HISTORY OF COASTAL ENGINEERING IN AUSTRALIA

A Keynote Address given on 17 July 2000
by

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North Reef Lighthouse

Mr Chairman, distinguished guests and colleagues. I invite you to commence our historical journey today as tourists on a small island in the Great Barrier Reef off the northeastern coast of Australia.

If we were watching the sun rise over the reef at Heron Island about 25 years ago, it would have been seen also by the light keepers in this light house on a small reef 20 km to the north of us. It has been there for over 120 years and has survived many gales, as well as storm waves breaking into the light keepers' living quarters. The sand cay, which originally was next to it, initially moved away, as if affronted by the presence of this foreign intruder, but in recent years the cay has slowly moved back again to touch and eventually closely embrace the light house as it has become a familiar and constant part of the seascape.

The colonial government engineer who designed this structure clearly understood the marine environment and built appropriately.

Today I intend to give you an overview of some aspects of the History of Coastal Engineering in Australia but, before I do so, I must acknowledge the considerable help that I have received from my coastal engineering colleagues both on the National Committee on Coastal and Ocean Engineering and throughout Australia in preparing the original paper and in supplying photographs and slides for this presentation. Thank you all for your contributions and for your encouragement to do the necessary research.

I will commence with a brief discussion of the significance of the coast for Australians and the nature of the Australian Coastal Environment. The main part of this address is divided into three unequal sections. I will spend most time with various developments concerning ports and harbours in Australia. This is real history beginning in the 1820s and continuing into the 1970s. During this period ports and harbours were built to service sea transport and the ships bringing immigrants to the country and taking away its many exports produced principally by the agricultural, pastoral and mining industries.

I shall then spend some time considering Australian coastal engineers' contribution to Coastal Protection and Coastal Management. During the period from the 1930s to the 1980s it became necessary to protect and secure many sea side locations for the increasing numbers of Australian and overseas tourists involved in leisure activities or living along the coast. This will be followed by a quick fast forward through the most recent developments from the 1970s to the present in which the focus of coastal engineering has shifted to Estuaries, Effluents and the Environment with the objective of stopping all kinds of pollution from all manner of careless people and undesirable practices.
Finally, before the sun sets off the Western Australian coast, I will come back to the Great Barrier Reef for a lesson from history.

Australian Coastal Environment

Historically European settlements in Australia were established on the coast and population centres developed around the ports and administrative capitals of each of the six British colonies established in the late 18th and the 19th centuries. When the Commonwealth of Australia was established 100 years ago next January, the former colonies became states and retained many of their original powers including development and administration of port facilities and overall management of the coastal zone. Because of this there have been diverse administrative systems for the coast and there has been no national focus for coastal engineering work in Australia.

Some years ago a Commonwealth Government report concerning coastal policy noted."*The coastal zone has a special place in the lives of Australians. Most want to live or take their holidays there. It is a priceless national asset.*"

Consequently during the last 25 years there have been significant increases in population, development and tourism in coastal areas, particularly in far north and southeast Queensland, the north and central coasts of New South Wales and the southwest of Western Australia. Australia is a large country extending over 40º of longitude and from latitude 11ºS to 44ºS. The coastline is over 35 000 km long. It is an old dry relatively flat continent with only the eastern, southern and western coastal margins and the extreme north receiving adequate but very variable rainfall.

So it is not surprising that Australians want to live on the coast – much of the inland is a very arid environment.

The major river system, the Murray-Darling, now discharges very little water and no beach forming sediments into the sea.

Australia's coastal zone includes several quite different coastal environments, defined by their dominant geological and geomorphological characteristics – indeed eight significantly different major coastal environments have been identified.

Tides are also very variable – ranging from semidiurnal in northern Tasmania to diurnal in the Gulf of Carpentaria. Tidal ranges in Western Australia are about 1m at Fremantle but may reach about 10m at Broome.

Now for some history ...

Ports and Harbours

Early times to Second World War

The early British colonial settlements were established on the coast where sheltered natural harbours existed – for example Hobart in the Derwent River estuary in Tasmania.

Apart from wharves, such as these in Sydney Cove, no significant structures were required.

The discovery of coal in 1797 at Newcastle, 120 km north of Sydney, led to the establishment of a port inside the mouth of the Hunter River. About 1820 construction of Australia's earliest known coastal engineering structure, a convict-built stone breakwater linking a nearshore island to the mainland on the exposed southern side of the river mouth, was commenced. Lack of funds and stormy seas prevented its completion.

