

EASTLINK REDEFINING THE POSSIBLE

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ABSTRACT

EastLink is the largest road infrastructure project ever built in Australia. The sheer size of the project presented a range of engineering, logistical and program complexities never seen before.

Featuring two 1.6km tunnels, 17 major interchanges and 88 bridges, EastLink demanded outstanding design, engineering excellence and innovative construction methods, all driven by expert scheduling and project management. It also relied on motivated people working together willingly, safely and productively. There was no margin for error.

Thiess John Holland not only delivered a world-class motorway but redefined what's possible in road construction – setting new standards in turnover, design, construction and sustainability.

EastLink was completed five months ahead of an already breakthrough contractual date, with limited disruption to surrounding communities and stakeholders.

The legacy of EastLink set a new benchmark for project delivery in Australia.

KEY WORDS

EastLink, Thiess John Holland, Southern and Eastern Integrated Transport Authority (SEITA), ConnectEast, Mullum Mullum tunnels, Latrobe Valley precast facility, Ringwood rail bridge slide.

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INTRODUCTION

EastLink is eastern Melbourne's major north-south link. Over one million people live in the corridor east of Warrigal Road and are serviced by EastLink.

It features 45km of freeway standard road, including 39km of tolled roadway and 6km of untolled bypasses at Dandenong and Ringwood.

At \$2.5 billion, EastLink required more than seven million cubic metres of excavation and earthworks, 1.3 million tonnes of asphalt, two million square metres of pavement and 17 major interchanges.

Work started on site in December 2004, and opened to traffic at 1am on Sunday 29 June 2008, more than five months ahead of schedule. More than 13,000 people worked on EastLink during the course of the project.

PROJECT SCOPE

EastLink was one of the largest, most complex and technically demanding road projects in Australia's history.

At its peak, in excess of \$100 million per month was spent on the construction of EastLink – outstripping turnover levels all previous Australian infrastructure projects. The project set an Australian and New Zealand record for 4,119 tonnes of asphalt laid in one day.

During construction more than 22,000 items were fabricated at a purpose built precast facility in the Latrobe Valley, including approximately 1,650 bridge beams, 4,630 barriers and parapets and over 15,000 precast noise wall panels.

One of the most complex aspects of the project was the design and construction of two 1.6km tunnels under the environmentally sensitive Mullum Mullum Valley. Five roadheaders together with rockhammers and drill and blast techniques were used to excavate 450,000 cubic metres of rock.

More than 50,000 cubic metres of concrete was used to line the tunnels, which lie up to 45 metres below the Mullum Mullum Valley at their deepest point.

Other major features of EastLink include:

- a state-of-the-art tolling system designed to handle five million transactions per day
- 500 hectares of parkland – more than 1.5 times the size of New York's Central Park – featuring 3.6 million native plants
- one of the largest road interchange jobs in Australia, including construction of six bridge structures and nine bridge widenings on an existing and operating freeway.

CONTRACT

EastLink was delivered as a Build Own Operate Transfer (BOOT) project, with direct tolls via a multi-lane freeflow tolling system utilising 13 tolling gantries in each direction. Thiess John Holland was responsible for all risks excluding a couple of carve-outs where risk was shared with the State, and on a fixed time, fixed cost basis.

Contract structure

The Southern and Eastern Integrated Transport Authority (SEITA) was the Victorian Government's 'single focus' project manager for EastLink, devising performance specifications, evaluating all competing bids and administering project design and construction.

ConnectEast was the winning bidder for EastLink, and became the Concessionaire with rights to operate the newly-constructed asset for 39 years. Principal stakeholders in ConnectEast included Macquarie Bank, Thiess and John Holland.

ConnectEast awarded the design and construct contract to Thiess John Holland – a 50/50 fully integrated joint venture between Thiess and John Holland. The contract was administered by ConnectEast and SEITA with the Independent Reviewer certifying the design and construction complied with the Deed requirements.

The Independent Reviewer included a small team of consultants led by Sinclair Knight Merz (SKM) in conjunction with Maunsell and Davis Langdon. The Independent Reviewer was employed directly by the Victorian Government and ConnectEast, with no input or influence from the contractor.

PROJECT DELIVERY

Setting the project direction

The primary challenge faced by Thiess John Holland on EastLink was coordinating a large and complex project against the background of a very tight timeframe, resource constraints, competitive budget and a variety of stakeholder attitudes and opinions.

One of the first major decisions was to divide the project into six key regions: Mitcham, Ringwood, Knox, Monash, Dandenong and Frankston. Each region included a regional office with locally-based management and project teams covering key aspects such as safety, environment, quality, community and traffic.

