# Oral History Program

Building bridges

**LAWRENCE HARGRAVE DRIVE (PART 2)**
**SUMMARY REPORT**
**JUNE 2006**

RTA Oral History Program

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5. Construction of the Gladesville Bridge.
6. Developments in Concrete Pavements.
7. Road Location and Design.
8. Traffic Management Initiatives.
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# About this oral history...

Oral history has been described as 'a picture of the past in people's own words'. It is based on stories by people who were involved in life's events, told in their own, passionate words. It adds to the official written history and gives us a more intimate and personal perspective on how, when and why things happened. Oral history is a means of communicating how individuals perceived and dealt with challenge, achievement and failure. It often reveals the unsung heroes, those actually responsible for innovations and important changes, and provides them with an opportunity to evaluate their actions in a wider occupational, social and political context.

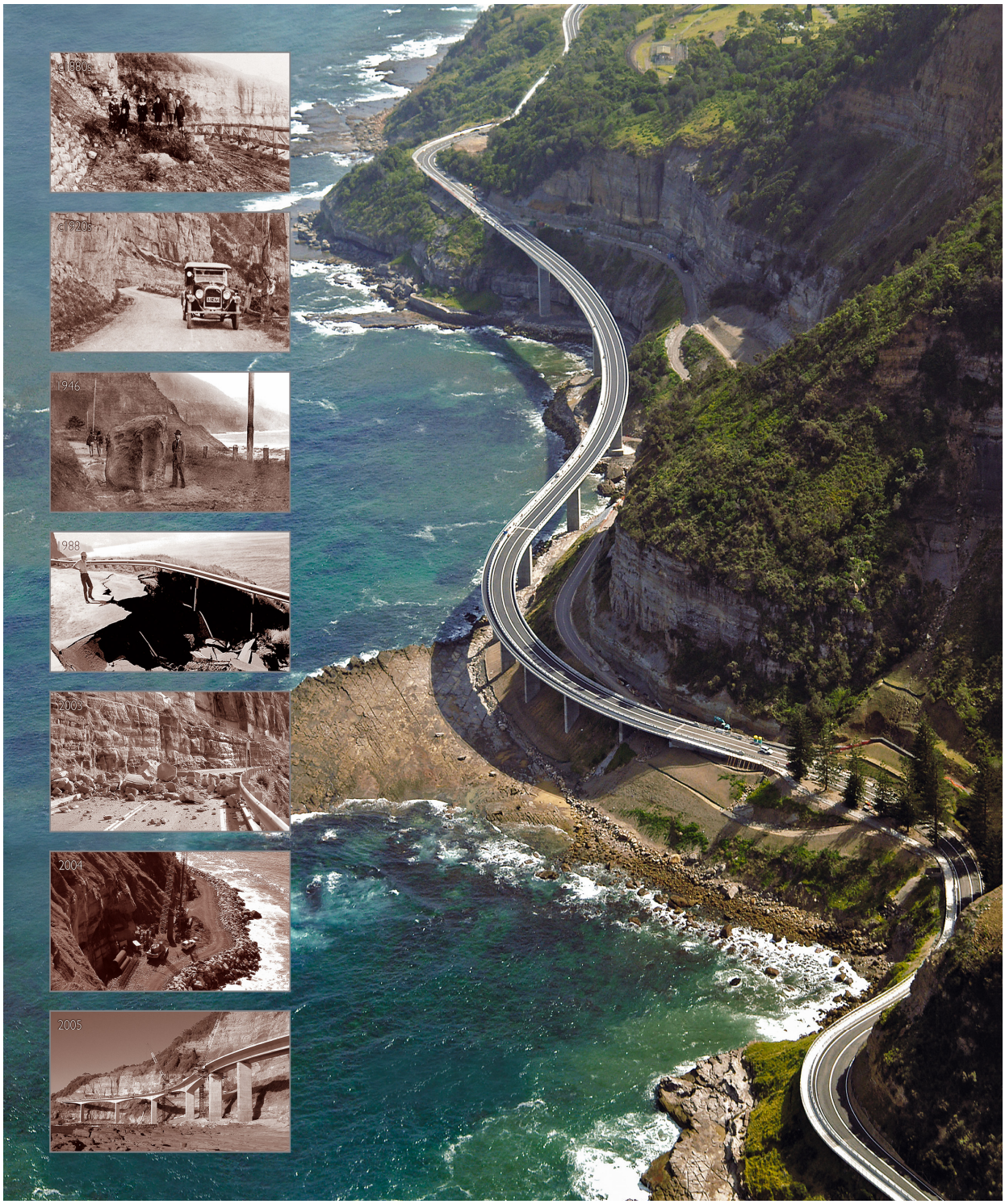
The RTA established its Oral History Program in 1997 to investigate various topics of historical interest. *Building Bridges - Lawrence Hargrave Drive (Part 2)* is the 11th thematic oral history to be undertaken as part of the program. It follows on from Part 1 which examined the history of the local area and the circumstances leading up to the closure of Lawrence Hargrave Drive in August 2003.

This oral history project was based on 15 hours of digitally recorded interviews with those involved in the planning, design, construction and naming of Sea Cliff Bridge. This report is a summary of the key themes revealed in the course of research, investigation and interviewing. It tracks the design and construction phase of the bridge through to the opening ceremony on Sunday 11 December 2005. It includes transcripts of the official speeches, and comments from a number of local residents and school children walking the bridge for the first time.

Outputs from this project include the original interview tapes, logs, photographs, research materials and an edited CD compilation. Compiled excerpts from the original interviews may be accessed on the RTA website at www.rta.nsw.gov.au. Click on 'Environment', then 'Heritage', then 'RTA Oral History Program', or simply type "oral history" in the Search window.

The author would like to acknowledge all who contributed to this oral history - the 15 interviewees named at the end of this document and the staff of the RTA Environment Branch and Wollongong Regional Office who assisted with the project.

The opinions expressed in the oral history interviews and summarised in this report are those of the individuals concerned and do not necessarily represent in whole or in part the position of the NSW Roads and Traffic Authority.


c1880s
c1920s
1946
1988
2003
2004
2005

# Contents

# The REF

In September 2003 the RTA invited proposals to form an Alliance to build the two connecting bridges on Lawrence Hargrave Drive to solve the rock fall problems experienced there since time immemorial. Part One of this oral history project dealt with the background to the communities that live along Lawrence Hargrave Drive, the geography and the geology of the area and the process in forming the Alliance. This second part deals with the challenges faced during the construction of the two bridges and its successful launch.

The Alliance was a first for the RTA and included the RTA as client, Maunsell Australia, the designers, Coffey Geosciences, the geotechnical consultants and Barclay Mowlem, the construction entity. Peter Stewart was chosen as the Alliance Champion, responsible for the overall performance of the team. In October 2003 the RTA convened a Risk Assessment Workshop at the Sydney Showground.

By November 2003 the Alliance partners were confirmed. In December, a two-day workshop on Risk Assessment and Option Selection was held to help decide on four options to be presented to the community. In March 2004 these four options were presented and the Preferred Option was proposed – a curved balanced cantilever bridge on the south that would join up with an incrementally launched bridge on the northern side. The budget for the whole project was costed at $49 million. In May 2004 the Alliance team formally presented the project to the RTA for approval:

> 'We got the go-ahead from the RTA almost the same day we presented to them, on the third of May – that in itself is a remarkable achievement, that they were able to say: "Hey, go!" and we suddenly said "Oh my goodness, we've got to go" and so the design team were charged with the main task at that stage of actually taking the design from 25% to 100%, so we had a huge task in front of us to do that.' (Peter Stewart, Tape RTA-LHD:FH39, CD Track 1)

Jay Stricker, the RTA's Manager, Southern Regional Office in Wollongong had been involved in the project from the time she took up her post in August 2003:

> 'If we go back to 29th August when the Chief Executive said, "This is now your region and this project in particular and the Minister is giving you two and a half years to have the road re-opened," and the Chief Executive said, "You've got to really have a good look at the environmental impact assessment, get cracking on it straight away so we don't have any delays." So I immediately got on to our internal environmental team and said "I want you to scour that whole length of road, the marine environment, the escarpment, the cliff line, the cliff vegetation, seabirds, everything, go right over everything, scour it, until you can tell me that there are no triggers for a significant environmental impact. Or conversely that there are and then we will deal with how we can mitigate them or avoid them." (Jay Stricker, Tape RTA-LHD:FH50, CD Track 10)

Late in 2003, before the Preferred Option had been selected the environmental team was instructed to prepare an REF (Review of Environmental Factors), although in projects as large as this usually an EIS (Environmental Impact Statement) is prepared. David Corry is one of the RTA's Environment Branch team members who prepared the REF:

> 'There was always the recognition or the potential that it could trigger an EIS. We didn't ignore the fact that there was strong community expectation that closing the road would have huge social and economic impact on the coastal villages. My task was to prepare an REF in as short a time as possible for release in April (2004) and manage its impacts. If it did trigger significant environmental impact we would cross that bridge when we got to it. We had no idea what the preferred option was at the time – our brief was to prepare an REF but on *what* we had no idea at the time.' (David Corry, Tape RTA-LHD:FH48, CD Track 8)

Michael Norman of Coffey Geosciences, the Principal Geotechnical Engineer in the Alliance team explains why an REF was selected:

> 'First of all we look at the regional geology so we have a pretty good idea of the formations that we are expecting to have there. We then do some visual mapping of the faces so that we actually know where the faults are and joints are and what sequences are there. We look at historical records, such as mining records, where the mine workings are. We look at all the reports that have preceded the project now - there was sea-floor mapping that was done just as at the beginning of the project by other consultants and then we use bore holes that we drilled from around the site and we had to build up models along the whole of the project. We even used a technique similar to air photo interpretation but it is done from a helicopter where we flew and took some high resolution photos and built up a 3-D model in the computer so that we could estimate size of boulders and the like. So that was pretty interesting and we used some pretty innovative techniques, there were many things.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 7)

The environmental team soon began their investigations:

> 'We started in earnest in December 2003 at Chatswood, which was the Alliance office, and we were working in there with the designers, Coffey's, the geotech consultants, people from Barclay Mowlem, who were our builders, and we were writing the REF in there, amongst the builders and the designers and if you had a question on how do you pour concrete here, or we need the footprint for bridge piers, or any questions like that we had it at an arm's length and that was, I found, a brilliant way to do an REF because we had our answers there on any aspect of design or constructability, or what number of machines you would use to do this. Especially with the designers if we needed a photo montage very quickly, we had it in a day and a half, nothing was too much. You could see that these builders and designers wanted to do something unusual but I had to explain to the builders and say "Look, fine, this is an urgent job but we just can't go and build this thing, we have to go through an approvals process." I explained the EIA [environmental impact assessment] process and what the REF was for and there were some who just saw it as a hurdle to jump over, "Why are we doing this, why doesn't the government just pass a law?" Some people think the RTA has more powers than it actually has and they are still surprised that we are required to go through this process. It was pretty stressful to get this thing out, it was a real team effort and we were working until ten o'clock most nights, a lot of nights, but we got it out, we made the launch date. Then post REF it didn't stop there, we had to go and have a meeting in town with our Legal Branch and talk about what conditions to impose on the REF and we were treading, no pun intended, we were treading unchartered waters, we'd never built on, or so close to the ocean before. We were dealing with the Coastal Protection Act, Wollongong LEP, and do things go below the mean high water mark or above the mean high water mark and who controls the inter-tidals, issues like that which we had never dealt with before. It

was very interesting but we got it through.' (David Corry, Tape RTA-LHD:FH48, CD Tracks 9 & 10)

David Corry signed off on the REF:

'I had to sign the front of the REF to say it's suitable and that it met our requirements under our quality system and that it's suitable for delivery to the client, who was at the time Alex Dunstan, so I signed, along with Ian McCardle who is the other joint Manager as part of the Alliance team – that's not before we did a lot of reviewing. I think I reviewed that document three or four times, still picking up typos and little contradictions in conclusions to paragraphs, so once these documents go out it's after very intense review by a lot of people.' (David Corry, Tape RTA-LHD:FH48, CD Track 12)

# Designing the bridges

This being the first Alliance project that the RTA embraced it is interesting to note the differences between it and a conventional project:

> 'In an Alliance project you need to throw in more resources and be very organised in doing it. You need to keep going back and challenge things on an ongoing basis. Every time you come up with a solution you need to challenge whether or not it's workable and sometimes things go a long way down the track and then you find that the work you've done for three months is not worthwhile pursuing any more – for example, we focused very heavily on the Southern Amphitheatre where the major rock falls were occurring and we did a lot of investigations through there until we reached the point of where we realised that we were going to avoid that entirely with a bridge. Once we'd decided to do that we then left that part of the project and we focused very much on the Middle Headland and tried to work out whether we could stay on the road around there or whether we needed to go and avoid that as well and that meant doing a lot of design of support for the cliff face around Middle Headland, which was done, and then we costed that and decided that a better option was to have the incrementally-launched bridge around that Middle Headland, so all of a sudden we left that alone and started focusing on the other parts of the project. So we built it up by focusing on those critical areas that needed to be designed first so that construction could commence and eventually we came up with our total outturn cost which we put to the RTA and they accepted that and we moved forward.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 7)

Peter Wyton is the Design Manager for the Alliance:

> 'The Alliance has altered the design process. We use an awful lot more workshopping in this, where we have the contractor, we have the RTA who own and maintain these types of bridges, we have our own people who are used to designing these types of bridges and we then bring in specialist people who advise us on how they construct certain aspects of these bridges. We would use these people to think- tank ideas on how we could refine the design to make it more optimal, how we could change things to make it more constructable, change things to make it easier to maintain in the future, so we were constantly taking drawings back for our guys in the office, we're constantly changing things, there's no freeze. Everything was very evolutionary during the design process. Once we'd settled on the concept of two bridges joining together in the middle to make a single structure we had to then look towards our international team for the correct expertise. We brought down from our Hong Kong Office one of our lead engineers in balanced cantilever bridges because the balanced cantilever component of the structure is probably the first curved in-situ cast balanced cantilever bridge in Australia. The incrementally-launched bridge is also possibly the tightest radius incrementally-launched bridge in Australia' (Peter Wyton, Tape RTA-LHD:FH37, CD Tracks 6 & 9)

In designing the foundations of the two bridges, many factors of loading have to be taken into account:

> 'There is a problem associated with temperature and thermal expansion of the concrete itself and these translate loads down to the foundations and so they will

> need to be catered for and on top of that we need to have factors of safety to ensure we're well and truly covering the design loading situation.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 5)

The Alliance team had the benefit of Professor Harry Poulos' vast experience in foundation design:

> 'I advised the project team on techniques that they needed to use to look at the various and many aspects of design of foundations for the bridges on Lawrence Hargrave Drive – quite challenging problems because of the nature of the geology, the fact that they were partly over water and the fact that there were coal seams below, all of which complicated the foundation design somewhat. When we're designing bridges and their foundations we look at a number of alternative scenarios and combinations of loadings, so we look at the weight of the structure itself, we look at the what we call the live load - in this case the weight of transport that is going to use it, we look at wind and we have certain combinations of those that are credible and then we look at earthquakes and generally we figure that you're either going to get an extremely heavy wind or you are going to get an extremely bad earthquake but not the two together. So we have standard combinations of loading that we use in design, it just depends on the circumstances as to whether it is wind or earthquake that is the most critical component for the horizontal or lateral loading.' (Harry Poulos, Tape RTA-LHD:FH38, CD Tracks 4 & 10)

Another challenge was the alignment of the bridge and the existing road leading up to it. Alex Dunstan was the RTA's Project Manager on the Alliance Team:

> 'When we were workshopping the bridge alignment we had in the back of our minds that any alignment would be better than the alignment that we had on the old road. The old road wasn't designed to any particular road design and couldn't possibly meet any particular road design and people had been driving around it for years and years and years and that was what was there. What we were going to give them was a much better alignment, the curves would be longer and the alignment would be much better, and so in that context the design proceeded with the bridge being two curves. The balanced cantilever bridge being one curve, curving around the embayment, the incrementally launched bridge being another curve, curving around the headland, and those two curves joined. When we came to review that design - and the design had progressed considerably - the Road Design Section pointed out that cars can't go from driving around one curve to driving around another curve without going through a transition and that what was going to happen was that the cars would, when they got to the end of one curve try and drive through the transition and they'd be on the opposite side of the road. Obviously we couldn't have that and so the whole design was reviewed and a transition put into the bridge and that caused, I think, quite a lot of communication between the various elements within the RTA and within the Alliance, and within the Alliance partners. If that was a normal contract that would have incurred an incredible cost to the whole process and we were almost in a position where we were, at that stage, boring the piles and yet the design was changed, the piles were slightly relocated and the process went on. So the Alliancing process has been superb for being able to deal with these issues quite immediately and get through them at minimum cost.' (Alex Dunstan, Tape RTA-LHD:FH45, CD Track 8)

Peter Stewart became involved in the design process at an early stage:

> 'I got involved in the design, particularly in design meetings, and resolving design issues which came up daily at that stage and we discovered there were so many issues that had to be addressed and locked away, as we call them, we had to make a decision and move on and that was quite a tricky process because really the sky was the limit and you could move in any direction you wanted. We had to start nailing things down, so we created what we called a 'frozen' list, so when we made a decision we put it on the list and said, "That's the decision we've made and it is frozen," and signed-off on it and moved on to the next one. But we kept finding we had to go back and unfreeze, so we came up with a new term which was "minus 273°C", that is when it really is frozen and you can't change it because we tended to unfreeze things and say, "Look maybe there is a better way of doing it." It is an iterative process, design, it is very involved in actually doing, actually saying, "What is the fundamental shape of the piers, what is the fundamental shape of the deck, what can we can change, what can't we change?" (Peter Stewart, Tape RTA-LHD:FH39, CD Track 1)

Peter Stewart reviewed the design changes:

> 'The original concept of the balanced cantilever bridge and the incrementally launched bridge have not changed but the geometry, the alignment, the tweaking of the span lengths have changed. We did a road safety audit on it and assessed that we could improve the alignment for the driver, so the incrementally launched bridge is actually a bit wider because of sight distances.' (Peter Stewart, Tape RTA-LHD:FH39, CD Track 5)

Mark Sinclair was Alliance Senior Project Engineer:

> 'Everything has changed on the job. The piers themselves have changed, the pile caps have changed, the pier head itself has changed, the offset on the pier head has changed, the segment lengths have changed. The segment widths have changed slightly as well in order to accommodate different geometry. The main bridge at the north, in order to meet some of the alignment criteria has been slightly widened over parts of it. There has been an awful lot of changes that are all significant but they have all just come through the evolution of the design and interaction with the site people' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 9)

One of the piers on the balanced cantilever bridge forced a change in design:

> 'One of the interesting things at the start was that we suddenly discovered that Pier D was rather dangerously close to an old boiler that was part of the coal mine, the original coal mine, so this was a very important heritage item. So panic mode went in, press the button, and redesign the foundation to miss the boiler. So we changed the whole pylon configuration, we changed the pier base shape, we did everything to come away from the boiler and afford some space for it, so we wouldn't have to undermine it, or dislodge it, or damage it in any way. That is something an Alliance can do but in other types of contracts you come to a bit of a stalemate and there are letters flying back and forth, so we were able to solve it within days and on we go and actually benefit from it. It was quite interesting - I think the pile cap and the pile design became more efficient as a result of that little pressure that was put on.' (Peter Stewart, Tape LHD-FH39, CD Track 4)

The shape of the curved bridges created its own design challenges:

> 'The balanced cantilever bridges that have been built in Australia have had generally only one degree of curvature to deal with, or one alignment to deal with. Most of them have been built on a straight alignment - this was the first one that I'm aware of that is built on a radius. That induces torsion into the pier and also tends to rotate the pier, so part of our things to assess and include for and make sure we don't overlook is that we pre-aim the bridge as we build it to some theoretical point in space so that when the two pieces get close and we have to join them that they are relatively speaking in the right spot and that we've allowed enough for the sag that occurs just due to the weight of concrete, but also that we cater for any rotational torsion that takes place as a result of the curves that we're building the bridge on.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 12)

Original coal mine boiler

# Securing the site

Before any construction could begin the main objective was to gain access to the site by the construction of access roads on steep slopes. Controlling erosion and the amount of material falling into the sea were challenges that had to be met. Jon Williams was the Alliance Construction Manager:

> 'I was involved with the General Superintendent, Tony Wood. He and I and the engineers sat down and went through how we were going to build these access roads and looking at the survey and the geographic constraints and working out what the best way of getting an access track down to the waterline was and I think we ended up with about seven or eight different options of trying to get this roadway to fit. Eventually we arrived at a solution and pretty much built what we were going to build.' (Jon Williams, Tape RTA-LHD:FH42, CD Track 5)

> 'We've had to bring in in excess of 25,000 tonnes of rock in order to build our access way down to the water from the original road alignment. That road in itself is about five or six metres wide, it has got to take a lot of heavy construction plant over quite an extended period. It is subject to weather. We've had the issue of the ocean. The ocean levels haven't been too extreme, but there was one or two days last week where it was breaking over the top in quite spectacular fashion.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 6)

No sooner had the access roads been constructed than parts of it were washed away. Steve Montgomery was Supervisor on the project:

> 'There was a really big swell the weekend before Easter (2004) that did a lot of damage to our temporary roads, which means we have restricted access until we get excavators to clean them up. Then in May we had another one which was very, very big seas that caused us a bit of grief. Had to relocate the workers because you couldn't go down there, the waves breaking onto and over the rock wall, ten, twelve metres.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Track 6)

Tony Wood had additional safety concerns:

> 'We were worried about rock falls every day. We've had our geotechnical partners look over the site and give us as much advice as they can. We've identified a few potentially dangerous areas that certainly are a 'no go' area for the guys. Even as recently as this morning there was a rock that had come down onto the road, possibly caused by this heavy rain, early this morning. So yes it is a live site, there is no doubt about that, we certainly realised that while we were there. I have seen some fairly large falls come down into the catch pits up on what we call MCA5 and if those catch ditches weren't there they certainly would have caused some damage.' (Tony Wood, Tape RTA-LHD:FH40, CD Tracks 2 & 4)


Access roads under construction

# Foundations

By the end of August 2004, the access roads had been constructed and work was about to begin on piling to anchor the piers that would support the bridge deck. David Peacock is the Alliance Project Manager on site:

> 'Well, I made a comment at the start of the job to my team, "We don't want to get our feet wet." So the attempt was to design a bridge so we didn't have to get into the water. Well, that didn't last long - as the design developed we decided we had to get our feet wet, or do something to keep the water out so that we would not get our feet wet and that took a bit of analysis and decision-making but in the end we decided yes, we had to built piers which had we not built our revetment would be in the water. We have solved that problem, it has been solved very successfully. We've built a breakwater and fill behind it, so had they not been there all the piers would be in the water.' (David Peacock, Tape RTA-LHD:FH33, CD Track 2)

Compression tests are also done on the foundations for the piles:

> 'The amount of compression you will get below a foundation depends on the magnitude of that load which is something that is worked out generally by the structural engineer and the designer of the bridge so the loading is an important factor and then the other factor is the compressibility or the stiffness of the ground below it and this is what we do the tests on – to try and work out its compressibility. This is where we use our prior experience with similar types of geology to work out what are reasonable design values. If we've done our ground investigation right then the ground under each pile will be solid enough, but you can never be sure, so this is one of the reasons why in doing foundation design we have to allow for safety margins and also we tend to be reasonably conservative with our estimates of the bearing capacity and compressibility of the ground. If there are major differences between our concept of the foundation conditions and those that are exposed during foundation excavation - for example if we have a fault that runs across the pile then obviously we will need to reconsider whether the pile is adequate. We may have to redesign the pile or add additional piles.' (Harry Poulos, Tape RTA-LHD:FH38, CD Tracks 7 & 9)

Michael Norman explains the pier configuration for the bridges:

> 'The balanced cantilever has four piers, so they are the four large piers in the southern amphitheatre, and there are seven piers along the rock platform for the incrementally launched bridge and there are abutments either end for the two. The balanced cantilever bridge and the incrementally launched bridge meet at a particular pier, they connect on the top of the pier. So they are not actually connecting on land -they are connecting on a pier up at some height.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 5)

