is capable of removing both wet and dry waste materials. Licensed to remove hazardous materials as well as sludge and slurries, Drillline's Kingvac has a capacity of 10,000 litres and is environmentally friendly thanks to its low cost maintenance system, noise reduction and its clean air emissions.

For the New MetroRail City development Drillline Pty Ltd provided their Kingvac 9000 Vacuum Tanker and five dedicated trained employees. The unit was used to remove grout from treatment plants and silt from silt pits, including the tunnel catchments pit and the four silt pits used for pumping ground water. The process was expedited thanks to the Kingvac's exceptionally powerful suction capability that was used to a depth of fifteen metres at the Wellington Street construction site, on occasion this necessitated laying some sixty metres of hosing.

Through their experience, reliability and their top quality, modern technology equipment, Drillline Pty Ltd were able to offer services tailored to the rigorous schedules and demands of the MetroRail construction sites.



Dia 900 Poly Pipe Installation

Pumping it out

Cobey Industries are specialists in the design and construction of pumping stations, sewerage pipe installation, civil work, mechanical installation and fabrication work, water and fire pipe installation. Founded in 1998, numerous of the company's employees and the director have extensive experience in the industry, stretching back thirty years. Cobey Industries have a work record that includes successfully completed contracts on all manner of construction projects, from small-scale developments to large-scale infrastructure developments. The company run a 700m² workshop that is fully equipped with BHB cranes, excavators, loaders, backhoes, and Hiab Trucks.

Cobey Industries highly skilled staff includes numerous trades specialists – civil and mechanical engineers, boilermakers, pipe fitters, steel and polyethylene welders, carpenters, registered builders, and plant operators. The specific knowledge of these employees has enabled the company to grow in reputation and build on its previous successfully completed contracts. Further the industry experience, skills, and knowledge of Cobey



Southern Suburbs Railways underground pipe work installation



Subiaco Waste Water Pump station



Aboriginal community water tank installation

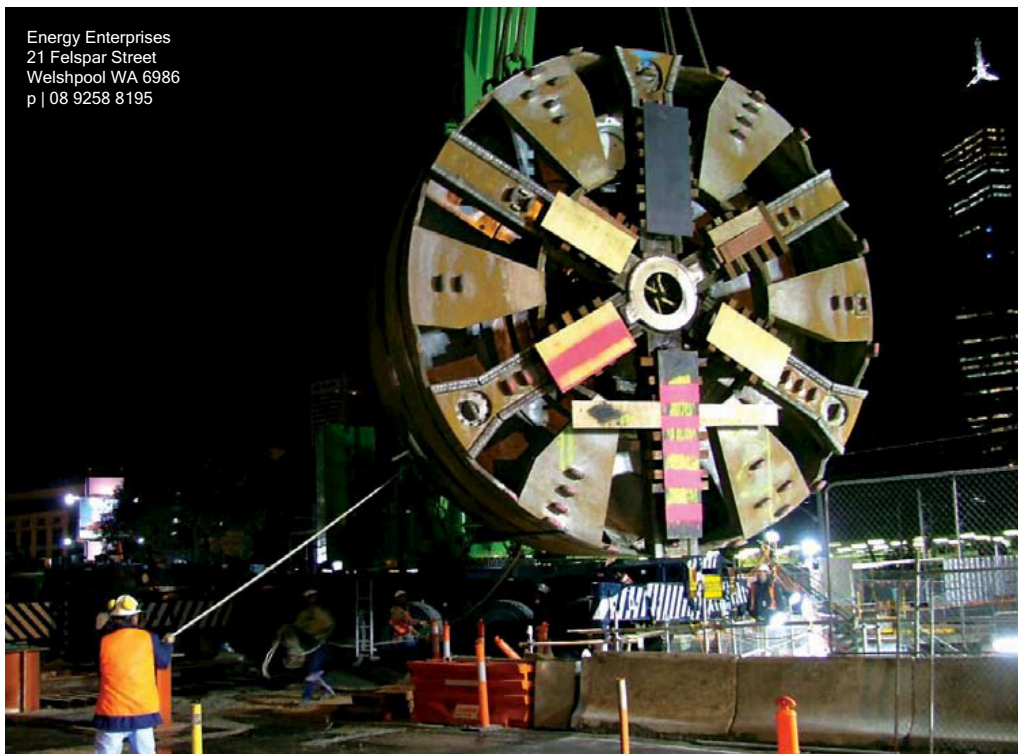
Industries staff enables the company to complete work within rigorous time schedules and budgets and to an exceptionally high degree of quality.

Maintaining quality is essential in the modern construction industry and Cobey Industries are proud to work to an integrated safety, quality and environmentally management system that is ISO 90001:2000 compliant.

With their successfully completed role on the New MetroRail City, Cobey Industries are able to further maintain their key role in the construction industry in Western Australia.

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Enterprising Energy

Western Australian owned Energy Enterprises Group are a service company primarily focused on providing a diverse range of rental equipment to the construction and mining industries. The company's marketing strategies are directed towards mining and civil infrastructure developments throughout Perth and regional sites in the northwest of WA.

The demand for reliable machinery matched with Energy Enterprises' personalised customer service has seen the company grow to a level where they now employ more than fifty staff, including machinery operators, mechanical fitters, electricians, boilermakers and administration and QA teams all dedicated to providing clients with guaranteed service.

For the New MetroRail City project Energy Enterprises provided a bespoke service for their clients which necessitated the disassembling and reassembling of the tunnel boring machine used to bore two tunnels from the Esplanade, under the city and up to Roe Street in Northbridge.

The assignment - better described as a "challenge" - presented to the crew at Energy Enterprises was to cut the tunnel boring machine into three sections enabling it to be more readily transported back to the initial start point of each tunnel.

Once transported to the entry point of the second tunnel, the tunnel boring machine was then re-assembled, welded back together and made ready to complete another rail tunnel under the city.