These regions were supported by a global project team based in Mount Waverley, which included senior management, human resources, planning and design.

Stakeholder management

Thiess John Holland found early communication was the key to successful stakeholder management. Giving people time to comprehend the project and ask questions helped manage a wide range of potentially damaging issues.

Thiess John Holland's approach included letterbox drops and doorknocks, a 24-hour community contact line, a quarterly newsletter, community forums, one-on-one consultation, information days, development of a virtual model, website updates, flyover DVDs that showed project progress, media updates, presentations, site visits and a project Open Day.

Five Community Connect Forums (CCFs) were the primary consultative mechanism between Thiess John Holland and the communities along the EastLink corridor. Another proactive measure was to create an internal haulage route through the site to take hundreds of trucks off local roads.

Other measures to mitigate stakeholder concerns included:

- based on a specific set of criteria, at certain locations changing the noise wall material from concrete to see-through acrylic panels to address concerns regarding loss of significant views
- temporary relocation to self-contained apartments for people affected by prolonged tunnelling works at night
- SMS alerts to advise residents of blasting in the tunnel
- altering construction activities to minimise disruption to road users and maintain access to properties at all times.

Accommodating utilities

Even before earthworks and construction could begin the EastLink project required a massive number of utility relocations involving major metropolitan water mains, gas mains, powerlines, telephone lines and cables.

More than 850 services were relocated along the 39km motorway. In most cases construction work could not begin until utility relocation was complete. One of the largest jobs was the relocation of three 104 year-old water mains, situated near the Maroondah Highway, which supplied all of the eastern suburbs of Melbourne.

Archaeology and heritage

EastLink was constructed over the largest archaeological site uncovered in Victorian history, which involved significant interaction with local Indigenous communities. This was not known during the project development phases, and was only discovered during pre construction site – surface testing.

Thiess John Holland had an obligation to conduct sub-surface testing prior to construction. When significant archaeological deposits were identified, archaeological excavation took place and any artefacts found were either retained for further analysis or given over to the representatives of traditional owner groups for their safekeeping.

Most finds were stone fragments, chips from the making of stone tools and some tools themselves such as hammer stones and Bondi spearheads.

Close control over construction activities was necessary to protect the archaeological work, including diverting hundreds of truck movements a day away from the trench via a specially constructed chicane. Earthworks were also completed on either side of the trench, construction crews were relocated to other areas, and a toll gantry and shelter were relocated further south.

Simplified lifting

Thiess John Holland purchased the biggest road crane of its kind in the world.

‘Snow White’, as she was affectionately named, was a 16 metre long, 16-wheel giant boasting a lifting capacity of 500 tonnes. Her involvement reduced the time taken to

complete bridge lifts by approximately half, as well as considerably improving the safety aspects of Thiess John Holland's heavy lifting operations.

Ringwood rail bridge slide

Completion of the Belgrave-Lilydale railway line bridge in Ringwood was an innovative milestone for the project.

As the railway line could not be shut down for long periods – it is busiest rail line in Melbourne with a train every five minutes in peak periods – the solution was to construct the new 106 metre, 1,840 tonne steel bridge immediately north of its final position on temporary footings, then slide it into place on permanent footings using five hydraulic jacks.

The bridge consisted of two separate structures, both measuring 106 metres long and each made up of four spans of steel girders with a concrete 'trough' deck that retained a ballasted track and supported a service walkway containing railway cables and electrical equipment.

A trial slide was made to verify the method could work, and the actual process required two weekend closures of the line – the first to allow construction of footings and culverts under the railway line and the second to slide the bridge into place.

Precast concrete tunnel invert

Due to the number of activities taking place concurrently during tunnel construction, a decision was made to precast concrete tunnel invert to reduce construction hours within the tunnel and minimise construction traffic.

Precast units were placed well in advance without constraining the concrete obvert lining, which was a first in Australia for a non-tunnel boring machine (TBM) excavated tunnel.

Tanked tunnel with low water ingress requirements

As both EastLink tunnels were constructed beneath the environmentally sensitive Mullum Mullum Creek Reserve, protection of the environment was paramount.

Specifications limited water ingress to one litre per second for the combined groundwater inflow to both the internal and external drainage systems of the tunnel.

The system that was designed and installed by Thiess John Holland achieved this outcome by utilising a waterproof membrane that covered all of the shotcreted surfaces of the excavated tunnel profile.

Remote rock bolting system

The enhanced rock bolting system Thiess John Holland adopted used a remote control system that meant none of the workforce had to work beneath any unsupported ground, which considerably improved worker safety and also improved productivity by seven minutes per cycle.