> 'Each individual pier of each bridge has to of course be custom-designed - you don't have a standard design - each one of those piers is dependent on the local geology and so there had to be a very careful evaluation of each pier and sometimes of each pile within a group under a pier and that is one of the characteristics, I think, of geo-technical engineering is that you don't have off-the-shelf solutions to any problem. They depend on the ground, the ground depends

> on geology, geology depends on nature and nature is not reproducible or reliable. There are a number of piers below which there are coal seams and coal seams generally are a little bit of a worry because they tend to be a little bit softer, in some cases a lot softer, than the surrounding rock and they perhaps are liable to change with time. However, it is not always economical, nor is it always necessary, to go right through the coal seams because these piles that we use for Lawrence Hargrave Drive can be quite large in diameter, so we try and look at what the consequences are of actually founding above the coal seam - will this potentially cause a problem with the capacity of the foundation, will it potentially cause a problem with the settlement, the vertical movement, of the foundation and therefore of the bridge support, because these are things that we have to ensure. In many cases we found that we could found the pile above the coal seam rather than have to go through it.' (Harry Poulos, Tape RTA-LHD:FH38, CD Track 11 & Track 6)

On the 28 August 2004 the first pile was poured:

> 'The ones we're pouring tomorrow are 19 metres deep, but they are bored with an augur, they are 1500 millimetres in diameter, that is five feet under the old system. They're piles that support the piers for the balanced cantilever bridge and the first pier, which is Pier D, which is closest to the Clifton end, the first two piles in that pier – the foundation will be poured tomorrow. A big day tomorrow, a very important day.' (David Peacock, Tape RTA-LHD:FH32, CD Track 9)

Soon the first problem with foundations revealed itself. Marc Hendrickx was one of the Alliance geotechnical engineers:

> 'While they were excavating for Pier Two the construction guys uncovered a block failure behind the pier and there was some significant concerns about how that would affect the subsequent performance of that pier and where they should finally put the structure. The block failure in Wombarra claystone had moved, historically probably due to heavy rain event and the movement we could see on the rock face was up to about 30 cm. We were just concerned that there could be subsequent movement sometime in the future and as a result of that we were looking at designing the pier so that there would be no possibility of that movement affecting the structure, so we actually recommended that they excavate below the toe of the failure and then insert some compressible material around the pier, so that if there was movement then it would be taken up by that material rather than affecting the pier. So that was a significant challenge and we were able to respond to that quite quickly, thanks to the way the Alliance is structured. Another interesting event was in regard to Pier A, the pylon works there, where the two easternmost piles are actually going through the cliff wall and Coffey's were asked to be on site for one of those where the piling rig actually broke through the cliff wall and was exposed to the open ocean, so that was an interesting time. The construction team had actually erected a platform that was probably about two metres out from the cliff face, with the construction team basically walking out on this, more or less diving board to look at the way that pile was put in. But it was quite successful and in the end it was close to what we predicted the conditions would be.' (Marc Hendrickx, Tape RTA-LHD:FH41, CD Track 4)


Boring piles – Pier A

Pile reinforcement prior to placement into bored pile

Piling works

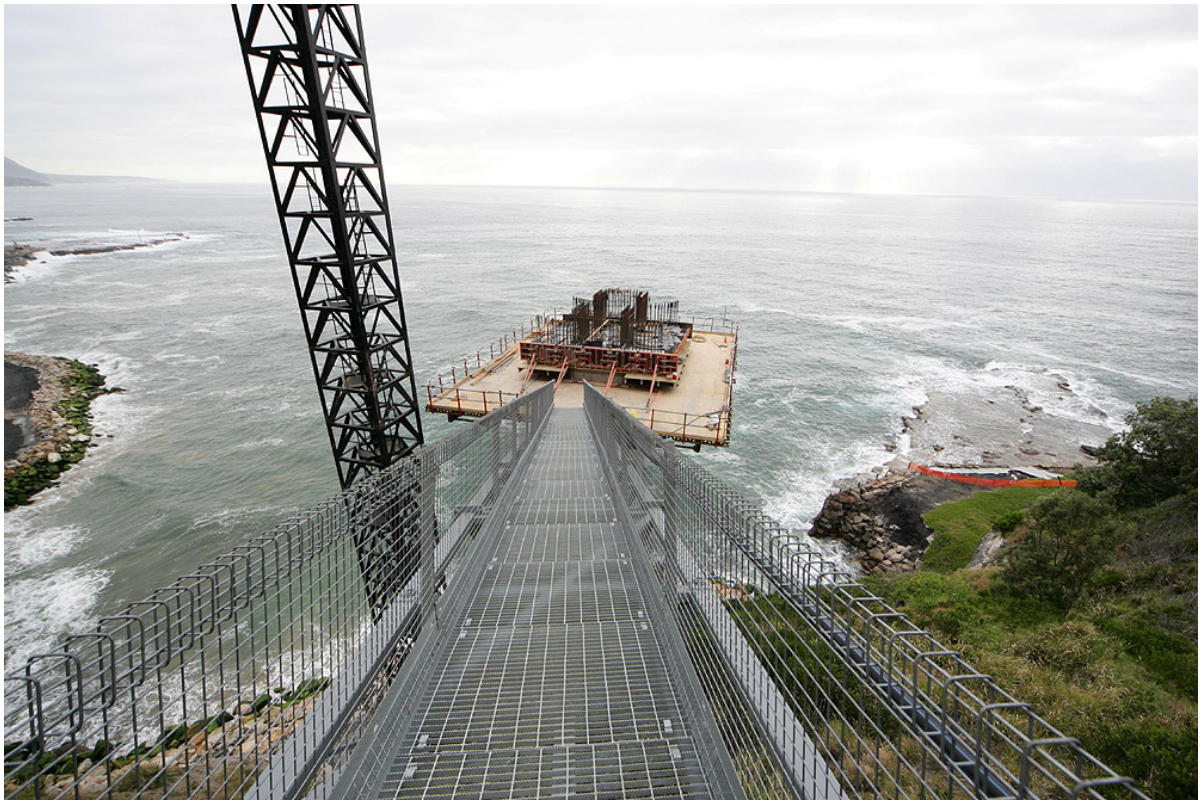
Pier work proceeding, southern amphitheatre

Pier D rising; old jetty behind on left

Pier almost complete

Bridgework underway – balanced cantilever (top of photo) and incrementally launched (bottom)

Southern balanced cantilever bridgework



Access ramp to southern pier

Commencement of balanced cantilever bridge spans

# Piers rising

By October 2004 piling was still under way and the piers were rising out of the ground:

> 'The two southernmost piers are being constructed, so we've got the piles out of the ground, the pile cap and now we're forming up the piers and pouring the first couple of sections of pier. There's a lot of reinforced steel – sometimes we have trouble understanding how the concrete is going to get in around the steel.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 8)

> 'Where we are now – we're well through our foundations for the main bridge, (the balanced cantilever bridge) which is affectionately known as GD2. We're just completing the final piles on Pier A, which is the northernmost of four of the major piers – that's all but complete. Quite a few of the foundations for the smaller, incrementally-launched bridge are complete – we've got a couple left to do there, there's seven piers plus an abutment, so another two weeks from now, which will put it in the middle of November we should be all over on the foundations. The casting bed area for the incremental launch is currently being put together, which is effectively our mould for extruding the 'sausage' and on the main bridge we've now built two pile caps complete, the third one is due any day now. We're then following through with the commencement of the southernmost two piers, which are Piers D and C and we've got two tower cranes in position. No piers are at their full height yet – we've got approximately five lifts to complete the tallest pier.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 8)

Mark Sinclair described what would happen over the next few months:

> 'For the main bridge, which is the balanced cantilever, we've drilled some 1.5 metre diameter piles. There is typically six in a cluster on the main bridge and there are four main clusters, one for each of these piers A, B, C and D. They are drilled through the alluvium which we have basically put there, then through some coal, then into the sandstone underneath and they go up to about 20 metres long which is quite major, but on the overall scale of things pretty standard stuff. So that gives us a nice stable starting point. On top of that we are building a pile cap which effectively allows the load from the bridge to come down the pier and then be distributed into those piles. That pile cap is, depending on where we are anything up to about 8.5 metres by 7.5 metres by 2.5 metres thick so it is quite a big lump of concrete and there is 35 tonnes, or thereabouts, of reinforcement just within that concrete. From the top of the pile cap we build the pier. Now the pier is six metres across, but only 2.8 metres wide and it is 500 mm thick, so we have got an open rectangular box inside the pier. Those piers are built typically in about 4 metre lifts, so we build one segment, wait for it to gain enough strength for us to lift our forms, place our next lot of reinforcement, then jump again, so we build the piers in these 4-metre increments. When we get to the top of the piers it gets a little bit tricky because we want to build something wider than the pier and of course there is nothing to actually build that off, so short of scaffolding it all the way down to the ground we've come up with a solution where quite a large platform, which will be 15 metres by 12 metres will be built in space and that will be clipped onto the top of the pier. From that large platform we build what we call the pier head, which has the full width of the road deck, which is approximately 12 metres, and we build six metres in total width. The pier is only 2.8 [metres], so we've got a little stub sticking out either side. That is all we plan to build off this quite large platform and we've got to do that in three stages.

> We've got to build the floor slab, we have then got to build the walls, which are about six metres high and then we've got to put the road deck on top. For the incremental launched bridge it has similar foundations to the main balanced cantilever, except the piles are smaller because the loads are much less. There are a couple of very odd-shaped piers that belong on the incremental launch, mainly Piers 6 and 7, effectively because they are in the ocean, or all but in the ocean. They don't have a regular number of piles: one has got six and one has got five piles in it - they are smaller in diameter. As we get more towards the northern abutment instead of needing to put piles in we are able to just use spread footings, which are a common situation. Then as we get to Pier 1, because of the location of Pier 1 which is half way up the hill, we've actually had to pile that one and the northern abutment is also piled. So the sub-structure is not that greatly different, slightly smaller in pier size, the heights are also slightly less than what they are on the balanced cantilever.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 10)

Jon Williams pointed out the differences in construction methods of the two bridges:

> 'The incrementally-launched bridge doesn't have any pier heads – it just purely has a stem pier with sliding surfaces on top which allows it to slide across the top as we jack it out of the incremental launch casting yard. Those two bridges are a different style of construction and the incremental launch is a lot simpler in that all the work is carried out for construction of the bridge deck in one location and it's sent out around over the piers in increments, thus the name incremental launching. We use a series of hydraulic jacks that basically launches the bridge roughly 300 millimetres in one and a half minutes, so it's a slow process but when you're talking of pushing out upwards of four or five hundred tonnes per segment it's a fair bit of weight to push forward.' (Jon Williams, Tape RTA-LHD:FH42, CD Track 8)

Southern piers almost complete


Pier C - travellers in place

Placing reinforcement

Looking north towards incrementally launched bridge

Southern balanced cantilever bridge nearing completion (Pier D)

Balanced cantilever bridge spans approaching

Pier D (on left) complete and traveller being dismantled

Balanced cantilever bridge spans about to meet

# Launching on a gradient

One of the requirements of the project was the challenge of launching a bridge on a curve and a gradient. Mark Sinclair clarified how this was to be achieved:

> 'One of the little things we're just fiddling around with at the moment is the geometry of the incrementally-launched bridge. It must launch, an incremental launched bridge, on a curve and it must be on a constant curve. However, we also have an uphill gradient to contend with. Now that doesn't sound all that unusual and there are lots of incremental launch bridges launched uphill, there's are lots of curves in incremental launches, but when you put the two together you end up with a complicated issue where our planned view of the road is a true plan, a horizontal radius for the incremental launch of 150 metres, but when you off-set that on the 2.5%, or nominal 2.5% gradient you actually don't end up with a perfect curve. So the issue is: how do I launch something in a perfect curve and then still achieve effectively something in plan view that is in the right place? We are just slightly fiddling with the radius, only by 40 mm in 150 metres, so it is a very small fiddle but if we don't look at making a minor correction we'll end up probably anything up to 90 mm from where we plan to be. There are issues also that we've addressed, such as the braking system. When you launch a bridge uphill you've got to overcome gravity and then when you have overcome gravity, pushing uphill, the last thing you want is for it to slide back down the hill. You actually launch it on a very low friction Teflon pad which normally has an internal friction of round about 2.2%, give or take a bit. We have a downhill gradient of 2.5%, which technically means that if the bridge became active it would become self-launching in the wrong direction, so we've got to avoid that, so there are detailed braking systems that have to be implemented, considerations for earthquake, considerations for how to wet cure the concrete because of the nature of the mix, it has got to be seven days wet cured in an environment which really doesn't lend itself to having the hoses going and I am sure our friends at Sydney Water aren't too chuffed at the cost of us spraying too much water around, so we've got to have specialist mechanisms for the wet curing. We've got access issues that we have had to consider - where to get the men to the top of a 40 metre high pier: we can make them walk up thirteen levels of stairs or we can think of something a bit smarter. What we've done, because of the relative proximity in most locations to the road, or somewhere that is our access track, we are looking at building a pedestrian bridge which will be anything up to about 41 metres long, so building a bridge to build a bridge, and we'll drop that light-weight structure from the land side out onto the pier head. The top of the pier on the main bridge is where we have formwork travellers operating in sequence, one building a north section, one building a south section, so to get the manpower out there we've come up with this method of quite a long walkway.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Tracks 10 & 8)

Working at heights has its inherent dangers, as Steve Montgomery pointed out:

> 'The piers are fairly small in diameter so for the guys with the formwork there is not much room. They're talking 800 mm or 700 mm to work in around the formwork on the platforms, they're up thirty or forty metres and there's tools and formwork, so you're working in close quarters with your workers, you can't be afraid of heights and there are a couple of blokes who hadn't done it before – they leaned over the edge and their hard hats fell in the water, or down on the

cliff face. We've also had a fair few small rocks falling, we've had a couple of large ones overnight – quite often after rain and then when it dries out there's a tendency to have some rocks. We put a lot of catch ditches in to catch them – one missed the ditch and it was fairly large – about 1200 mm in diameter, landed on the road overnight - that's why we're building a bridge.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Track 7)

Placing reinforcement for the first deck section in the casting yard

Overhead view of northern incrementally launched bridge

Northern incrementally launched bridge – jacking almost complete

# Making the cliffs safe

While the construction teams were building the bridges the geotechnical team was engaged in securing the cliff face above the site:

> 'It's mainly in the Scarborough cliffs around the Northern Amphitheatre and also immediately above the southern abutment on the Southern Headland, so there's installation of rock bolts, mesh and shotcreting sections that can easily erode, or the establishment of some catch fences to catch any rock falls.' (Michael Norman, Tape RTA-LHD:FH34, CD Track 10)

> 'One of the significant challenges, I suppose, was trying to feed information to the construction team as construction commenced and the frustrating thing from that point of view was not having the geotechnical works commence when we initially thought they would. We thought that the geotechnical program would have been more or less completed when construction of the bridge started. Some of the elements involved in that are rolling some of the large rocks down the slope and removing all those hazards from the slope and we were envisaging, particularly for the GD4 area where they're building one of the casting bays for the bridge that goes down GD3 that that area would be free for us to roll rocks in, quite large rocks, 8-10 ton boulders, and because of the way in which the geotechnical contract was let work wasn't started until November (2004) so we already had a lot of infrastructure, temporary work sheds and piling had already commenced in an area, so we could no longer roll these large rocks into GD4, which necessitated a whole change of scope as to how we were going to treat the hazards on the slopes. Part of it was solved by reducing the rocks in situ – to actually breaking the rocks down high on the cliff face and then removing smaller boulders, so we reduced the size of the blocks high on the slope and then took them down.' (Marc Hendrickx, Tape RTA-LHD:FH41, CD Track 1)

The company contracted to perform this work, Geovert from New Zealand used PCF (Penetrating Cone Fracture) explosives high on the slopes:

> 'This is a fairly slow-burning gas type explosive but the material has got the same rating as a firecracker, so it's not regarded as a high-energy explosive, so it can be used on sites where there are close hazards and they've also used straight line drilling – they've got an air drill rigged up on a rope and they're basically drilling a line of holes across the boulder and using some sort of pressure-splitting device to break the boulders up.' (Marc Hendrickx, Tape RTA-LHD:FH41, CD Track 2)

Cliff stabilisation works

# Pier heads and travellers / the bridge decks

For the balanced cantilever bridge, special pieces of equipment called travellers were brought in:

> 'We've imported a special formwork system from Norway, used on a bridge in Slovenia – it's a system which supports the formwork to build up from the pier head across the spans.' (David Peacock, Tape RTA-LHD:FH32C CD Track 6)

Peter Stewart outlined the process involved in building the pier heads:

> 'January 2005 will see the construction of the pier head itself on Piers D and C. Now the pier head is six metres deep, a quite significant section, it's 6.2 metres long and 12-13 metres wide. It sits on top of the piers. We will have created the 'dance floor' - that's happening before Christmas, then we erect the formwork and start casting that pier head in sections, so that then sets the platform, what we call the 'dance floor' for erecting the travellers. (Peter Stewart, Tape LHD:FH39, CD Track 7)

> 'Once the dance floor is in place they place the formwork for the soffit of the pier head which is basically 1.5 to 2 metres on the side of the pier, then the reinforcement and the concrete are placed. The next step is to place the scaffolding on both sides of the pier head to give access to construct the walls. The formwork for the walls is then in place, reinforcement is placed and the concrete is placed, including the diaphragm that joins the two walls together to give it structural stability. That same scaffold then is also used to provide the falsework support for the upper forms of the soffit of the deck - post-tensioning ducts get put in at this point in time though there's no post-tensioning in the pier head and then the top is formed and the whole thing is stripped out progressively under the deck. That process can take four to six weeks.' (Jon Williams, Tape RTA-LHD:FH42, CD Track 7)

> 'The traveller takes out from the pier heads and we can pour the concrete decks incrementally and then launch out again, so it travels equal distances out from north to south and we travel out to the centre of the bridge and then we pull it back and go up on the pier and start again and meet it in the middle. The traveller holds the formwork for the concrete, so it's an in-situ formwork system where once it's set up it's cantilevered out, anchored back, cantilevered out and then all the reinforcing and the post-tensioning stressing goes in, formwork goes in and the concrete is poured, it's stripped and then it's anchored back again and then it's cantilevered out to the next section and that happens on the opposite side as well.' (Tony Wood, Tape RTA-LHD:FH40, CD Tracks 8 & 10)

Steve Montgomery took us through a typical working day on the job:

> 'We start at 6.30 with a meeting with the Supervisors and the General Superintendent, that's the equivalent of a Site Manager in building. We discuss the day's activities, any shared operations using either trucks or mobile cranes or whatever, work out where all our men are going to be working for the day in relation to concrete pours. We then have what we call a pre-start tool box with our individual workers - each Supervisor goes to his own area, tells the guys what we expect of them for the day, we go through any safety issues from the previous day , we then outline the day's activities and we always give the workers a chance

> to reply and if they've got any comments or they've had any dramas from the day before to table them so that we can action them or take them another step up the ladder. Today we poured a segment of one of the travellers on the pier, so the day after a pour we strip the formwork off the end and then start pulling all the formwork apart and on the other end, because each pier has got a north and a south, we're getting ready for a pour, which meant launching the traveller, which is on ramps, clean all the formwork up from the previous pour, get the Surveyor out to tell us to make sure it's going in the right direction, lock it all up and then get the steel fixers to start putting all the reinforcement on that section. That takes about a day, so they'll be finished some time tomorrow morning, so on the north end we'll be getting that ready for a pour, so we're pouring every four to five days on each end. The amount we pour for each segment varies slightly because from the first pour of the pier to the last one is getting smaller because of the shape of the bridge, but it fluctuates between 42 cubic metres and 34 cubic metres. That's between seven and five concrete trucks. Each segment weighs about 300 tonnes.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Track 2)

By March 2005 work had begun on the construction of the decks for both bridges. The travellers were used on the balanced cantilever bridge whereas the incrementally-launched bridge used a steel nose:

> 'The bridge deck has started for the balanced cantilever bridge. We've poured two segments off Pier D and by the end of this week we should pour another two segments on Pier C. We are starting the segment construction process, we should be able to get a segment out per week and there are 10 segments for each traveller to produce. A total of four travellers, so you get four segments out a week for the four travellers.' (Jon Williams, Tape RTA-LHD:FH42, CD Track 6)

A casting yard was set up at the northern abutment of the bridge to form the sections of the bridge deck for the incrementally-launched bridge:

> 'The whole casting yard itself is all equipment required to make that bridge deck. There was a lot of work involved in setting up the casting yard, the frames, the formwork, the special jacks that come from Germany – that's a typical jack that launches the bridge like a caterpillar moves forward: it lifts the bridge, goes forward, drops back, lifts forward, drops back and that way it launches the bridge forward. There's two of those jacks – they're significant pieces of equipment and a huge crane, the Lampson crane to service the whole casting yard at GD4. (Peter Stewart, Tape RTA-LHD:FH39, CD Track 6)

> 'In order to build the bridge deck for the incremental launch what we've done is we've set up a purpose-built mould which will produce segments up to 15 metres long. What effectively is done there is we achieve one segment per week, a segment length is usually typically half of a span. Our typical spans are 30 metres, so our standard segment lengths will be 15 metres. So every week we place reinforcement, we pour concrete, we stress some cables and then we push out this 15 metres of bridge and at the end of the day we will have launched fourteen segments and we'll get the bridge in its final position. By the time we've finished the incremental launch bridge the formwork travellers should be just coming free of the main bridge on Piers C and D and then they will relocate to A and B. So the incremental launch bridge will be finished first from a bridge deck perspective, the launch nose will then be removed and then eventually the balanced cantilever bridge will somehow join up at Pier 7 and eventually we'll have a continuous structure.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 11)

'I'd say in about February/March 2005 the project will really start to take on a different dimension. One of the most spectacular times will be when the incremental launch is just about at its full length and the balanced cantilever segments are built but not joined. You've got a 50-odd metre long cantilever which is a big lump of concrete swinging around in the breeze, not joined, just hanging up there in space. I think people if they are able to be there at that particular time will be quite surprised how it all goes and how it all happens.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 10)

Placing reinforcement


Concrete pour underway – spine beam in northern casting yard

Northern incrementally launched bridge

# The concrete mix / cathodic prevention

One of the crucial aspects of quality control was the composition of the concrete mix:

> 'In terms of the concrete quality that had to be absolutely impeccable. Some of the RTA people who had been working on bridges, concrete bridges, for a very long time are just saying the quality of the concrete on this bridge exceeds anything that they've done before - exceeds our own standards for concrete quality, which was quite amazing.' (Jay Stricker, Tape RTA-LHD:FH50, CD Track 11)

> 'The concrete that we are using is what they call a 50 megapascals RTA mix, it is a very unique blend of concrete, which makes it very challenging, especially in the early days for the batching plant to get the consistency right.' (Steve Montgomery, Tape RTA-LHD:FH35, CD Track 6)

> 'It's a fly ash-blended cement which gives enhanced durability but also allows for construction to occur in a reasonable time-frame. One of our major concerns of course is even where we are building this particular structure it is probably the most exposed bridge certainly in New South Wales and one of the most exposed in Australia. It is subject to a lot of salt spray and salt spray and reinforcement and concrete doesn't usually go for longevity, but in order to address those issues and hopefully come up with the best solution we tossed around lots and lots of ideas with outer coatings, different types of steel for the reinforcement, none of which quite satisfied our longevity goals. What has been addressed and what has been incorporated in the sub-structure of both of these bridges, the incremental launch and the balanced cantilever, is cathodic prevention. Cathodic prevention is effectively a system where a small current is applied into the reinforcement, which is such to overcome the currents and electron movements et cetera that would normally result in the onset of corrosion. So by putting a small amount of current into the structure you are actually able to prevent the corrosion from starting. So that in itself is an innovative solution for an otherwise fairly major disaster that could be looming years from now. We've installed titanium anodes and those titanium components have a certain current density that they emit and the longevity of those anodes is expected to be in the region of two hundred years - the design-life of the bridge is around a hundred years. It effectively drives the corrosive ions, which are effectively the chlorides out of, or away from the reinforcement and effectively passivates the reinforcement in that fashion.' (Mark Sinclair, Tape RTA-LHD:FH35, CD Track 6 & 7)