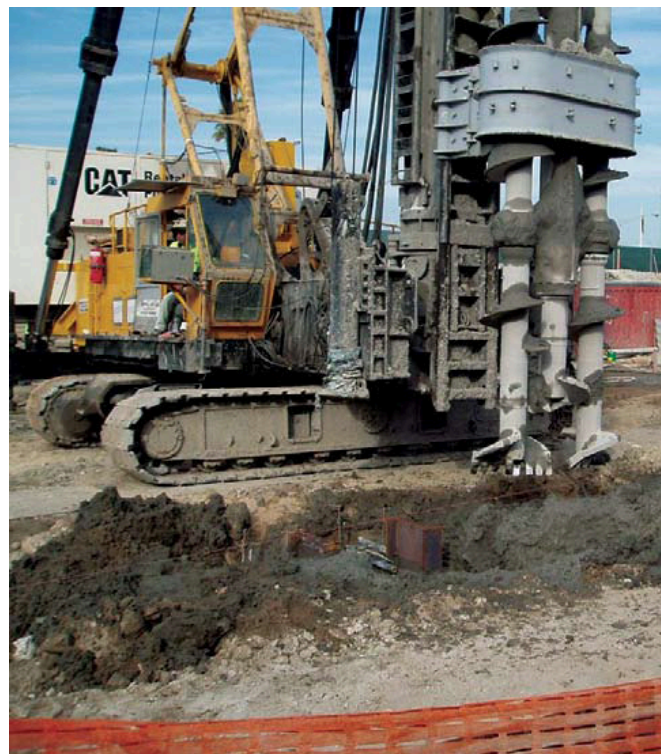
General Manager Garry Granger states, the job was exceptionally unusual, the size and shape of the tunnel boring machine meant the logistics of the breaking down process were complex and the time frame allocated by the client meant this part of the project was critical to the completion of the overall MetroRail City project.

However, Granger notes, "the Energy Enterprises management crew have an exceptionally wide variety of professional skills and technical expertise," and the company pride themselves on being able to meet the challenges of any job.

Granger says that he knew the Energy team could handle this complex task and had no hesitation in taking the job on, "basically we put our heads together and came up with a strategy and procedures to complete the unusual task".

The success of the Energy Enterprises innovative "Cut and Shut" method contributed to the timely completion of the second tunnel to be brought forward and helped the project proceed ahead of schedule.

Innovators in their field, Energy Enterprises management and staff have the initiative and professional experience to deliver the results demanded by the modern construction and mining industries. Encouraging innovation and rising to any challenge presented, Energy Enterprises provide premium service to its long list of blue chip clients.



A strong foundation

Package F of \$1.4 billion MetroRail Project is the city project. This section requires the creation of 340m of cut and cover tunnel, 744m of twin bored tunnel, 594m of open dive tunnel, 140m of open rail track, two underground stations, railway track, overhead power, signalling and communications, associated drainage and landscaping.

With regard to the requirements of the \$325 million package F, Leighton Contractors and Kumagai Gumi, undertook a detailed assessment of the subsurface geology in the Perth area. This resulted in certain sections of the cut and cover works being deemed too unstable for sheet pile retaining (in some areas soft mud was located to a depth of 30m). An additional complication was the proximity of the river and therefore tidal influences in the groundwater which negated the possibility of de-watering.

Looking for a new solution to the creation of a stabilised and watertight environment for the eventual tunnel the project leaders contracted the services of Compile-Ryobi. Compile-Ryobi have

been pioneering new stabilisation technology for a number of years. Their Grout Mix Pile (GMP) and Solid Mix Wall (SMW) are innovative new systems that combine cement with the sub-surface soil to greatly increase stability.

On the MetroRail project, Compile-Ryobi was engaged to make a cut 9m deep through alluvial river mud, 140m long and 20m wide. Soil Mix Wall piles were installed through a 3m pile created floor slab. The combination of the GMP floor slab and SMW pile created the watertight and stable environment required. One of their 100 tonne drilling rigs was converted to use triple head augers enabling them to drill overlapping piles that created the continuous stabilised wall. Within the wall steel I beams were embedded on which to attach walers and struts.

It is the first time this technology has been employed on such a project within Australia and the project has provided Compile-Ryobi with a perfect opportunity to showcase their abilities. The works undertaken by the company demonstrate their unique abilities in stabilising complex sub-

surface geology without the need for de-watering. By setting a new benchmark in the industry on such a high profile project, Compile-Ryobi is sure to be in even greater demand in the future.

COMPILE-RYOBİ

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Moving heaven and earth

By 1985 the mining and construction sector of West Australia had become extremely active and required vast capital expenditure to remain competitive. Sam Graham, the Managing Director of Haulex, realised that Perth was likely to become the city of the future and would expand to accommodate the affluent lifestyle for many Australians moving to the area. Having completed several kilometres of rock seawall at the Burrup Peninsula and North West Oil & Gas at Woodside, Sam saw an opportunity to apply experienced gained in these projects to the expansion of Perth.

Prior to the America's cup, Sam Graham was very proactive in the development of the Fremantle docklands excavating and placing most of the rock and fill for the project with longreach excavators and special grab. He had a vision that Fremantle, after the Cup, would become the gateway port to Singapore, South East Asia and the world of sea traffic.