Precast concrete piers and bridge cross-heads

Precast concrete pier elements were match cast as 'building blocks' at the precast facility in the Latrobe Valley and could be stacked one on top of each other. This

method greatly minimised the time and cost needed to occupy major roads and divert traffic. It also reduced the OH&S risks of working in an operating road environment.

Bridge design reflected construction needs

Early completion of many of EastLink's bridges was crucial to the opening of an internal haul route for trucks. This route was vital to separate heavy construction traffic from existing roads and speed up overall construction.

Northbound bridges were designed to carry greater loads resulting from off highway haulage equipment than southbound bridges in line with the proposed haulage route, while difficult access meant innovations were also required to assist crews to erect bridge beams and noise walls in some areas.

Creek realignments

One of the most impressive environmental initiatives of the EastLink project was the temporary diversion of the Mullum Mullum Creek at Ringwood to allow for construction of interchange bridges.

Due to a lack of suitable ground for cranes as well as nearby overhead powerlines, the creek was diverted through a number of concrete pipes and earth placed over the top to create a solid access point for the cranes. To carry out the diversion, a small dam was created upstream of the works with a bypass pump re-directing water further downstream. Once the pipes were in place, the dam was removed and the creek was returned to its normal course.

Dust prevention and water conservation

During the construction of EastLink dust prevention, water reuse and water recycling was a high priority. As a result, approximately 75 per cent of all water used on the project came from recycled sources.

Wherever possible the use of water for dust suppression was avoided by minimising areas of exposed soil. Where this was not practical, chemical dust suppressant or a temporary grassing method known as 'hydroseeding' was used to reduce dust.

The vast majority of water used on site was obtained from the project's 250 sedimentation ponds. However, due to drought conditions Thiess John Holland was forced to use recycled water from the treatment plant at the Mullum Mullum Valley tunnels and from the Melbourne Water Eastern Treatment Plant in the southern section of the project.

Another water innovation was an inventive flocculating system at the Monash wetlands. Instead of mixing flocculant (a chemical that attaches itself to dirt and silt in water making it settle at the bottom) directly into the water, the chemical was contained in a 1,000 litre water tank situated next to the wetlands. Water from the wetlands was pumped into the tank, mixed with the flocculant and then spread out over the wetlands using a series of sprinkler heads.

Mullum Mullum Valley Shared Use Path

Another proud environmental achievement of EastLink was the development of a visually stunning and environmentally sensitive path through the Mullum Mullum Valley.

The 2.75 kilometre shared use path winds through the valley between Deep Creek Road in Mitcham and Park Road in Donvale, and crosses the Mullum Mullum Creek five times. It predominantly follows long-established foot and cycle routes, and is part of the wider EastLink Trail which includes 35km of shared use bicycle trails and pedestrian overpasses along the motorway.

Boggy Creek Wetlands relocation

Another significant achievement was the successful relocation of the Boggy Creek Wetlands near the Mornington Peninsula Freeway, which contains several rare species of pre-historic ferns including the endangered *isoetes drummondii*.

The wetland was in the direct path of EastLink. After extensive consultation, it was agreed the ecosystem should be moved one sod at a time to a nearby location.

Believed to be an Australian first, the work was carried out using a front end loader with a large flat steel plate. The plate was slid 300mm under the natural surface and carefully lifted out of position to minimise disruption to the wetlands.

The relocation included the installation of a sediment pond, drainage and an irrigation gate to control water flow in and out of the area. It set new standards in conservation and environmental management.

Platypus tunnel

With many reported sightings of platypus in the Corhanwarrabul Creek, a specially designed platypus tunnel constructed. To make it as natural as possible, the realigned creek consisted of an arch culvert with specially selected crushed rock placed on the floor and a skylight as some platypus are wary of enclosed spaces.

Public art

EastLink boasts the largest and most ambitious public art program along any major road in Australia. The \$5.5 million initiative includes four large-scale artworks situated next to the motorway and 10 smaller works on adjacent cycling and walking trails.

