

## **CONSTRUCTION OF THE ORD RIVER DIVERSION DAM – AN ILLUSTRATED HISTORY**

*On 2 September 2009, Peter Knight, a founding member of the Kimberley Society, delivered an excellent PowerPoint presentation. It was prepared with the assistance of Hamish McGlashan, focusing mostly on aspects of the dam construction in which Peter was involved but also showing the official opening and other sociable moments. The presentation included two video clips and 48 slides, commencing with one of the dam. Peter's verbal component of the presentation follows.*

In discussing the construction, I will give an idea as to how I became involved, and I will comment on some of the other people. We are fortunate to have amongst us tonight John Lewis, who was the man responsible for the design of the Diversion Dam, and Gil Marsh who designed the roadway over the dam and the Dunham River Bridge. What a great joy it must have been for these men to see this project come to fruition.

By comparison, I was the most junior engineer on site! Because I was involved in the concrete work, my comments will I am sure be biased in this direction and not give sufficient credence to the other aspects of the undertaking.

Just for background, I graduated from UWA in 1960 and looked around for a job. I wanted to work in construction but not for the Government, even though they did most of the interesting and substantial work in this field. This left me with few choices. Christiani Nielsen and Clough (CNC) had a joint venture to build the Narrows Bridge across the Swan River in Perth, and they had, about that time, won a tender to construct the Ord River Diversion Dam. This looked to me like the ideal chance. I applied and was hired by the JV to go to the site and work on drilling and grouting the foundation and as assistant engineer for concrete on the dam. This meant setting out the works, planning and supervising the site preparation, and the placement of the concrete under the guidance of a senior engineer.

I got the opportunity to go north and took it with both hands! At the time the Kimberley was a pastorally dominated society .... days were measured by sunrise and sunset .... seasons by the wet and the dry .... access controlled by inadequate road systems, poor flight schedules, the State Shipping Service. RFDS radio for communication .... no telephone of any consequence.

Thrust into this pastoral scenario was a construction contract that depended on timely arrival of all the components, the manpower, the staff, the food and the beer! There had been the construction of the port facilities in Derby and Wyndham, the building of meat works etc but nothing on the scale of the Dam. Major logistical challenges had to be met and overcome.

Before all this could start, of course, there had been serious investigations, concept planning, establishment and operation of an Agricultural Research program and then the detailed design of the scheme. On top of this were the political manoeuvres and will to get the funding in place to allow it to proceed. So what I will talk about is really only a small part of the project, albeit a very interesting part, to me at least!

The dam structure consisted of an abutment on each side of the river and, in between, 20 Radial gates supported by concrete piers resting on a spillway sill, which in turn was bedded onto the rock. The abutments were linked to the banks with earthen embankments. Over the top of the gates a roadway was built and this was used not only as a bridge across the river but also as an access way to carry a gantry to service the gates.

Fortunately, CNC had within their organization some very talented and experienced people who were able to address the challenges presented and make the project work. The Project Manager was Mr. Leif Ott Nielsen, a widely experienced and competent engineer who had been project manager on the Narrows Bridge and had worked on remote sites in South Africa and elsewhere. He master-minded the plan.

The detailed planning was done primarily by Mr. Uffe Hansen, an exceptionally talented engineer. He planned the work from go to whoa, getting all the materials, stores, equipment, personnel to site in a timely manner. Transport of cement from Cockburn Cement, in Cockburn Sound just south of Fremantle, to the site was handled by converting the State Ship MV *Dulverton* to a cement-carrying vessel using specially designed equipment made by F.L. Schmidt from Germany, installing storage bins at Wyndham, and providing specially designed spherical containers to be placed on the road trains to transport the cement to site. I was fortunate to work under Uffe in my first year on site and benefitted from his support and guidance.