> 'It won't hum, it won't be warm. The amount of current that runs through the actual computer that controls the current actually needs more current than what actually runs through the bridge, but it is an extra $1.5 million that the RTA have decided to put against this bridge. This will be an iconic structure this bridge, I think it is going to be noticed by people and people are going to travel to see it, a bit like the Opera House or the Harbour Bridge. They didn't present very good value for money at the time they were constructed, but nobody would argue against not having them now.' (Peter Wyton, Tape RTA-LHD:FH37, CD Track 8)


Concrete pours underway

# The workers

For this project the combined skills of many different workers were brought together and managed, as Tony Wood, the General Superintendent, remarked:

> 'You've got to sort of set the whole thing from the ground up. You start gathering your Supervisors and your staff that are going to help you on site. Then you start employing the direct labour, the carpenters, concreters, steel fixers, whatever other disciplines that you might need to complete the job. You day-to-day manage the operations on site with subcontractors, suppliers, the engineers normally stick with a Supervisor, so they form a team. You try and get as many teams going as you can. Supervisors will work with an engineer and they become responsible for a part of the job and you've just got to make sure that those operations are going alright, making sure that the level of manpower is correct in each area, make sure that everyone's behaving themselves - it's quite a broad job, you've got to cover pretty much everything on the whole site - it's everything but the money side of things really – obviously we're watching budgets but the actual purse strings are held by the Project Manager – everything other than that we run it on site.' (Tony Wood, Tape RTA-LHD:FH40, CD Track 2)

The Supervisors, formerly called Foremen, set targets for their crews:

> 'The guys are split into crews. Each crew has their own foreman, between 6-8 guys per crew. They all have their own tasks – they stay until that task is completed, whether it be the piers, the pier head, the deck crews, they all have targets to achieve and the foremen set the targets. For example the incremental launch crew have a target to construct a segment and launch a segment in less than five days, so they're always driving forward to get that cycle time down and only last week they achieved a cycle time of four and a half days on one of the segments, so fifteen metres of bridge to be constructed and pushed out in four and a half days is pretty good going. The pier crews they've got a cycle of roughly four to five days to do a four point two metre lift – they'll do that on two piers concurrently, so they all work together pretty well. If we need to move guys from one team to another they all slot into their team quite well. The foremen are pretty crucial in how they interact with each other and help each other out as they need to.' (Jon Williams, Tape RTA-LHD:FH42 CD Track 8)

Steve Montgomery detailed what's involved on the level of Supervisor:

> 'For the Supervisor, most are carpenter background and your basic thing is being able to read a plan. If you can read a plan you can virtually build anything and we are the ones that take it from plan to reality. With a Supervisor probably the biggest thing you need is people skills. You've got to make the men work together because they are not there for a popularity competition - some guys don't give a damn who they annoy but they are a good worker, other guys are too friendly and happy and chatty - they don't get anything done. So it is trying to manage all the workers, get the best out of the workers and that is probably the biggest need of a Supervisor is being able to manage his work crew. A classic saying we have got on site is "It is not rocket science, they have been building bridges forever." It is a matter of managing our environment and also managing the design and making sure that it all gets done as quickly as possible without breaking everyone's back. It's also important to be a lateral thinker: if you can't lateral think you can't be a Supervisor. You think you can plan something's going to happen…. you can spend

weeks, or engineers can spend, on paper, say how something is going to work and it just doesn't work, it just physically doesn't fit - the line could have been on the wrong side of another line, and you've got to basically think how to solve the problem there and then with what you have around you.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Tracks 9 & 11)

# Pre-stressing and post-tensioning

The balanced cantilever bridge is a reinforced post-tensioned concrete bridge. David Peacock elaborated on what that meant:

> 'You pour the concrete and let it set, get some strength, then you let it stress with stressing strands to make sure it doesn't fall off the last pit you've poured, otherwise it would fall off. You tension it with cables. All concrete we use now is pre-stressed. Pre-stressing is usually when you cast a precast beam - the strands will be stretched against two strong backs and then you pour the concrete around them and then you cut the strands. Here you pour the concrete, feed the strands through ducts and when the concrete is strong enough you then stress them to hold that segment against the last one you poured. That goes all the way back to the pier head at the top of the first pier, so they're tied back to each other all the way. You're tensioning post-concreting, whereas pre-stressing or pre-tensioning is prior to concreting – it's as simple as that.
>
> The incrementally-launched bridge is also post-tensioned – you cast the segment, then you stress it, then you jack it out and then you cast the next segment, tie that to the first one, stress it, jack it out, so it's gradually jacked out over the piers until it gets to the last pier.' (David Peacock, Tape LHD-FH32, CD Track 12)

Southern balanced cantilever bridge

Northern incrementally launched bridge (casting area on right; launching nose on left)

End of southern balanced cantilever bridge span

Inside the span

# Forging ahead

By June 2005, work on both bridges was well advanced and the project was running ahead of schedule:

> 'All piers are finished on the balanced cantilever bridge. The incrementally launched bridge, the northern bridge would have been finished by now but the piers aren't ready, so it's gone ahead better than scheduled and it's got four more pours to go. There are seven piers on the north bridge and the four major ones for the balanced cantilever on the south. Pier D, the southernmost one is finished and there are ten pours either side of the pier. As of today they've poured eight to the south, which means they've only got two before they reach the southern abutment and join back onto land again. On the north they are getting Segment 8 ready now, so next week they will pour that on Wednesday, so then they'll only have two more. I'm on Pier C, which is the next one north, I poured Segment 7 South yesterday, which means I've got another three to go before it meets D. On the north the same thing, I'm getting Segment 8 ready, which means there is another two after that. Then all that big formwork structure goes back to where it came from, back to the middle of the pier, so that can be dismantled and moved over to the next two piers. So all the piers are finished, the south abutment is finished where we meet the old road, the incrementally launched bridge at the north, as I said has got four more launches to go, they've also started the gabion baskets, the wire baskets with the basalt. There is a lot of work around the pine trees to stabilise the bank - that started about two weeks ago. Further north around what they call Gardy's Point, which is the only variation to the job, the road wasn't wide enough for a semi and a bus to pass, so as a variation we are now widening the road and putting a cantilevered walkway all the way around the northern headland.
>
> I think what is going to be the one everyone is looking forward to is when the two piers touch - when we can shake hands with the next pier, I think that is going to be a real highlight when my pier touches up against Pier D and hopefully, the surveyors have got it right and they line up perfectly.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Track 8)

# Safety on site

With men working up to 50 metres above sea level, safety became the primary objective of the Alliance:

> 'We have an OH&S plan which has been developed specifically for this site. It addresses issues we have, which is working at heights. Obviously on a bridge as high as this one it's one of the issues concerned with working in an area where you may get rock falls. It's a normal part of business in our industry to have these plans - in fact you can't work without them, it's a legislative requirement. Apart from that it's not my wish, desire or intent to have anybody on this site leave in a state other than walking without being wounded and I can safely say that on every job that I've worked on to date that's been the case. Safety is an issue for everybody, from myself down to the guy cleaning the sheds and if everyone's aware of safety it makes everybody safer, but to achieve that you also have to have in place the right equipment for people to work with so they're not working with poorly designed or poorly assembled equipment and on this particular job they won't be. So we should finish this job with an exemplary safety record. We have a trained occupational health and safety person on site with his own dedicated office and facilities for minor injuries. Anything major, of course, is taken to the nearest hospital and the closest hospital here is Coledale which is probably about five minutes down the road.' (David Peacock, Tape RTA-LHD:FH33 CD Track 1)

> 'There are plenty of hazards on site but I'm never worried about it because there is a high level of safety consciousness right through the whole site and I'm very impressed with the whole attitude to safety. Whilst it is an incredibly dangerous site maybe that heightens the awareness and heightens people's attention to detail. That's good.' (Peter Stewart, Tape RTA-LHD:FH39, CD Track 4)

> 'We haven't had any lost time injuries yet. We got an award, which I think was to December, of 100,000 manhours without a lost-time injury. It is a physical job, so you do get blokes that strain a muscle, so we make sure that they are treated straight away. It is obviously in our best interests to keep the men at their best and also for them, for their own personal ….. the old motto, you know, you come to work to go home.' (Steve Montgomery, Tape RTA-LHD:FH43, CD Track 6)


Looking south towards balanced cantilever bridge span

# Wildlife and environment

Working in an environment close to cliffs and the sea, the men have witnessed a few welcome distractions. Steve Montgomery illustrates:

> 'It's a fairly good environment – the biggest impact is probably the views of the bridge. The wildlife around there – we've had a 40-50 kilogram pig running around on site in the blokes' lunch sheds, we've got a black pet diamond python snake which a few of the guys have patted, there's goats on the top of the hills, one of the guys saw a wallaby the other day and there's a nest of eagles which soars over the top above the north compound. Then you've got what's in the water: there was a turtle about three weeks ago that I didn't see but the whales are back at the moment and they're not that far offshore, they're quite spectacular, quite slow-moving, so all the guys get a look at that. When the water is very still – we're 35 metres in the air, but we can still see the fish – jewfish, blackfish. There's a 12 foot manta ray that sails up and down the coast and then you've got the dolphins which are quite regular and the sunrises at the moment are quite spectacular too, so the guys appreciate the environment they're in – they're all quite impressed by what they have to work with. I've been hit by about six or seven waves and my car's been swamped eight times by waves, yeah, it's just a unique environment. I've lived on the ocean all my life but to be actually over the top of it for work is quite a unique experience.' (Steve Montgomery, Tape RTA-LHD:FH432, CD Track 5)

# The Community Support Fund

While construction was ongoing, the road was closed, causing a distinct disadvantage to the local communities. To manage and respond to the community's distress, Ros Muston was engaged as the RTA's Community Relations Manager:

> 'My role was to serve the Minister's promise that communication between the community and the RTA would be improved. It has been two years of crisis management. I feel it is a crisis for somebody when they ring in - and it is a business person - and they say, "Seven cheques have just bounced. I don't know where I'm going to find the money to pay the fee on the cheques that have bounced. I'm dependent on somebody coming into my shop and buying some things tomorrow so that I can honour the cheques." There are eight villages affected by the road closure. There are sporting clubs in those villages, football sort of things in the winter and surf club-type things in the summer - those sporting clubs provide a community service, a social service, and those clubs are supported by donations from businesses. When the businesses started to lose money these sponsorships to the clubs ceased and first of all the businesses made contact with us and said they couldn't sponsor the clubs and the clubs made contact with us and said that they didn't have the money to keep running and they were also losing…….they couldn't recruit for their teams because some of the children were too far away to come to training, et cetera. This is where the Community Support Fund comes in because when the Minister announced that the road would close and there would be a budget for repairing it, and there would be a time frame for repairing it he also announced that there was a $2 million Community Support Fund. My role in the project is to facilitate the allocation of the fund, so I suddenly had a budget where I could offset expenses and costs that were caused by the road closure. We expected people to come to us with submissions for money, or for other sorts of support, because a lot of these problems you can't solve with money anyway. They were not always able to put their submissions forward to us so we had to assist. Often we helped them develop the case, we then often helped them develop the solution and then we often implemented the solution. Now that is a little odd for this sort of situation but here you've got perhaps a set of shopkeepers who have put all their casual staff off, they are working very long hours, it is impacting on their family, it is impacting on their health, it is impacting on their finances, they really don't have a lot to spare to come in and do all of the work that they need done to support them.' (Ros Muston, Tape RTA-LHD:FH46, CD Tracks 6, 8, 9)

The Community Consultative Committee

# Nearing completion

By mid-2005 things had gone so well on site that the completion date was being moved forward from 2006 to December 2005.