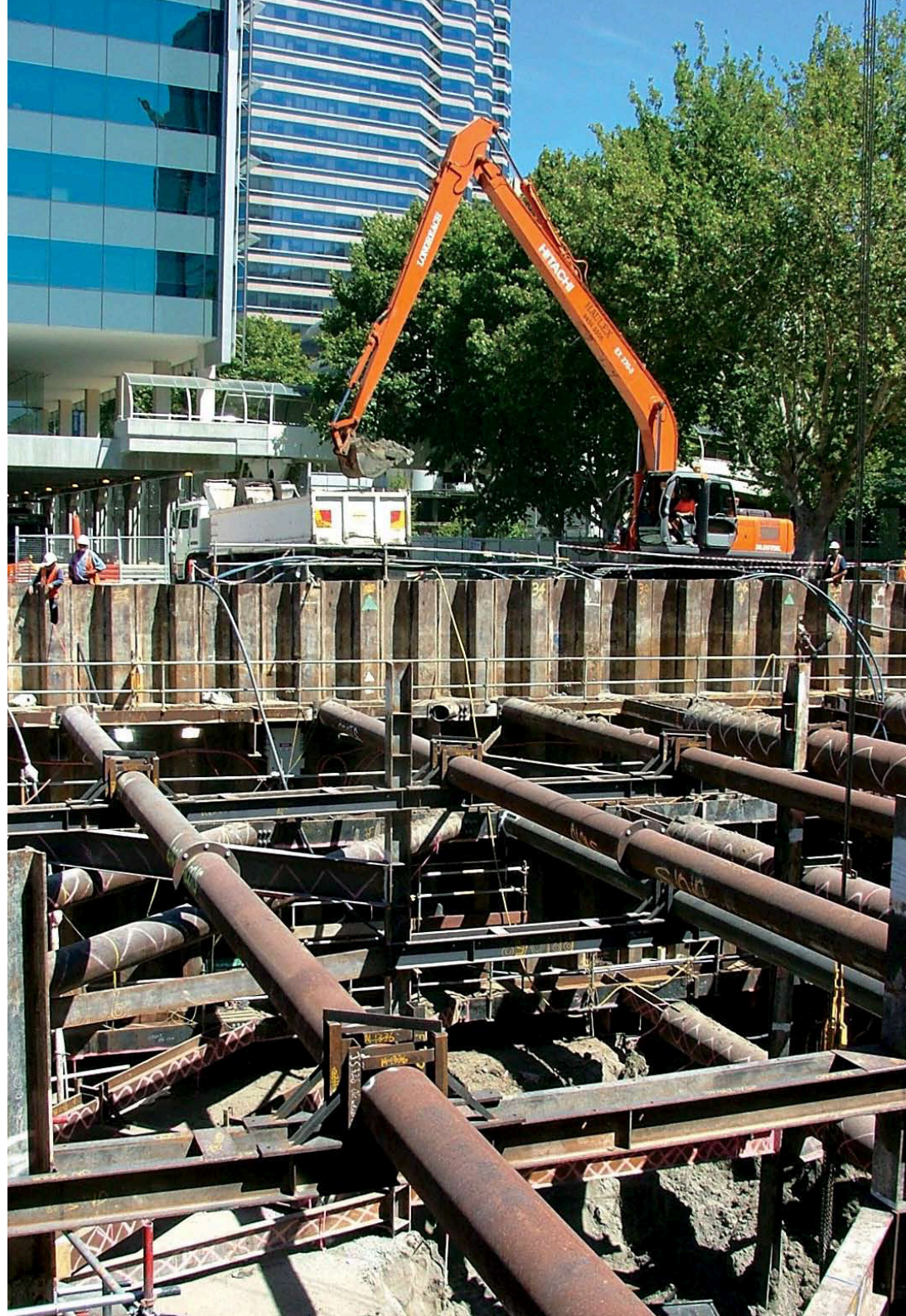
In order to accommodate for this future expansion, Sam Graham concentrated his efforts and experience in forming Haulex to become the plant hire division of Fargo Investments. He also set out to develop interest in the plant hire market as a long reach excavation and marine wall specialist. Rous head, South Mole, Fremantle Marina, Whitfords, Hillarys and Garden Island Causeway bear tribute to his expertise. The

Company's experience (Sam Graham has held a W.A. Operators ticket since 1966) with Draglines, Cranes and Cable operated grabs proved invaluable.

In 1990, Sam Graham recognised the need to invest in more hydraulic excavators to cope with the expanding market in particular rock breaking in the civil sector and rock grabs in the resource recycling sector. Out of sentiment for the mining sector Haulex still maintains a presence in the iron ore regions of the state and the construction sector of the northwest.

Business grew and expanded throughout the 1990's at a very healthy rate and in the early 2000's Sam Graham had an opportunity to obtain a large excavator hire contract with Leighton Contractors to whom Sam Graham and Haulex's deep excavation expertise was well known from previous large construction and civil contracts. Having been introduced to Kumagai, the Joint Venture partners, the excavating section was relatively smooth and productive.

Much of the work required was in preparation for the tunnel boring machine, providing bulking out. A demanding aspect of the excavation and bulk earth removal required a considerable degree of expertise and precision – using the longreach excavators, Haulex were required to remove earth from between bracing supports that ran across



the cut sections. At times Operating from ground level and removing earth up to sixteen metres below – where the operator was without clear line of site to the bucket. Working with a spotter who was able to coordinate the operator's actions provided a challenging solution and it was only possible due to the skill and cooperation between the two.

Another challenge on the project was the discovery of a 1 metre thick concrete foundation wall that remained from the demolition work and obstructed the tunnel boring machine's path. Drawing on experience gained over the years, Haulex were able to lower one of their excavators with a rockbreaker attachment into this confined section and complete the demolition of the obstructing wall allowing free passage to the tunnel boring machine.

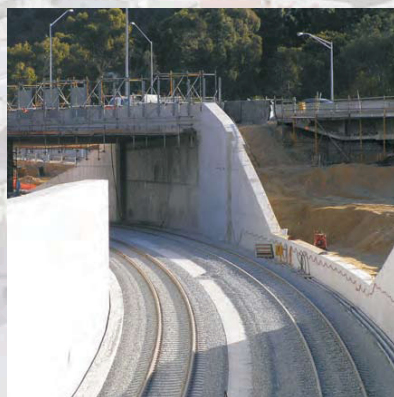
Haulex has been honoured and rewarded by having been part of such a large unique project.

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AT THE CROSSROADS WHERE NATURE AND TECHNOLOGY MEET

- Tunnelling, Geotechnics and Geological Engineering
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- Structural Engineering
- Infrastructure Planning

New Metro Rail Project, Perth, Western Australia
Detail design of retaining walls and geotechnical consultancy services



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Retaining their integrity

Geoconsult Asia Singapore has been heavily involved in the entire MetroRail Project from the outset. The company was engaged to provide detail design of the temporary earth retaining structures, groundwater control, and ground treatment for deep excavations and to provide the geotechnical manager who was responsible of design and implementation of all geotechnical aspects of the project. Detailed design was undertaken by Geoconsult on the Foreshore dive section, the Foreshore cut and cover section, the Esplanade Station, William Street Station, Perth Rail Yard and the bored tunnel sections.