Program

Critical to the success of EastLink was the ability to monitor the construction of all works in real time and generate updates on progress quickly and easily. To keep the project on track at all times a number of programming initiatives were implemented, including:

- monthly development and supply of programs from each of the regions, the design team, the tolling team and other contractors. These individual programs were then integrated, analysed, used to instigate changes and reissued both to the individual regions and externally
- monthly summary reporting involving tracking the project's most critical paths/works (approximately six to eight most critical paths at any point in time) and quantifying any delay or gain in time, productivity contingency available, float available and explaining both the reasons for changes to the program and the actions being undertaken to re-gain any lost time

- Contractual Completion Obligations were documented and tracked on a daily basis over the last 12 months of the project to ensure no completion obligation, as compared to physical work, was responsible for any delay to the project
- Time Chainage Chart Programming occurred allowing the representation of work locations within programs. This assisted work teams to understand the relevance of activities across different regions/management teams
- Schematic Completion Diagrams/Programs were implemented to provide a graphical representation of tunnel works, civil works, fit-out works and mechanical and electrical (M&E) installation and commissioning
- ‘myth-buster’ photographs were taken of all major works on site at least twice a week to document actual progress.

In addition to these activities, some project areas required special attention to ensure supplies were maintained, and overall project demands were met. These included:

- a weekly review of precast production and changes to site requirements – resulting in weekly re-sequencing of fabrication (for bridge super-T beams, parapets, piers and cross-heads)
- a weekly review of steel reinforcement supply – to prioritise all orders to critical works on a project-wide basis. Where required, steel was also supplied from New South Wales and South Australia
- prioritisation of all concrete pours for the upcoming week, every week, according to project critical works and project costs.

MAJOR ACHIEVEMENTS

Fast-track mobilisation

Getting the right resources on the ground fast was essential for the success of EastLink, including securing skilled and experienced personnel.

Initial estimates showed Thiess John Holland would need at least 550 core staff while calculations of resource requirements and industry capability indicated shortages of precast concrete elements, sourcing of landscape plants as well as asphalt and concrete supply. All of these issues were considered carefully before a commitment was made to the tight four-year timeframe.

Thiess and John Holland employees from around the country were seconded to EastLink, despite competition from other major projects such as the Lane Cove Tunnel in Sydney.

An important first step was establishing a project office in Mount Waverley, located central to the project. The design team from Hyder, Parsons Brinkerhoff and CW-DC moved into the Mount Waverley office with the Thiess John Holland team straight away so that close interaction was established from the outset.

Effective working relationships

Thiess John Holland ensured lines of communication were always open with ConnectEast and SEITA, and all major decisions regarding project planning, design and construction methods were completely transparent, fully discussed and any issues resolved before works began.

Effective partnerships were also built with project team members and contractors. Detailed workflow planning and reporting, from the top down, proved vital in terms of meeting the relentless schedule, maintaining quality and addressing the needs of all stakeholders.

Quality systems

A quality management system was developed for EastLink in accordance with the international ISO 9001 standard. Methods were developed for documenting the quality of all aspects of construction including safety, environment and community. Inspection and testing was undertaken regularly. All quality records were attached to Work Lots created in a central database and were available for internal and external review and approval.

Some 28,500 Work Lots were created for the project with a further 24,000 for the precast facility. The use of the data base to compile quality records also enabled monitoring and management of the status of completed work and closed Work Lots. The data base was fundamental to the presentation of Completion Plans for external review as part of the comprehensive external review and approval process to achieve contractual completion.

Design and the user experience

EastLink's urban design features lead the way in terms of artistic and architectural achievement on roadways in Australia.

All elements were designed using a palette and textures from the local environment, including tunnel portals, pedestrian bridges, noise walls and exposed rock faces right through to handrail detail. Coloured acrylic panels were also used in close proximity to houses to protect views and avoid potential overshadowing.

Industrial relations initiatives

In a major breakthrough for the construction industry in Australia, particularly in Victoria, EastLink was completed without any major industrial or strike action.

This was due to the cooperation and goodwill of all parties involved, including the Australian Worker's Union, the Construction, Forestry, Mining and Energy Union, the Electrical Trades Union, the Australian Manufacturing Workers Union and Thiess John Holland.

The most important initiative was the negotiation of a project-specific Enterprise Agreement with all unions, which included a number of pioneering measures in terms of workplace flexibility. These included:

- an ability for project to keep working through RDOs and holiday periods for critical works
- 13 fixed and 13 flexible RDOs
- no non-working shop stewards

- increased All Purpose Site Allowance, overtime rates and superannuation contributions.

Training and development

Every Thiess John Holland team member completed a thorough induction, covering project aims, safety, roles and responsibilities, and the core values of the team.

An in-depth training program was developed, with courses available to all of the workforce and core staff. Some courses were also available for subcontractors. Courses included working at height, confined space entry, 4WD training, rigging and first aid as well as stress management, computer skills and time management.

In total, more than 24,000 participants attended more than 150 courses.