> 'Within about a month they'll start to pour the final sections of the balanced cantilever bridge and there is basically ten segments to that, and they pour out from each pier, so that is twenty segments on each pier. They pour two of those segments every week, so I guess there is about three months of intensive concrete pouring left. The milestones for me will be getting the footpath, which Council are going to build, between the bridge and Clifton complete. If we can do that then we've achieved the connection, not only of the road but also a footpath connection between Clifton and Coalcliff, which will be a huge community asset. I guess within the Alliance we are now up to the point where the geotechnical works are almost complete, the widening of the northern headland is progressing well. The finishing works on the incrementally launched bridge have to be done because the incrementally launched bridge is now in its final position and the bridge deck on Piers A and B for the balanced cantilever bridge need to be complete. Then of course the landscaping and the finishing off works, including the removal of some of the revetment works at the bottom of the balanced cantilever bridge.' (Alex Dunstan, Tape RTA-LHD:FH45, CD Tracks 9 & 11)

The final concrete pour occurred on 15 November 2005, as Sean McCallion, the foreman on that day recalls:

> 'This morning we put the last soffit in into the slab for the bridge, the final closure pour. We fixed the reo off in there, cleaned it out, made it ready for concrete and then we poured the final slab about an hour and a half ago. You can now walk across the bridge from one end to the other. The bridge is all there now - we've just got three expansion joints to put in, one at each end of the two bridges and one where the bridges meet in the middle. The parapet barriers are going on and the handrail for the walkway, kerbing is going on at the northern end and the roadway has already been partially built around there and the whole walkway, from one end of the job to the other. There's a bit of work to go yet.' (Sean McCallion, Tape RTA-LHD:FH52, CD Track 2 & 3)

> 'Well, once the decking is done then it is the finishing works. It is the black-topping for the surfacing, the line marking, New Jersey kerbs and just the tying into the road at both ends. Where the bridge finishes there is an abutment and that will be done concurrently with the deck, so they'll come together at the same time. We've got to do some work on the existing road around the northern amphitheatre as it goes round into Coalcliff, that will need to be rebuilt, resurfaced, new guard rails. We are looking at improving the road around the northern headland which we call GD5 as it comes out of Coalcliff to improve the passing distance between opposing buses and trucks - currently they cross over the double line.' (David Peacock, Tape RTA-LHD:FH32, CD Track 11)

For some, having worked on Lawrence Hargrave Drive has been a career-forming experience:

> 'There's been some good tradesmen come out of this job. There have been some guys who have surprised themselves I think about what they can achieve. We've had house carpenters who have become terrific bridge carpenters and dogmen

> that have become good riggers. Some good guys have fronted up here and had a crack at this job. Not everyone has worked on a bridge before and this is a first for quite a few of them.' (Tony Wood, Tape RTA-LHD:FH53, CD Track 6)

The actual date for the opening of the bridge was now set for 11 December 2005 and a competition was launched among local school students to coin a name for the new bridge.

> 'With all the discussions around naming the bridge, it's now also 'name the drive', from where you get from Bald Hill, when you first see the coast all the way to Bulli, which is what we call the Coast Road, give that a name. Forget about the bridge on its own, it's just part of the full coastline and they reckon it's within the best ten drives in the world, so it'd be interesting to see what they name it and how they promote it.' (Steve Montgomery, Tape RTA-LHD:FH44, CD Track 2)

As opening day neared the community was getting more excited about their new bridge:

> 'Oh, I think they're besides themselves, yeah. I mean when we first arrived here I remember talking to some members of the community and they were almost in disbelief that we were here and they certainly didn't believe we were doing anything, they thought we used to go behind those closed gates everyday and come out and nothing was happening. But now they all know the opening date and they are all pretty ecstatic, yeah.' (Tony Wood, Tape RTA-LHD:FH53, CD Track 4)

> 'Many people are planning many celebrations. There is an almost out-of-control aspiration for celebration when this bridge opens. We are receiving submissions from all sorts of people who have good ideas and who fear that the RTA may not be thinking about this. Charities are suggesting that they may organise the opening celebration so that they can promote their good works. Service clubs are offering to organise it so that they can have bucket collections for their good works. Commercial people are ringing in, saying they've got the best idea for the opening and would we like to pay them to organise it for us? The community people themselves are just in a party mood and wanting to be part of the partying. So yes, there will be celebrations - if the RTA doesn't facilitate celebrations then they will be held anyway.' (Ros Muston, Tape RTA-LHD:FH46, CD Track 12)

Kerb and railing placement

# Opening day

The morning of Sunday 11 December 2005 dawned with a great deal of excitement. Hundreds of schoolchildren were assembled on the bridge approaches. Helicopters flew overhead as TV news crews videotaped the event. The atmosphere was electric. Paul McLeay, the local member for Illawarra welcomed the crowd:

> 'It's a beautiful Illawarra morning and thank you all for coming. Let me first acknowledge Premier Morris Iemma who has come for this important event, Minister for the Illawarra Dave Campbell, Minister for Roads, Joe Tripodi, my parliamentary colleague Barry Collier, Member for Miranda, our local Federal Member Sharon Bird, Lord Mayor and Lady Mayoress Alex Darling, Mayor Hamilton, fellow councillors, Mike Hannon, acting CEO of the RTA, Dave Stuart-Watt, Jay Stricker from the RTA as well, representative of the Alliance, other special guests and more importantly our local school kids from the Illawarra community. My name is Paul McLeay, I'm the local State MP and we will start the morning very significantly and importantly with Cheryl Davis-Fulcher who will give us a welcome to country on behalf of the Wadi Wadi people.' (Paul McLeay, Tape RTA-LHD:FH54, CD Track 2)

Cheryl Davis Fulcher revealed that the name of the new bridge would be the Sea Cliff Bridge and congratulated 11-year old Makenzie Russell from St Brigid's Primary School, Gwynneville for coining the name:

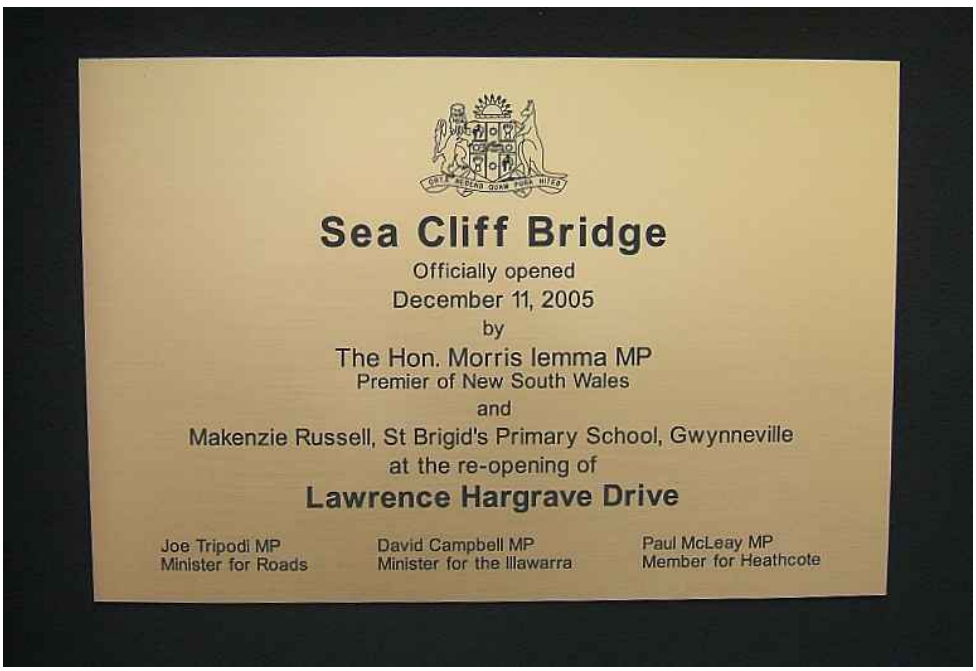
> 'Firstly, I would like to acknowledge all our official guests and the community and especially the school kids that have turned out here today to witness the reopening of Lawrence Hargrave Drive and the official opening of the new Sea Cliff Bridge. The name Sea Cliff also has an Aboriginal perspective which can be related to the heritage of my people. The sea is a significant feature of the traditional custodians, as we are known as the Salt Water People. The cliff is the face of the escarpment. The escarpment is the natural keeping place for rock shelters that signify the history of Wadi Wadi people. Congratulations Makenzie, the name Sea Cliff can only be described as unique. What a spectacular view, which makes driving along Lawrence Hargrave Drive crossing over the new Sea Cliff Bridge an absolute pleasure. I acknowledge all who have been involved in the construction of this magnificent bridge. This landmark will be a prominent tourist attraction. This is an historical event and will certainly be talked about in many years to come. Therefore, on behalf of the Wadi Wadi people and the traditional custodians of this land I welcome you to country. Thank you.' (Cheryl Davis Fulcher, Tape RTA-LHD:FH54, CD Track 2)

Premier Morris Iemma addressed the crowd and declared the bridge open:

> 'It is a great day for us all. It is an example of good government action and government listening. Listening to what you have been telling us about, ensuring greater safety and better access, of dealing with the issue of the rock slippage and getting some action taken and we dipped into our state budget for forty-nine million dollars to build this magnificent bridge. It is a great engineering feat, a very practical solution to what has been a very difficult problem here and one that is compatible with the environment and one which will see a reopening, a reuniting of two communities, cutting travelling times, better safety, better access. And Makenzie, you are part of the history that we are making today. When your family drives along the bridge you can very proudly say, "Well, I named that bridge and

I'm part of history." Well we have waited long enough, the engineers have done their work, a smart, excellent design, the workers have done their job, the RTA have done their job and the community have done their job. The uncertainty is over, the waiting is over and I now. in the name of the community very proudly name this bridge Sea Cliff Bridge and declare it open.' (Morris Iemma, Tape RTA-LHD:FH54, CD Track 3)


NSW Premier The Hon. Morris Iemma and Makenzie Russell unveil the bridge plaque



As Makenzie Russell unveiled the sign with the name, the ribbon was cut and the crowd began to cross the bridge. As they did so, their comments and impressions of their new bridge were recorded. Claudia Schmidt is a school student from Wombarra:

> 'Oh it was really exciting being able to walk across the bridge, like I'm going to be able to see my friends a lot more often and ride my horse and all that.' (Claudia Schmidt, Tape RTA-LHD:FH54, CD Track 8)

Jessie Brown, another student from Stanwell Park will use the bridge to go surfing. Christine McMaster had this to say:

> 'It's a great feeling to access the road again and have all the people be able to come down and go back up. So it will be a lovely drive to be able to drive up and see the other side. I actually haven't been up to Stanwell Park since it's shut, so yeah.' (Christine McMaster, Tape RTA-LHD:FH54, CD Track 4)

Steve Montgomery was among the crowd:

> 'Oh, it's great mate - everyone is very happy, it is just a beautiful bridge. I didn't realise it would be that spectacular until the full entirety was finished, it is better than we all expected, I think. Thirteen months I was on the project. (I finish on it) this afternoon, that's it. Tomorrow it is back to the public and everyone is using it that's what we're after.' (Steve Montgomery, Tape RTA-LHD:FH54, CD Track 5)

Also walking over the bridge was local resident Warren De Clouett:

> 'I've travelled across the road, you know, the old road, taken all the horses into the coal mine and all that and to be able to walk across now with my grandchildren it's a real privilege – it really is.' (Warren de Clouett, Tape RTA-LHD:FH54, CD Track 5)

However, not everyone was as happy with their new acquisition. Trevor Gardiner from Stanwell Tops made the following comment:

> 'I liked it the way it was. I would have had the money spent on a cycleway and a footpath so my children didn't have to walk along Lawrence Hargrave Drive with the coal trucks. That was probably a more important issue than this was for the general safety and movability and committing of the community. Kids can't walk between schools, walk between the villages, without walking on Lawrence Hargrave Drive with the coal trucks, or the cars.' (Trevor Gardiner, Tape RTA-LHD:FH54, CD Track 7)

Makenzie Russell described how she thought up the name:

> 'My mum knew about the competition before and I thought about the area and the hang gliding and I brainstormed some ideas.' (Makenzie Russell, Tape RTA-LHD:FH54, CD Track 9)

Ros Muston offered these comments:

> 'The community generally are very excited about the bridge opening, they are looking forward to reconnecting with friends and relatives. They are looking forward to getting back into their routine of where they like to shop and the way they like to travel to work. They're very excited.' (Ros Muston, Tape RTA-LHD:FH54, CD Track 12)


The Sea Cliff Bridge sign is unveiled

NSW Premier The Hon. Morris Iemma and Makenzie Russell cut the ribbon

Jilly Martin of Oak Flats would have her life restored:

> 'We always used to bring our children up here and watch all the hang gliders but it got to the stage where going all the way round just took too long and what have you, so this way we will be able to go back up and sit up there and have picnics and everything like that.' (Jilly Martin, Tape RTA-LHD:FH55, CD Track 3)

Diane Mitchell and Bronwyn Cuppitt thought:

> 'I think it's going to boom the community. Whether they like it or not tourism will just take off. I mean mum and dad live down in Austi, so we've got strong ties. My father was one of the original surveyors, my grandfather, at Coalcliff Colliery and a foundation member of Austinmer Surf Club, so our history goes back to the early twenties in this area. I think you just can't stop history, in another 50 years this is just going to go down in history as being a great event. And I've got an extra special thing, I've got a blister and I'm the first casualty on the Sea Cliff Bridge. So I got the first Band Aid - good job, excellent work.' (Diane Mitchell & Bronwyn Cuppitt, Tape RTA-LHD:FH55, CD Track 3)

Val and Ray Crump came from Port Kembla to experience the new bridge:

> *Ray:* 'I give them full credit for this one. But I was thinking in terms of the period ahead - you've only got one lane either way - what is the future going to be? In time, if this becomes as busy as it might do they are going to have to search for extra space somewhere.'
>
> *Val:* ' Oh well you won't have to worry, love.'
>
> *Ray:* 'No, I won't - I'm eighty now.' (Val & Ray Crump, Tape RTA-LHD:FH55, CD Track 4)

Among the crowd was Peter Wolfe, a former Bridge Engineer at the RTA. He offered his professional opinion:

> 'I was in the Bridge Section – I was Bridge Engineer, Operations. This is certainly one of their better efforts isn't it? It is a very fine piece of work. It has solved what has been an age-old problem here of course, it is the solution, and I think they have gone into a lot of thought and a lot of trouble to pick the right one. It will be an asset to this area, it will keep this road open and that in itself is a major achievement.' (Peter Wolfe, Tape RTA-LHD:FH55, CD Track 5)

Ellis Eyre was on the Community Consultative Committee for the new bridge:

> 'Well, we pretty well got what we wanted. Everything works and I can't see anything that we talked about in those times that hasn't been corrected and listened to and it should be here for a 100 years. And as a local I'm completely safe riding around here, there will be no more rocks hit me ever, no matter how big they are.' (Ellis Eyre, Tape RTA-LHD:FH55, CD Track 4)

With the bridge festivities over, Jay Stricker evaluated the Lawrence Hargrave Drive project in a broader context:

> 'I was just reflecting actually on the way the focus on the project has changed somewhat because in the beginning the impact was on the local communities and the project was all about rejoining those local communities, particularly Coalcliff, Stanwell Park and Clifton and Scarborough, so it was a very localised focus. And

> then when we came up with this solution that was such a wonderful structure and people like the local council, Tourism Wollongong, other organisations started to really take notice of that and see that this was in fact a completely new gateway to the Illawarra. Tourism Wollongong in fact have been promoting this tourist drive now in Japan and Taiwan and to some extent I'm a little hesitant about the impact that this is going to have on the local communities because although there are some who really want the tourism dollar there are other people who are seeing that their lifestyle will be changed forever by this new road.' (Jay Stricker, Tape RTA-LHD:FH51, CD Track 1)

Ros Muston had this to add:

> 'I became concerned about a sense of loss and grieving for the old road early on in the project and it was a day that we took the Community Consultative Committee onto the site, prior to the work starting. It was their last chance to have a look at the old road and they walked a gregarious jolly group down the hill toward the cliffs and I was walking along behind them and listening to them point out to each other features of the cliff, features of the road. They were using their own stories to explain to each other how they felt about the road and my heart sank into my boots as I walked down behind them because I thought we thought we were dealing with conflict over road closure, but coming out the other end of this project we've had people cut off for two and a half years for something that they feel is a part of their own identity and it will be gone and they will suddenly realise they will never, ever have it again. I started to become very worried that down the track we would have a different sort of conflict emerging out of grief which would be very, very difficult to manage and that's really when I started to think about oral histories. I thought that the oral history might give us a mechanism to create a memorial for the old road, something…. a keepsake, something that people could put away and bring out when they wanted to, or show their children or their grandchildren when they wanted to tell their stories about what used to be there but isn't there any more.' (Ros Muston, Tape RTA-LHD:FH47, CD Track 1)

Jay Stricker was asked how she thought the project would be regarded by the engineering profession in future years:

> 'I think they will see it as a step forward in engineering in Australia. It is a very bold project to build two different types of bridge construction, particularly in such a challenging site, so you know, in that respect it has been challenging and I think it will stand out as a landmark in engineering, and indeed in road design - we've had some significant design challenges just in terms of the alignment of the bridges and so on purely from a road safety driving sort of perspective, so from the traffic engineering as well as the civil construction it's been quite a landmark project.' (Jay Stricker, Tape RTA-LHD:FH51, CD Track 3)

*The opinions expressed in the oral history interviews and summarised in this report are those of the individuals concerned and do not necessarily represent in whole or in part the position of the New South Wales Roads and Traffic Authority.*

The community walk the Sea Cliff Bridge for the first time

# List of interviewees

| ***Name*** | ***Tape No*** | ***Date*** | ***Place*** | ***Duration*** |
|---|---|---|---|---|
| David Peacock | RTA-LHD:FH32-33 | 27/08/04 | Clifton NSW | 69:23 |
| Michael Norman | RTA-LHD:FH34 | 27/10/04 | Cremorne NSW | 57:05 |
| Mark Sinclair | RTA-LHD:FH35-36 | 01/11/04 | Cremorne NSW | 69:47 |
| Peter Wyton | RTA-LHD:FH37 | 30/11/04 | Cremorne NSW | 58:11 |
| Harry Poulos | RTA-LHD:FH38 | 07/12/04 | Cremorne NSW | 53:47 |
| Peter Stewart | RTA-LHD:FH39 | 08/12/04 | Cremorne NSW | 38:47 |
| Tony Wood | RTA-LHD:FH40 | 17/01/05 | Austinmer NSW | 51:19 |
| Marc Hendrickx | RTA-LHD:FH41 | 24/01/05 | Cremorne NSW | 38:48 |
| Jon Williams | RTA-LHD:FH42 | 30/03/05 | Cremorne NSW | 55:35 |
| Steve Montgomery | RTA-LHD:FH43-44 | 09/06/05 | Stanwell Park NSW | 70:20 |
| Alex Dunstan | RTA-LHD:FH45 | 27/07/05 | Cremorne NSW | 55:28 |
| Ros Muston | RTA-LHD:FH46-47 | 27/07/05 | Cremorne NSW | 66:53 |
| David Corry | RTA-LHD:FH48-49 | 28/07/05 | Cremorne NSW | 70:09 |
| Jay Stricker | RTA-LHD:FH50-51 | 06/10/05 | Cremorne NSW | 71:23 |
| Sean McCallion | RTA-LHD:FH52 | 15/11/05 | Clifton NSW | 23:04 |
| Tony Wood | RTA-LHD:FH53 | 15/11/05 | Clifton NSW | 28:03 |
| Day of Bridge Opening | RTA-LHD:FH54-55 | 11/12/05 | Clifton NSW | 77:21 |

# Interviewees' biographies

# David Corry

Born in 1957, David Corry obtained his love of the environment from his childhood living near the bush and from attending courses in Earth Science and Town Planning at Macquarie and Sydney Universities. After graduating he worked for six years at McDonald Wagner as one of their first environmental staff members, a position he describes as 'lonely' in the company of conservative engineers. In the 1980s he wrote many Environmental Impact Statements for McDonald Wagner (now Connell Wagner) and then joined the Department of Main Roads as an Investigations Officer. David has spent 19 years at the DMR and RTA, and was the key person in preparing the REF for Lawrence Hargrave Drive.

# Alex Dunstan

Alex Dunstan graduated from Sydney University in Civil Engineering in 1983. Since then he has been employed by the DMR/RTA on a variety of projects. He started at Homebush as Assistant Works Engineer, then Dubbo as Assistant Works Engineer, Sydney in Technical Training as a Training Consultant, Blue Mountains as the Construction Engineer, Grafton as the South Grafton Works Engineer and then Area Maintenance Manager and is currently at Wollongong as an Area Maintenance Manager. He was responsible for the design and construction of the Woodford Bends project, one of the very last major roadworks projects carried out directly by the RTA.

In 2002 he began working on the problems associated with the rocks falls on Lawrence Hargrave Drive and engaged consultants to look at risk management options. He commissioned the construction of the catch ditch in the southern amphitheatre and rock bolting & catch fence construction on the middle headland, together with the introduction of a road closure strategy based on increased risks after prolonged or heavy rain. Following constant heavy rains and rock falls in early 2003 and the frequent closure of the road, then finally a large embankment failure, public outcry triggered a reassessment of the approach. He was responsible for engaging consultants and working with them on the alternatives.

In August 2003 after the announcement of the closure to address a more permanent option and the engagement of the RTA's first Alliance agreement, he was appointed Project Manager and represented the RTA at the many public meetings. He provided the interface between the many stakeholders and the Alliance. He was responsible for the Review of Environmental Factors and ensuring the project was delivered to these undertakings.

He worked closely with Ros Muston to provide community support through the State Government Community Support Fund. Every month Alex, Ros and the Alliance met with the Community Consultative Committee to discuss issues associated with the project and the road closure impacts. He will continue to provide the client role on this project dealing with the final issues of client acceptance, funding and land acquisition, along with any issues associated with the performance and use of the constructed facilities.

# Marc Hendrickx

Born in Canada in 1968, Marc Hendrickx has lived in Australia since 1970. After completing a B.Sc. Honours degree with a major in Geology, and after winning several academic prizes, he found a job with the State Geological Survey of Victoria, mapping major parts of the east of the State. He describes geology as 'putting a whole story together - a puzzle where one is intellectually challenged'. Marc worked in the Tanami Desert in Central Australia for two years from 1998 and then obtained a position with the RTA as Scientific Officer working on Slope Risks and other geological work. Marc has examined all the DMR files relating to Lawrence Hargrave Drive and has put together a detailed site history of the road. He joined Alliance partner Coffey Geosciences in April 2004 to work on the Sea Cliff Bridge and other projects.

# Sean McCallion


Born in 1965 in Auckland NZ, Sean McCallion became an apprentice carpenter at 17. He came to Australia in 1988 to work as a carpenter in all fields of construction, including bridges in WA and NSW. He was engaged on the construction of the Sydney Harbour Tunnel and the M5 Motorway. The Sea Cliff Bridge is the largest bridge project he has worked on so far. He began on the job during construction of the piers, set up the formwork and has poured concrete. He completed pouring the final slab for the bridge deck on 15 November 2005 and has spent 14 months on the job.

# Steve Montgomery

Born into a family of builders, Steve Montgomery came to live at Stanwell Park at the age of 17. He helped his father with building an average of 30 homes a year in Sutherland Shire for ten years, then quit the construction industry to become a disc jockey, working in the nightclub industry and on cruise ships. He returned to live at Otford to run a video store for eight years. He then rejoined the building industry and worked at Leighton and Barclay Mowlem where he worked as Site Supervisor on Sutherland Hospital, a large project. He was then given the opportunity to work on Sea Cliff Bridge as Supervisor. He is a down-to-earth person with a sense of humour and great dedication to his work.

# Ros Muston

Ros Muston majored in Ecology, Botany and Geomorphology at Sydney University and then did her Honours year in association with the NSW National Parks & Wildlife Service researching a project on the impact of bush fire on catchment hydrology and ecology. She wrote her PhD thesis on the same topic. Following her time at Sydney University she worked as Assistant Director of the National Trust of NSW, then moved to the South Coast and taught biogeography and ecology at the Wollongong University. In 1989 she created and managed Quality Environmental Management Pty Ltd, an environmental consultancy. She currently works for Evans & Peck. Her first contract with RTA was a flora and fauna assessment and community consultation for the route selection of the Tomerong Bypass. After that she worked on numerous community consultation programs and environmental assessments for road realignments on the north & south coast of NSW. She drafted early versions of the RTA's Biodiversity Protection Guidelines and in March 2003 was engaged by the RTA as independent consultation mediator to improve dialogue between the RTA and community members within the coastal village communities affected by the closure of Lawrence Hargrave Drive. In August 2003 she was appointed as the RTA Community Relations Officer for the Lawrence Hargrave Drive Project. In that capacity she mainly worked on the Minister's $2 million Community Support Fund, a unique fund which funded support activities for local business and volunteer service groups affected by the road closures. Ros refers to her involvement with Lawrence Hargrave Drive as 'two years of crisis management and conflict resolution' but feels proud of what she has been able to achieve to create a harmonious outcome.