The Site Manager for CNC was Mr. J J Hussom. The Resident Engineer for the Public Works Department was Mr. Roy Hamilton, and his 2IC on site, Brigadier Frank Hussey. Mr. J E Parker was the Chief Engineer for the PWD and Mr. C Munro the Project Engineer. There are also others here tonight who were involved in the construction ... notably Don Young to whom I am eternally grateful for his guidance, patience and tuition during the work on site. He was my boss in 1962. There are others here also I am sure who were there at the time!

My first job was to supervise the completion of eight houses for CNC and then build an outdoor movie theatre! Still standing I believe!

The site of the dam was on an exposed quartzite outcrop across the river known as Bandicoot Bar. The first job was to remove the excess rock down to foundation level. This was done by a subcontractor, D F D Rhodes. It was a very tough job and Don Rhodes lost a lot of money carrying out the work. To his credit he finished the work in a timely fashion.

Following this the foundation was drilled on a regular pattern and grouted with cement to fill any cracks in underlying rock. As it turned out the rock took very little cement grout as the fractures in it were in effect very well naturally sealed with fine clay. Then a deeper line of holes was drilled to form a curtain along the axis of the dam. These too were really of little effect as the job had already been done by the clay. We pumped in only about 10% of the volume of cement expected to go into the grout holes.

Next came the concrete. The rock had to be cleaned to near perfect cleanliness before one was allowed to place concrete onto it. It got down to a level of little dust pans and brushes and small foam pads like one uses in washing up, to get the standard demanded by Roy Hamilton!

We started off placing so-called dental concrete on the rock surface, filling in the major cavities. The technique was to place a cement-rich fine grout onto the rock surface before placing the concrete and then vibrating the courser graded concrete mixture into the surface indentations. This applied to all rock concrete interfaces.

The baseline survey was carried out by the surveyors and, from these few points, the rest was done by us on site. As you all know it can be quite warm in the Kimberley so, in order to minimize the effect of the heat shimmer, we did

our key surveying at first light before the workforce arrived at 6.30am. Don and I would arrive while still semi-dark and set up our instruments so that as soon as we could see we would carry out our work.

One morning we were walking in along the dam with our instruments on our shoulders and as usual the backs of our shirts were black with flies. This particular morning we had a young engineer who had just come out from Denmark and had never seen flies. I called out to Don, in front of me, "I see Fred's here this morning... and Sam is back." Then, after a few more paces, "Tom is here as well!" The young guy then said in amazement, "You don't know them all by name...do you?"

I mentioned that the cement for the construction was shipped up from Fremantle on the MS *Dulverton*. The other prime ingredients of concrete are aggregate and water. Aggregate was taken from the water worn gravel deposits in the river below the Bar as was the water. The concrete was mixed in a very efficient pan mixer on site. The batch plant, as they are known, provided the concrete for the precast yard as well as the concrete for the dam.

The plywood-faced timber formwork was prefabricated in the carpenter shop. The formwork was then erected on site, lined up and checked for its position before the final inspection prior to ordering the concrete. There was always a great push to get the concrete placement started, which occasionally caused a bit of friction but overall it was a very harmonious site. My goal was for 2,000 cubic yards to be placed in a week. I got very close a number of times but the only time we achieved it was when I was off-site at the Wyndham Races. That week we got 2,040 cubic yards! I put it down to the good planning I had done in the week previously. Others didn't see it quite so clearly! Mind you it was a great race meeting! But that's another story!

The roadway beams as well as the Dunham River Bridge roadway beams were made in the precast yard which was located near the batch plant. Steel formwork was used throughout and the concrete was water-cured. The roadway consisted of seven post tensioned Tee beams (one of which was removable to allow the stop logs to be placed and removed) and two side beams that supported the rails on which the gantry ran.

After we poured the sills – the spillway – we had to form and pour the piers that supported the gates. These progressed across the dam without much of a problem.

Once the piers were constructed, the trunnions on which the gates hinged had to be placed and stressed to the piers with macalloy bars. This was a fairly delicate task, which had to be done with considerable precision. This operation progressed across the structure as we finished the piers.