The sub-surface geological variety within the MetroRail Package F, that is the Perth City section, is diverse and presented a number of unique challenges. In particular the foreshore section, which incorporated deep alluvial clay, and the tunnel section beneath Perth Railway Station that was driven through soft sand beneath very shallow over-burden.

The foreshore Cut and Cover sections used mainly strutted sheet pile walls as temporary earth retain-

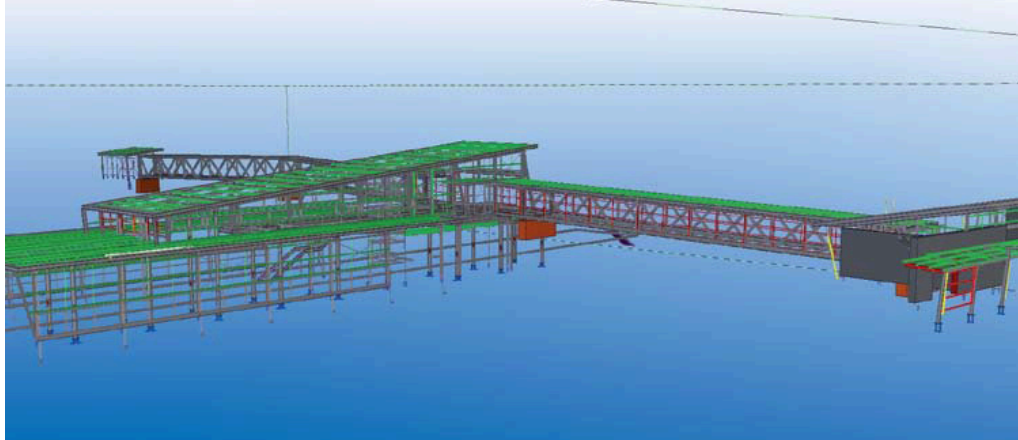
ing structure (see photo above). However, within a prehistoric flow channel of the Swan River (palaeochannel), the soft alluvial clay was particularly deep ruling out sheet piling due to depth and low soil strength and requiring soil stabilisation by ground treatment. Geoconsult's design employed an innovative soil stabilisation system that used deep soil mixing method to create the retaining walls and the ground treatment floor slab. The retaining walls, which were reinforced by embedded steel beams, were integrated with the ground treatment slab creating a single structure that was watertight and strong enough to avoid any distortion or shifting. The same ground stabilisation method was also used in creating the ground treatment block at the TBM retrieval shaft at the Perth Rail Yard. There the ground treatment end wall was fully exposed during excavation requiring no other additional support. Walls were placed directly against the soil mix wall.

The bored tunnel section was constructed using an earth pressure balanced tunnel boring machine (EPB TBM). The tunnel passed beneath the Perth Railway Station and continued towards the retrieval shaft where the crown of the tunnel was

only 2m below the surface. With the tunnel being driven through soft sand below very shallow overburden, under the operational railway station and the old Claisebrook main sewer line, this was a main area of concern involving significant risks. Geoconsult provided TBM face pressure calculations and consulted closely with the TBM team during tunnelling through this sector contributing to the safe and efficient expedition of this section of the project.

Geoconsult Asia Singapore has clearly demonstrated their extensive tunnelling expertise on the MetroRail Project. The fact that all deep excavation and bored tunnelling on the project was conducted very successfully with no major geotechnical complications or incidents is testament to their skills. Naturally they are very proud to have been involved.

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Plan of action

Westplan Drafting have been specialising in producing fabrication and structural detail drafting for local, national and international companies since 1980. A family run business with eight to sixteen employees, many of whom now work from home offices. Westplan drafting utilise electronic data transfer to deliver exceptional high quality drawings and 3D models to clients across Australia, Indonesia, New Zealand and America.

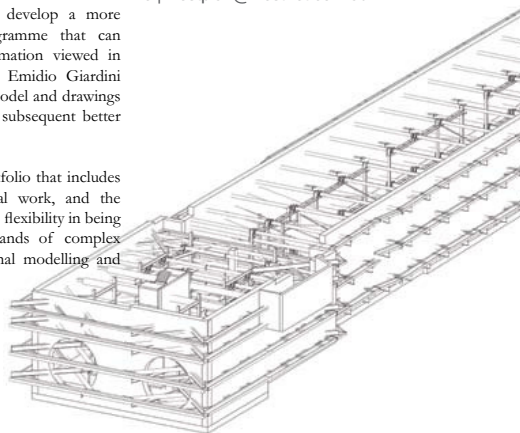
For the New MetroRail City the company provided structural detail drawings and 3D modelling for Thompson's Lake Transit Station and a steel bridge between the Narrows designed to carry the railway in the CBD. This bridge has to replicate the concrete powers of the Narrows Bridge and accurate precambers and welding was essential. In addition the company also provided the complex detail drafting for what spokesperson Emidio Giardini refers to as the "invisible 1,000 tonnes of steel that was used as sheet piling props for the tunnel entrances". These temporary steelworks retained the earth before the forming of the

concrete dive tunnel some twelve metres below ground level, and was essential in establishing the correct alignment of the tunnel.

The company offers a unique visualisation of intricate steel that enables the client to better understand the process and develop a more integrated construction programme that can take advantage of the information viewed in the 3D-computer model. As Emidio Giardini states, the client can use the model and drawings to coordinate fabrication and subsequent better erection processes.

Westplan Drafting have a portfolio that includes infrastructure and commercial work, and the company is able to boast of it's flexibility in being able to respond to the demands of complex projects and deliver exceptional modelling and drafting.

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Movers and shakers

A new young company, AJM Loader Hire have only been in existence for two-years, but they have already established themselves in the Western Australia construction industry. Specialists in the hire and operation of front-end loaders, the company currently operate two loaders in the state, and have already contracted onto a variety of jobs in civil and infrastructure areas. Successfully fulfilled contracts include subdivision and civil work, as well as lake construction and work on the Riverside Drive development.

For the New MetroRail City development AJM Loader Hire supplied and operated a loader on site for a year. AJM Loader Hire predominantly worked on the road construction for the development, as well as waste removal, and back fills on the tunnel. The largest construction site the team had worked on since the company was formed, owner/operator Troy Melbin believes the company rose to the challenges of the large scale site with ease, as he proudly states "it was nothing we hadn't done before".