A shortage of qualified construction workers meant Thiess John Holland also employed a number of people with little or no construction experience. Nearly 300 employees completed traineeships and received a Certificate III qualification, which were run by the Caterpillar Institute. These courses included qualifications in Tunnelling, Plant Operation and Road Construction and Maintenance.

As well as focusing on the development of the general workforce and staff, training was also provided to senior personnel. Many line managers and supervisors participated in a variety of leadership workshops, such as the Safety Leadership Program and the Supervisors Development Program, which provided them with the opportunity to network, hear from inspirational leaders and learn other key skills.

The establishment of the precast facility in the Latrobe Valley resulted in Thiess John Holland training 200 personnel, the majority of whom were new to the construction industry. More than 140 workers completed Certificate III in either Manufactured Mineral Products or Transport and Distribution.

Design process

Although the detailed design of EastLink was undertaken by a number of design consultants, overall management remained with Thiess John Holland.

An in-house design management team was assembled to oversee all designs, plans and drawings issued by five civil works design consultants. Before a drawing was issued for construction (IFC) it passed through a rigorous review and comment process. This involved distributing plans to approximately 11 internal and external parties for review and comment. Once this process was completed twice (at preliminary and final design stages) the designs were ready to issue.

The design was broken up into a series of elements such as bridges, road geometry, landscaping, noise walls and mounds and conduits. The InCite document tracking system used by Thiess John Holland proved invaluable for handling hundreds of design packages through various iterations.

Designers remained on the project until it opened, with a Design Management Team and Construction Phase Team in handle last minute queries from construction teams.

Safety

Thiess John Holland's key safety strategies included in-depth project induction, localised site inductions, daily pre-start meetings, project safety as its own brand (SafeLink), regular site safety walks and very thorough and documented planning of critical tasks.

During construction, many project regions achieved outstanding safety milestones. The Frankston Region maintained an unblemished safety record, successfully completing the project without any Lost Time Injury. And the Mitcham Region completed tunnelling excavation all the way through to breakthrough without a single Lost Time Injury, a first for a job of this size, and went on to record a continuous 754 days without a Lost Time Injury.

With a total of 14 million man-hours worked, the project recorded a Lost Time Injury Frequency Rate of 2.9.

A number of the project regions conducted family days at which awards were presented for safety performance milestones. Awards were also issued to employees in recognition of team and personal performance safety achievements.

Environmental practice management

Thiess John Holland implemented a number of innovative environmental practice management initiatives on EastLink, which led the way in major construction projects in Australia. These included:

- early preparation of an Environmental Management Plan prior to being awarded the contract. This included external stakeholder review and comment. It also established operational controls for early works, thus ensuring no issues arose for activities such as drilling at the tunnel portals, surveying and other early activities
- appointing Site Environmental Officers to each region who reported to the Regional Manager rather than to the Project Environmental Manager. This was important to demonstrate environment protection was a key delivery team responsibility.
- extensive use of Site Environmental Plans (SEPs) to establish detailed operational controls for work sites. SEPs were placed in crib huts at the work site and all personnel were made fully aware of their requirements.

A dedicated precast facility

One of the first tasks faced by Thiess John Holland was how produce the huge number of precast concrete elements needed to construct EastLink. Investigations showed the existing industry in Victoria did not have the capacity for the task.

For this reason Thiess John Holland decided to establish its own world-class precast facility in 2005 at a disused 11 hectare site in Morwell in the Latrobe Valley to meet the exclusive needs of EastLink.

Within six months the facility employed more than 100 people, with a total workforce of about 250 people during peak production. Over the life of the project more than 20,000 precast items were built at the facility.

Casting the first super-T, non-standard bridge beams within five months of arriving on site set a high production standard for the facility, and this was maintained for the duration of the project. Over the next 18 months the facility produced 1,600 beams, 4,631 off structure barriers and parapets, 1,446 rock-faced cantilever noise walls, 336 vent stack panels, 13,589 post and panel noise walls, 147 wing and fender walls and 321 piers and cross heads.

CONCLUSION

Never before has Australia experienced an infrastructure project of the scale or complexity of EastLink.

Thiess John Holland managed to complete the nation's largest infrastructure project five months ahead of an already breakthrough contractual date, with limited disruption to surrounding communities and stakeholders. Certified project turnover exceeded \$100 million for each of 5 months, and over \$1 billion for a 12 month period.

The community response to EastLink has been extremely positive, with the vast majority of neighbours happy, commuting times reduced, and businesses benefiting along the EastLink corridor.

Government client and stakeholder outcomes and relationships are excellent.

The legacy of EastLink has set a new benchmark for project delivery in Australia.

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