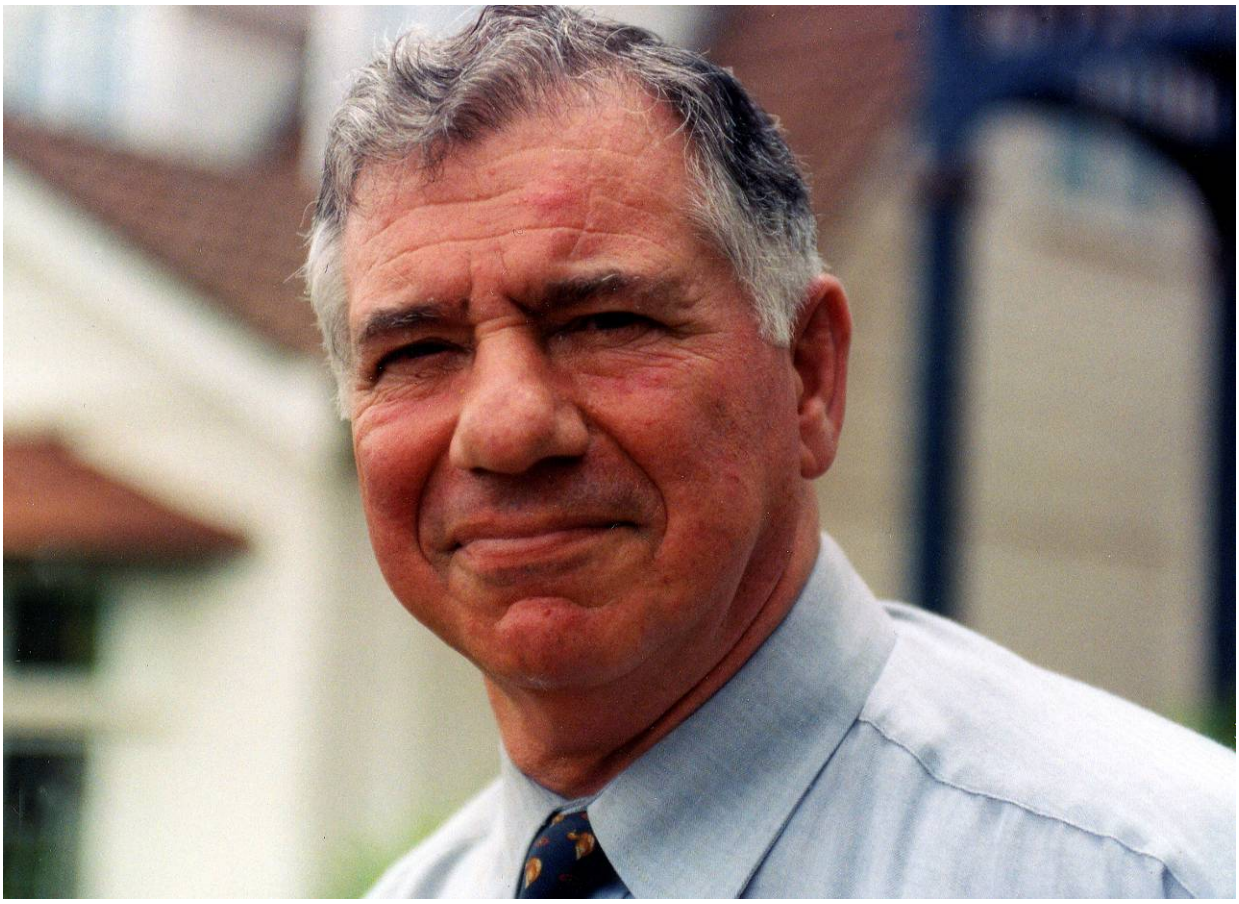
# Michael Norman

Principal Geotechnical Engineer with Coffey Geosciences and Manager of the Sydney office, Michael Norman studied Civil Engineering at Northwestern University in Chicago for five years and did a Master of Engineering Science at Sydney University. He then spent two years in the Northern Territory designing dams and six years being involved with mining infrastructure projects throughout the coal industry. He was a partner in the successful bid for the Lawrence Hargrave Drive Alliance. After being commissioned he was appointed Geotechnical Team Leader and collaborated on the design of the two bridges in consultation with Maunsell Australia and provided pile analysis and anticipated settlement characteristics to the structural engineers. His team was responsible for the slope stabilisation and slope risk assessment for the project. He started on the project in November 2003 and was a member of the Alliance Management Team throughout the project. He describes the whole undertaking as a fantastic project with lots of innovation - a lot of which can be attributed to the Alliance.

# David Peacock


David Peacock grew up in Launceston, attended Scotch College and obtained his Diploma of Civil Engineering at Tasmania Technical College, 'the hard way', as he describes in his interview. His first job was with the Hydroelectric Commission in Tasmania and he then worked for Pearson Bridge as a site engineer. He came to Sydney to work on three bridges near Penrith and following that on an oil and gas refinery in East Kalimantan, Indonesia. He was then involved as Project Director in the design and construction of a new grain terminal in the Philippines, which included a new wharf, silos and a large warehouse. When completed, the new facility was able to unload 60,000 tonnes of corn in three days. He then supervised the construction of a coal-fired power station in Malaysia with a workforce of 2000 people, spent eight months in Dubai and joined Barclay Mowlem in May 2003. He was attached to the Lawrence Hargrave Drive project in September 2003 when the company was invited to submit an expression of interest. He then became Senior Project Manager for the Alliance on the project. Unflappable under crisis, he has relished the challenges that the Sea Cliff Bridge has offered and has overcome every hurdle to complete the bridge in record time.

# Harry Poulos



Professor Harry Poulos is one of Australia's eminent foundation engineers. With a passion for Chemistry in High School, he wanted to become a Pharmacist but was advised to study Engineering instead. At University he was taught by Professor John Roderick, a former President of the Institution of Engineers and Professor Ted Davis, who became his mentor. Poulos believes that he took away from university the ability to analyse and solve problems as well as his degree of Bachelor of Engineering in Civil Engineering and a PhD. He worked with McDonald Wagner and Priddle, a firm of leading structural engineers and then became a lecturer in Soil Mechanics at Sydney University in 1965. His major research there focused on methods of designing pile foundations subjected to both vertical and horizontal loadings and methods to estimate settlement of foundations. He published many papers on his work which was the basis of his career as a foundation specialist. Joining Coffey Geosciences in 1989, he developed computer programs to analyse pile behaviour and ground loadings and instructed the Alliance team how to use the programs to optimal effect. As Senior Principal of Coffey Geosciences he has done the complex calculations for the pile foundations of the Sea Cliff Bridge in the challenging marine environment.

# Mark Sinclair

With a degree in Civil Engineering from University of Technology, Sydney, Mark Sinclair has worked for over 20 years on the construction of about 110 bridges and remedial measures on dams, including the Nepean, Cataract and Warragamba dams. The biggest project he was involved with prior to Lawrence Hargrave Drive were the repair works to Canning Dam in WA for which he developed the world's largest permanent ground anchors. He also devised all the electrical and mechanical works for the moving of the stadium at Homebush 16 metres after the Olympics. He has put up proposals for cable-stayed, balanced cantilever and incrementally-launched bridges and has travelled overseas as a dam consultant. He started on the Sea Cliff Bridge in March 2004 as Chief Project Engineer.

# Peter Stewart

Peter Stewart is the Alliance Champion. Born in Belfast in 1944, he attended Strathclyde University in Glasgow and graduated in Civil Engineering in 1971. He was offered a position in South Africa and moved into bridge construction. He was at the forefront of innovation in South Africa when he built the first incrementally-launched bridge there in 1977. Peter has lived in Australia since 1985 and has many spectacular bridges to his credit. Peter was honoured with the 2005 Civil Engineer of the Year Award given by Engineers Australia Civil College Board for his contributions to Civil Engineering. As part of Barclay Mowlem, he put together a team and was successful in obtaining the contract to construct the proposed bridges for Lawrence Hargrave Drive. Peter has successfully and safely brought the RTA's first Alliance project to completion in record time.

# Jay Stricker

Jay Stricker studied ecology as the major in her Science degree and worked with Professor Harry Recher at The Australian Museum assisting research into the effects of fire in the Nadgee Nature Reserve, and then moved in to wetland ecology. After some work as an independent consultant and freelance photojournalist, she completed an inventory of Sydney wetlands for the Department of Planning and was appointed to the newly created position of Natural Resources Manager at the Water Board in 1989. In 1995 she moved to the RTA as General Manager Environment, a position she held until her move to Southern Region. As General Manager Environment, she worked with project and regional teams across the state on a variety of projects and issues including M5 East air quality and biodiversity issues on the Pacific Highway, and Chaired the Pacific Highway Noise Taskforce in 2003.

Jay was asked to take up the position of Regional Manager Southern Region of the RTA on the day that the Minister for Roads made the announcement that Lawrence Hargrave Drive would be closed for up to two and a half years to allow the RTA to find and build a solution to the problem of reducing the risks inherent in the road. Jay is the first non-engineer and first woman to be appointed as a Regional Manager in the RTA.

Jay regards the responsibility for managing the LHD Alliance and the Community Support Fund as a rewarding privilege, not only because it is RTA's first Alliance, but because it has been able to provide constructive support to the local communities and overcome such a technically challenging environment.

# Jon Williams

Jon Williams grew up on a small farm near Maitland with his parents, two sisters and grandparents and then attended boarding school at Armidale. He then took up Civil Engineering at UTS, graduating in 1996 with a Bachelor of Engineering. He joined Barclay Mowlem in 1993 where he worked on various road, bridge and multi-discipline projects, including the 200 metre Colo River Bridge. In 1997 he worked in Gladstone on a materials handling mine project and from 1998 to 2000 was engaged at Lake George on the construction of the Federal Highway. He has been at various times a Quality Assurance Officer, Site Engineer, Project Engineer and Site Manager. He was involved in the option development, design and ultimately became Construction Manager on the Sea Cliff Bridge project. He is young, enthusiastic and capable - qualities needed for a project as complex as this one was.

# Tony Wood

Born in Wellington, New Zealand in 1958, Tony Wood became an apprentice mechanic and then travelled to Australia in 1980 commencing work as a builder's labourer. He continued in a variety of jobs within the construction industry. He then moved into heavy civils gaining experience over the next 18 years in the Pacific Region and South East Asia. He returned to Australia in 1998 to take up a role as General Superintendent with Barclay Mowlem. After major bridge structures on the Alice Springs to Darwin rail line and Yandi Coogina Creek Bridge in the Pilbara, Tony was asked to join the Alliance team that was selected to engage in the building of the Sea Cliff Bridge. During this time he managed day-to-day operations on site with crews, subcontractors, and suppliers and checked that the level of manpower was suitable for each area and aspect of the work. He and his crews have been able to meet all of the milestones during construction of the project, something that came about through team effort. He is particularly pleased with the amount of expertise the men have picked up on the job and displayed.

# Peter Wyton

As Design Manager for the Alliance, Peter Wyton was responsible for leading the team that produced the design for the Sea Cliff Bridge. He grew up in Longreach and studied Civil Engineering at Queensland University of Technology, a course which he found very intriguing. The technical aspects he learned at university gave him a grounding in problem solving – thereafter he built technical knowledge from the working environment. Wyton has been working with Maunsell Australia since 1992, at first in the Traffic Engineering Division, then in Quality Assurance. After 18 months overseas with Maunsell in the UK, he went for a long walk to Iran, something he wanted to achieve for himself. The Sea Cliff Bridge project captured his imagination early on and, in the first part of the analysis, they came up with 76 different options which were reduced to 26. After that, together with the design team and the community workshops they used multi-criteria analysis and a systematic approach to bring it down to the preferred option. He believes that the project combines the best answers on safety, community, environment, road availability and geotechnical risk criteria in addition to being an iconic structure.

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