Despite the comparative youth of the company, AJM Loader Hire are a company with ambitions, and enjoyed the challenges of working on the New MetroRail City project, as Troy Melbin states "while we have not worked on anything that big before it wasn't a particularly big deal, as professionals working on any site is second nature to us", he goes on to say "Our experience in all aspects of earth moving is supported by a resourceful and results driven work ethic." Currently working on Southern Gateway Alliance, AJM's adaptability and can-do attitude has helped place the company in a good position to build on their ever-expanding portfolio of projects.



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Hard act to follow

Beginning as a family run business in 1988 Improved Concrete Pumping Services PTY LTD are now one of the largest concrete pumping businesses in Australia and the biggest in the state. The company have successfully completed many contracts and their portfolio includes large scale infrastructure projects such as major freeways and numerous dams, as well as projects such as the North Bridge Tunnel and the Woodside C and G Plant, amongst others.

With sister companies in Victoria and the Northern Territories, Improved Concrete Pumping Services are, when necessary, able to draw on specialist experience from across the country. Their Victorian sister company boasts a profile that includes the Melbourne Cricket Ground and both companies have collaborated on construction projects in the mining industry. As company spokesperson Neville Willett proudly states Improved Concrete Pumping services work on everything “from major infrastructure to the garden shed”.

The company operate thirty pumps in Western Australia and four of these were dedicated to the New MetroRail City project, on which the company pumped concrete for bridges, walls, floors and tunnels. The length of the train tunnel meant that at times they were pumping to a length of 500 metres. While the Perth soil and water ingress could have posed a problem careful planning and liaising with other trade specialists meant that the project progressed free of any serious difficulties.

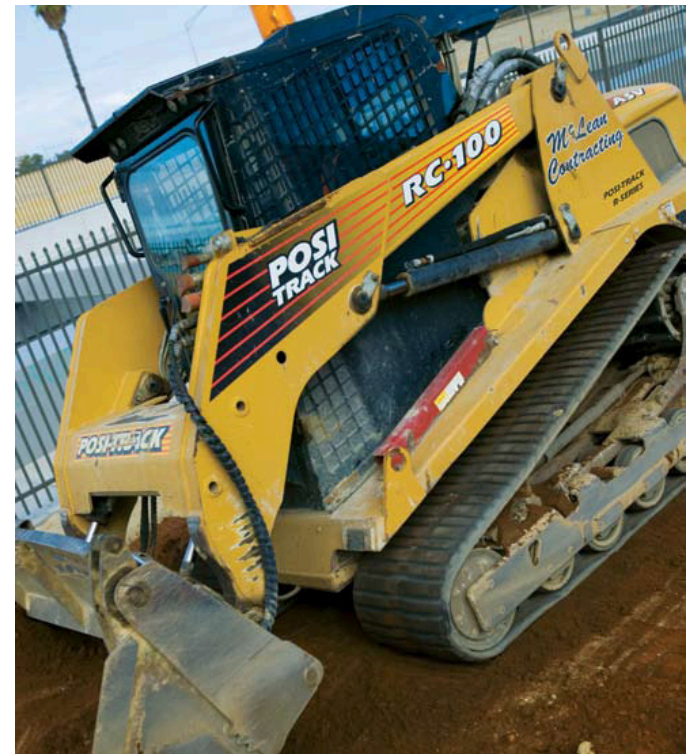
With the William Street Station constructed beneath heritage listed properties Improved Concrete Pumping Services were required to construct the station from top down, with pumping proceeding on the top level first and working down to the station floor. Neville Willett states that this approach was unique in his experience, but acknowledges that such strategies helped preserve the integrity of the street and existing constructions located above the station. He also observes that while such approaches to construction may be radical, Improved Concrete Pumping

Services are fully able to adapt to the demands and requirements of any modern construction programme.

At the forefront of their industry, Improved Concrete Pumping Services boast the largest pump in the Southern Hemisphere, with a 55 metre boom concrete pump.

Employing a team of 40 the company are also dedicated to training staff, helping the company maintain a high degree of workmanship and maintain their position as industry leaders.

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Piling it on

An Australian owned company with extensive experience in their field, Pilequip Australia Pty Ltd have specialised in supplying foundation equipment since 1988. The company represents world leading equipment manufacturers from across the globe, into the Australasian and New Zealand construction markets. In addition they provide professional advice and tailor methodological solutions for large and complex construction projects.

For the New MetroRail City project, Pilequip supplied specialist piling equipment, professional training and devised a strategy geared for the demands of the site. The scale of the project necessitated a response that incorporated both speed and also an awareness of the environmental factors associated with constructing in the Perth CBD.

Sourcing highly specialised machinery according to the specific needs of each of the MetroRail City's construction sites necessitated that Pilequip develop a working methodology that would enable

construction to proceed effectively and according to schedule. Drawing upon their experience, Pilequip were able to advise Leighton Kumagai on the benefits and limitations associated with each type of sheet pile installation and extraction method. This enabled Pilequip to tailor an appropriate solution for Leighton Kumagai that included considerations of the environmental requirements of the site.

Amongst other machinery Pilequip supplied ICE hydraulic vibratory hammers, Junttan and Dawson hydraulic impact hammers and Dawson sheet pile accessories including sheet pile threaders, lifting shackles and pile lifting shoes. Pilequip supplied three new technology Universal sheet pile threaders from Dawson in the UK, which enabled the sheet piling operations to proceed quickly, whilst ensuring utmost attention to safety. Also, for works undertaken near the historic listed buildings Pilequip supplied an ICE resonance free (RF) vibratory hammer, imported from the Netherlands. This technology is recognised as the most advanced in the world for minimising

ground disturbance adjacent to construction works, hence ensuring the integrity of adjacent buildings, services and other facilities.

Pilequip endeavours to be a company that provides comprehensive service, and this is backed by our highly mobile and experienced workshop team that provide first class field service and maintenance support. Pilequip specialise in the sale and rental of piling equipment including piling rigs, hydraulic impact and vibratory hammers, and excavator attachments. They are also staffed by a highly experienced team that provide expertise to ensure the correct equipment is supplied for any job.