In the first season we got partly across the Bar before the River started to flood. We had not had any substantial rain at the site and no one expected the river to flow. It happened that one Sunday another chap and I had taken a vehicle and gone up to the main Dam site to have a look at the gauging station. When we got there, we were astounded to see the river flooding through the gorge. Anyway, we were out for a bit of fun and it was, after all, Sunday, so we found a big dead tree and with considerable effort rolled it into the river and floated down through the gorge lying on the tree and admiring the sky above and the gorge walls as we gradually rotated in the swirling flood waters. It was great fun until a school of fish leapt out of the water under us! What was chasing the fish I wondered as I rapidly swam for the bank? It

dawned on me that this could be of significance to our work on the Bar so we returned to Kununurra and informed my boss Jens Hussom.

That night we mobilized an earthmoving fleet and started to lift the elevation of the coffer dam which was built to protect our site so that we could continue to work for another month or so before the river came down in earnest. The river eventually came down on 6 January 1962 and the work substantially closed down for the wet. Things were a little more relaxed as we waited to get a flight back to Perth.

With the oncoming of the wet most of the workforce left the site. This meant for most of us a trip to Wyndham across the flowing creeks to catch the DC3 for the many-stopped flight to Perth. On the trip I took we got to Meekatharra and the pilot announced that we would have to wait there for a while as Perth airport was fogged in. We sat in the sweltering heat when to our amazement a BOAC Super Constellation touched down and pulled up beside us! God only knows what those £10 migrants said to one another as they looked out on the flat scrub expanse of Meekatharra and stepped out into plus 100°F heat and flies in their tweed jackets.

After a break in Perth, which I greatly enjoyed, it was back on the DC3 for Wyndham. We started again as soon as possible after the floodwaters went down, cleaned up the site, and progressed across the Bar. Once we got a few piers up to full height we put in the very accurately-placed stainless steel seal plates against which the gates were to seal. Then construction of the gates themselves could proceed.

On the final pier pour (Pier 19) we decided we needed to do something a bit special. So we got half a dozen bottles of champagne, chilled them in the chiller in the batch plant, and took them down to the pour in the last truck. We hoisted them to the top of the pier and there they were ceremoniously drunk and the bottles embedded into the pier concrete!



The Dam nears completion... all piers to full height... the roadway approaches the western abutment.

The gates were manufactured in Perth and shipped up in pieces. They are of riveted construction. This must be one of the last major constructions using this technique in Australia. The design was originally made by the Bureau of Reclamation in the States. John Lewis had spied these gates in operation on a trip he made there. He thought they would be just right for the Ord and so approached the Bureau for the design details which they generously provided. The design was also used on a project in NSW. It was quite a coup to get this tried and proven design for zero design dollars. It was also quite a challenge to get them completed before the floods came down in 1962 and, despite the best efforts of the metalworkers union, they were completed to a stage where they could retain water for the season.



Radial gates 1, 2 & 3 progress

In 1962 we had a bit of a disaster. One lunchtime, after the men had had their lunch, the mess caught fire and quickly burnt to the ground. There were very few options to feed everyone! The PWD mess was rapidly expanded. The contractor C R Keith, doing the earthworks for the main channel, had a mess and that was also expanded and swung into action. We chartered a DC3 and filled it with essentials and got this in the air that night! With some forbearance from the troops the crisis was overcome!

During 1962 an airstrip was constructed at Kununurra and in early 1963 the Queen and Prince Phillip paid a royal visit.

Painting and some other minor work was carried into 1963. To work on the gates when the dam was full stop logs were placed in the specially designed slots just upstream of each gate. This allowed access to the gates (one at a time) to be sandblasted and painted in the dry.



The Dam passes the 1962-63 flood

The Dam was officially opened by Prime Minister Robert Menzies on 26 July 1963.

Along with the dam construction, the development of the agricultural project proceeded with the main channel construction and the pump station together with development of the farms.

Kununurra itself gradually developed to the thriving town it is today.

To me it was a great introduction to construction. I was very privileged to be part of this project.