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Clearing the way

Earthmoving specialists McLean Contracting are a powerful force in Western Australia, with extensive experience throughout the state and a dedicated workforce of fifteen employees. Equally at home working in the outback or in Perth CBD, the company have provided services for both the construction industry and the mining industry across WA.

For the New MetroRail development the company were called upon to provide an innovative solution to a major construction challenge. The presence of water in some areas of the development initially created significant problems in moving and removing the sloppy mud. McLean Contractors provided the solution by supplying specifically sourced plant being excavators, D4 Dozer and a 'Posi Track' all terrain loader) to enable production to be maintained through the boggy conditions.

McLean Contractors have been on site since the inception of the project and are still providing their services in the final cleanup stage of the

project. Additionally McLean Contracting are currently working on mining infrastructure projects. McLean Contracting are excavating and installing single and multi barrel spiral steel culverts for railway lines, including mixing and placing cement stabilized backfill on site. Mclean Contracting continue to deliver a quality service with efficient productivity for which they are known.

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HASSEL Architects - Artists Impression, Metro rail platform



QUALITY TESTING FOR QUALITY PROJECTS

Thorough, Accurate & Reliable Materials Testing and Investigations

As one of the largest independent construction materials testing and investigations businesses in Australia Western Geotechnics (WgeoG) provides a comprehensive range of testing and investigation services. WgeoG has four permanent and fully equipped laboratories in Perth, Kalgoorlie, Karratha and Port Hedland. The company is corporately accredited through NATA and is quality endorsed with BVQI. The experienced staff compliment of over 45 technicians, 30 of which are NATA accredited signatories, conduct over 150 various tests to meet your needs.

- Extensive laboratory testing of soils, rocks, concrete and aggregates.
- Experienced in deployment of project laboratories to remote sites with capabilities tailored to client needs.
- Specialised testing – triaxial, consolidations, direct shears.
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- Pavement non destructive testing capabilities: Multi-Laser profilometer, Falling Weight Deflectometer and Benkelman Beam.
- Concrete technology including round panel shotcrete testing.

Our permanent and mobile testing capabilities coupled with our highly skilled technicians give us the capacity to meet your testing programs for projects regardless of size and location.

KALGOORLIE LABORATORY: Tel (08) 9091 4718

KARRATHA LABORATORY: Tel (08) 9144 0624

PORT HEDLAND LABORATORY: Tel (08) 9172 3135

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WgeoG
Western
geotechnics
Group

GETTING OUR HANDS DIRTY IS ALL PART OF THE SERVICE

It's a Shaw thing

With eighteen years experience and twenty two trucks dedicated to both construction cartage and general freight, a family owned business, Shaws Cartage are a powerful and well respected force within the transport industry in Perth and throughout W.A. As specialists in oversize work, with experience contracting to many of the State's construction projects, including repeat work for Delta to Multiplex, the company were well positioned to work on the New MetroRail City development.

Contracting to the New MetroRail City project from the commencement of works, Shaws Cartage carted the oversize steel cages for Leighton Kumagai Joint Venture, sundry equipment for tunnel boring machine, the steel used for the stations, the platforms and the escalators. In addition, in conjunction with Kingston Heavy Haulage, Shaws moved the massive Delta Concrete beams used for the bridge overpasses. As company spokesman Phil Larcombe states hauling such large-scaled beams necessitated meticulous advance planning and specific attention was paid to the logistics of the project. He also observes that Shaws Cartage have an exemplary reputation for hauling oversize loads, especially in tight situations, something that is particularly useful when

working in the relatively narrow streets of Perth's inner city. The drivers employed by Shaws Cartage are highly experienced and the company were able to draw upon their professional knowledge and expertise when delivering the oversize concrete beams and other oversize loads to construction sites. Such deliveries are made easier thanks to the modern, specially designed trailers the company uses in tight situations.

With their highly experienced staff and proven track record on numerous large scale construction projects, Shaws Cartage are an industry success, as John Padgett Operations Manager proudly states. "That Shaws have built a reputation on making the most difficult jobs look easy. / This can do attitude, matched with their skilled staff, guarantees that Shaws Cartage will retain at the forefront of the haulage industry in Perth."

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Seal of approval

Priding themselves on their personal touch, Concrete Waterproofing are a Western Australia family run company with fifteen years experience contracting to developments in both Western and South Australia.

With a hands on approach Concrete Waterproofing are able to offer specially tailored expert advice and skills geared to the demands and needs of their clients. The company has a proven track record of successfully completed projects and boast of never having a failure. These projects have included water tank work for both the South and Western Australian water corporations, in addition to projects for the South Australian transport department.

Working on the MetroRail development for eighteen months, the company have sealed all the leaks and seepage within the train tunnels and the underground stations caused by the exceptionally high level of the Perth water table.

Specialising in injecting polyurethane in order to seal areas of seepage such as cracks and joints. For the MetroRail development Concrete Waterproofing used hydrophobic and hydrophilic polyurethane, chemicals that use the hydrogen molecules in water to stimulate a chemical response that creates a water resistant seal. While these forms of polyurethane have been commonly used in countries with high levels of potential water ingress such as Britain, Hong Kong and Japan, this formula is used worldwide & is becoming the accepted practice in Australia, despite its effectiveness, positioning Concrete Waterproofing at the cutting edge of their industry.

Using a high power twin piston pump brought to Australia from England especially for the MetroCity development, Concrete Waterproofing were able to use the high pressure pump to force the polyurethane chemicals into cracks and joints in order to prohibit all water ingress. Thanks to their industry contacts Concrete Waterproofing are able to draw upon experience and human knowledge from across Asia and Europe, allowing the company to readily embrace new technologies.

Concrete Waterproofing are currently in the process of expanding their operations, and are opening a branch and office in New Zealand, where they plan to put their experience, knowledge and technical expertise to use in construction projects across the Tasman Sea.

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Perfect profile

A new, family run company with a dedicated staff of twelve employees, WA Profiling are specialists in road profiling using the latest most technologically advanced machinery. With the average road surface having a life span of some fifteen years, the company have the machinery and skilled workforce needed to chew-up and clean the surface of the road, commonly to a depth of 30mm, prior to the laying of the new asphalt surface. Training their construction teams in house has enabled WA Profiling to maintain control of the quality of the work undertaken, with employees trained in providing a service that is quality assured.

Perth's New MetroRail City project saw WA Profiling providing their services for a year. The nature of the development necessitated that WA Profiling work "on and off" as company founder Peter Blackburn says, "working when needed, and making ourselves readily available to the client". The nature of the construction process, and the time restrictions on site, meant that on occasions WA Profiling were working at 1:00am, but, as Peter Blackburn states, "we are happy to work ac-

ording to the challenges and demands of the industry, and are more than able to make ourselves available accordingly".

WA Profiling are a recognized force in Perth and Western Australia, and have the latest machinery in order to fulfil the demands of a project. For the New MetroRail project the company used a Polyplaner to remove the existing road markings, in order that new road markings and lanes could be demarcated immediately. WA Profiling is the only company in the state to employ such technology. WA Profiling also owns 3 x CAT Skid Steer Profilers for smaller works and the grinding of Kerbs, they are one step ahead owning their own trucks and lowloader.

In December 2006 WA Profiling took delivery of their second new W2000 Road Profiler in order that they can maintain their cutting-edge position in Western Australia, as well as continuing the technological standard that has enabled them to be at the forefront of the profiling industry.



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'Ground Penetrating Radar imaging sub surface presences for proposed bridge design. Burswood, Perth WA.

Underground detectives

Specialists in the design and location of underground assets, WH Location Services are Western Australia's largest dedicated sub surface detection company. WH Location Services maintain its position at the forefront of the cable location industry by focusing on safety, asset protection and a systematic location service providing fast, accurate detection on time for civil design and projects.

Non-Destructive cutting edge location technology is the focus of their asset detection services utilising Ground Penetrating Radar and Vacuum Excavation. The company focuses on underground asset survey for Sub Surface Engineering on infrastructure projects assisting planning and protection of metallic and non-metallic utilities.

This service was provided on the New Metro Rail project from the inaugural stages through development and consultation during construction. The team at WH Location Services under the project management of director Michael Ward assisted in the planning for the project, assessing requirements and identifying existing utilities that were in conflict with the station, tunnels and associated infrastructure.

In order to minimise project risks WH Location Services worked with the client to create a permit issuing system that aided communication of the detection service to the site managers. This system was successful in communicating work tolerance areas and underground presences for risk reduction and asset protection with no associated damage, costs or project interruptions.

The scale and nature of the project in the Perth CBD with a high volume and complex underground asset network meant that WH Location Services was faced with many unknown and old underground utilities. The company developed new verification techniques to assist in the identification of these utilities where there were often no records or plans available and to confirm the ownership of the assets for the New Metro Project progression.

WH Location Service's mission is to keep projects moving, and on Metro Rail the company made experts available around the clock in order to guarantee the demands of the project could be met immediately. Through maintaining such high standards the company have been able to consolidate their position within the location service industry.



Non Destructive Vacuum Excavation on services at the New Metro Project

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Studweld International

Studweld International has been established some seventeen years in Australia, it also has contacts in Asia, South Africa, New Zealand and Korea. Studweld International are one of a few specialised studwelding companies in WA.

Studweld International are specialists in welding shear connectors to any steel structure from bridge spans to buildings i.e. the Narrows bridge rail link, to the rail portal under the Horse shoe bridge. It also welds shear connectors through deck for composite floors i.e. 25th floor on the Woodside building Bunnings administration building in Kewdale. In addition to shear connectors, they also weld threaded studs to many grades of hardened steel wear plates for the mining sector, i.e. ehsp, bisalloy, dua plate and hardox. Studweld has also made a name for themselves in the refractory industry with jobs for the Woodside's gas turbine exhaust stack, some 43,000 refractory anchors.

For the New Metro Rail project the company were responsible for welding shear connectors and concrete anchors to the piles which connected the

floors to the walls of the rail portals where the trains enter and emerge from the tunnel. Studweld International had to produce weld procedures to pass the many strict guidelines put in place by the contractor and the Australian standards. The job was completed on time and budget.

The system used by Studweld International relies on a semi-computerised process which gives the operator infinite control over the weld, current and time to produce the same weld indefinitely to the highest standards time and again. The stud welding process has been proved to be 10 times faster and stronger than conventional welding, where normal welding would weld around a cylindrical object, the studwelding process welds from the inside out! While the semi-computerised process helps the company achieve the desired results, their employees are all trained in house and are specialists in the welding system, and their expertise is also essential in guaranteeing the success of the process. The work undertaken by Studweld International is all quality assured to the highest Australian standards.

With such experience and a portfolio that includes not just the New Metro Rail development but also high profile projects such as the Northwest shelf enclosure, Westfield Carousel, Convention Centre and Woodside Building, as well as numerous contracts for the mining industry across WA, it is not surprising that the company find much of their work from word of mouth recommendations and returning clients anxious to employ Studweld International's talents.

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Securing the site

The Western Australian Government's \$1.4 billion MetroRail Project is a massive investment in the future of Western Australia, and some would say, an investment that is long overdue for the booming state. Involved in the overarching project are numerous contractors fulfilling the many and varied roles involved with all the aspects of the new rail link's construction. Each one of these contracted companies has met strict guidelines with regards to OH&S, environmental protocols and training set down by the WA Government and developers responsible for the differing sections and aspects of the project.

JSB Fencing and Machinery Hire Pty Ltd are one such company that met the high criteria set. Established in the mid seventies, JSB have already proved their credentials by surviving the many booms and busts that have occurred in their thirty years of operation. Not only have they survived, but they have flourished, developing a sound reputation for providing personalised service, competitive pricing and consultation on a wide variety of jobs. The fact that JSB remains a relatively small company indicates their focus has always

remained on providing the highest quality of service to their clients. When a company is able to operate in its clients best interests whilst at the same time serving its own best interests, it is clear they have established a sound business ethic.

For the MetroRail project, JSB provided temporary security fencing along with labour hire and earthmoving services for the underground sections of the track. Utilising a number of confined space machines including excavators and positrack bobcats (which proved invaluable in the difficult conditions), JSB have once again set high standards for their work. It is a clear testament to their abilities that after 30 years in the industry they are still operating at the forefront on cutting edge infrastructure projects. As with all their work from the smallest project to the largest they are naturally very proud of the results they have achieved.

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United Equipment - on the right track

With Perth's most ambitious city infrastructure project happening at the same time as a massive mining boom, materials handling hire companies in Western Australia have never been busier.

Luckily, United Equipment (formerly WA Access and WA Forktrucks) had the depth in its hire fleet to supply more than 100 different elevating work platforms, telehandlers and forklifts to Leighton Kumagai, the contractors for the CBD underground section of Perth's new Metrorail City Project.

The state-of-the-art equipment used on the Metrorail City Project were a fraction of the 5000 machines available through United Equipment's impressive national rental network, any one of which could have been whisked onto site at short notice to take on any kind of task. But with a project like Metrorail City, a ready supply of the right equipment is only part of the story.

The underground tunnelling work was carried out in demanding wet conditions and the equipment was subjected to the rigours of constant use in this harsh, damp environment.

Reliable service and maintenance support was just as important as short-order supply to make certain that downtime was kept to a minimum.

United Equipment's reputation for servicing was put to the test – and the team passed with flying colours. United Equipment offers full servicing back-up at its Perth headquarters and all its depots throughout Australia. This offered the hassle-free reliability Leighton Kumagai needed to get the job done.

The Metrorail City Project was also an opportunity for United Equipment to put its new range of JLG equipment through its paces.

United Equipment was recently appointed national distributors for the sales and service of JLG telehandlers in Australia and New Zealand, and aerial work platforms in Western Australia, South Australia and the Northern Territory.

The JLG appointment is one of many highlights during an active period of growth for the United Equipment group.

United Equipment was founded in 1985 in Western Australia as WA Access and WA Forktrucks by chairman Laurie Puddy and has been included in BRW's prestigious list of "Australia's 100 Fastest Growing Private Companies" for five consecutive years. The group changed its name to United Equipment in September 2005.

United Equipment is now one of Australia's leading national materials handling networks, in-

involved in the sales, rental, training, finance and servicing of forklift trucks, access equipment and telehandlers.

Since establishing a financial partnership with private equity company AMP Capital Investors Limited, United Equipment has representation in Western Australia, Northern Territory, Victoria and New South Wales, and will soon add Queensland and South Australia to the list. The group is also looking to international opportunities.

Despite its national and international outlook, United Equipment's business focus remains proudly local. "We have a culture of cherishing the heritage of the companies we become involved with. And we make certain local people operate these businesses as they have in the past," the spokesman said.

"It's a big business advantage... with a lot of local know-how!"

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With twenty-five years experience in infrastructure works and construction, Works Statewide Kerbing were a natural choice for the MetroRail development in Western Australia. Employing 50 people, Works Statewide Kerbing had a crew of ten devoted to the MetroRail project.

This crew, one of six that work for the company in Perth, were responsible for laying all of the outside kerbing on the project, including the kerbing for slip roads, freeways and bus lanes. Although the crew dedicated to the project were highly experienced they still used various technologies in order to best assure the high quality of their work, including an automatic level which guaranteed the positioning and placement of the kerbs was correct. Working on the project for two years, the company are more than satisfied with the ease at which the job was completed, free of any major problems, and coming to completion both on cost and on schedule.

When asked, Works Statewide Kerbing spokes-

person Peter Gurney estimates that throughout the entire project the company have laid "approximately 15,000 metres of kerbing", but while acknowledging the large size of the project he is careful to observe that for Works Statewide Kerbing the job was a comparatively easy one, thanks to the size and resources the company was able to draw upon.

Peter Gurney attributes the company's successes to their size as he says they are possibly the largest company specialising in kerbing in Western Australia. Their size and reputation has given them an edge over competitors, enabling the company to run their crews efficiently, to keep their costs competitive and to maintain their overall efficiency.

Currently working on numerous projects, ranging from car parks to subdivisions, Gurney acknowledges that the company are enjoying Perth's building boom and that Statewide Kerbing are well positioned to benefit from this and maintain their strong position in Western Australia.



Structural integrity

Privately owned business Onsite Engineering specialise in structural steel, tilt panel and precast panel erection for medium and large-scale commercial projects. Onsite Engineering utilised a team of forty employees, with a variety of skill diversity throughout the project, including boilermakers, riggers, crane drivers and coded welders. Many employees have worked with the company since it was founded in 1990. The company has successfully completed many projects in Western Australia including Kings Park Federation Walkway, Warnbro Aquatic Centre, ABC Building East Perth, Whitfords Shopping Centre, and the Innaloo Shopping Centre, among others.

Devoting three years to the New MetroRail City development, Onsite Engineering (OSE Riggers) erected the structural steel in both the William Street and Esplanade Stations, much of the work being accomplished with low headroom constraints. Specialised lifting equipment was well-utilised including mini crawler and slab cranes capable of lifting 3T to height of 12M.

One of the more complex roles undertaken by Onsite Engineering involved the façade of the heritage-listed Mitchell Building early in the construction phase. In order for the façade to be preserved it was carefully divided into 45T pieces and lifted down in purpose made lifting cradles, rotated and loaded onto trucks by 250T and 100T cranes. Each section was transported off site into storage, ready for reinstatement when the William Street Station is completed. Drawing upon their extensive experience Onsite Engineering managed the removal safely and well within the allotted time frame.

While each level was excavated of what was to become the William Street Station, OSE Riggers installed and removed the structural bracing necessary for supporting the walls. Temporary bracing and stabilising of other works, along with craneage and rigging were provided throughout the whole project. Precast concrete was installed to both underground stations, including concrete stairways.



As the curved roof of the Esplanade Station took shape, accuracy of workmanship was essential in maintaining and aligning the curved steel beams due to the critical tolerances and weight of the assembled sections. Other areas of involvement by OSE Riggers included the installation of catwalks and walkways, and specialised welding including the Boring Machine.

Although being a one-of-a-kind project, Company Director Rob Nolan and employees were proud to have been involved in the MetroRail development. Working closely with the engineers and LKJV management, solutions to problems were speedily achieved despite the complexities involved. The MetroRail project has proven to be another successfully completed project.

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