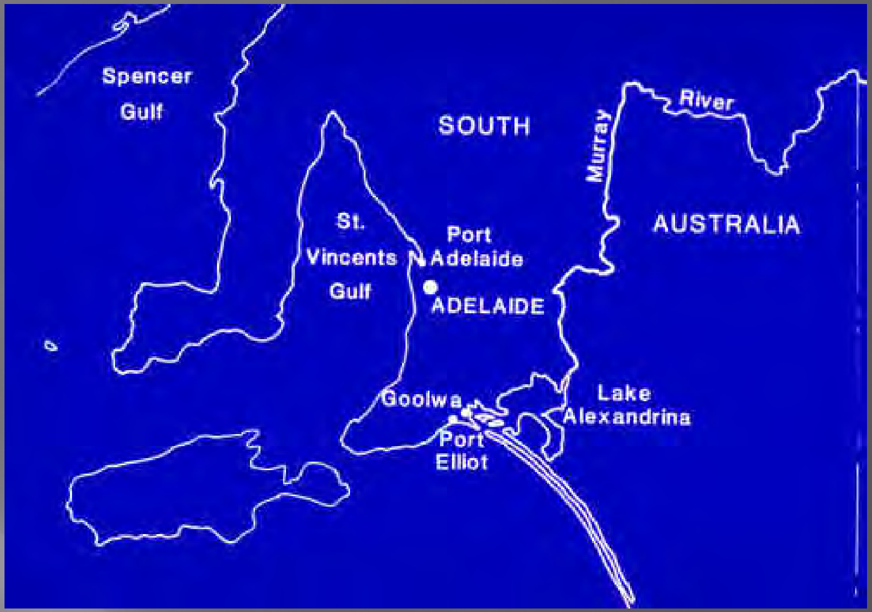
During the first Australian gold rush period in the 1850s the South Australian government tried to capture trade to the inland Victorian gold fields by encouraging river boat traffic on Australia's largest river, the Murray.

Apart from the difficulties associated with navigating the river, there was the problem of transferring cargo to and from ocean-going ships at the shallow mouth of the Murray, which was completely unsuitable for navigation. Indeed in recent times only a hovercraft would have been able to enter the river mouth.

The river port of Goolwa was linked to Port Elliot on the coast by Australian's first public railway – a horse-powered system.

A breakwater was constructed to provide shelter for the relatively small ocean-going ships of that time. The method of construction was a novel but typically Australian one and was described at a discussion of breakwater design and construction at the Institution of Civil Engineers in London in 1858.

Murray River – SE SA



Granite rocks of 2 to 7 tonnes were quarried from a nearby headland, transported along a rail track, which was progressively extended over the breakwater mound, and dumped. The natural slope of this dumped rock was about 1 on 2. This slope was not stable when subjected to large waves and the breakwater was damaged by a storm shortly after its completion. It was not repaired.

This structure was the forerunner of many similar structures.

River Entrances in NSW

Expansion of European settlement along the northern coast of New South Wales during the second half of the 19th century led to the establishment of towns in the various coastal river valleys. These were almost always located on the estuaries of the rivers, often at the upstream limit of navigation at that time. Transport to and from these centres was by sea with coastal shipping entering the rivers and using their tidal waterways to reach the towns. As ships became larger and more numerous and shipwrecks more frequent, the need to provide for the safe navigation of the often unstable, shallow and dangerous river entrances became urgent.

There was considerable difference of opinion among engineers as to how this should be done. The early British and Irish engineers were well aware of the influence of tides and offshore currents but it was sometime before the significance of wave-induced sediment transport at those river entrances was recognised.

One of the first engineers to accept that "*the battle is to be fought with the waves*" was Walter Shellshear, a railway engineer, who studied the improvement of "*these bar-bound rivers*" in his spare time. Shellshear deduced that the formation of sand bars at the entrances of the New South Wales rivers was mainly due to wave action stirring up sand in shallow water and the incoming tide then transporting this sand into the estuary and depositing it there. The outgoing tide, not being assisted by the waves, was unable to return the sand seaward and so the estuary tended to close completely unless runoff from the upstream catchment was sufficiently large to remove the bar and reopen the river entrance.


Walter Shellshear

Shellshear corresponded with Sir John Coode, engineer in chief for the British Admiralty who had made two visits to Australia to advise on port developments for the various Colonial Governments. Coode advised him that the wave stirring action was negligible in depths greater than 6 m.

Shellshear concluded that river entrance training walls (jetties in American terminology) should extend to at least this depth and that their alignment in plan should concentrate the scouring action of the ebb tide and upland runoff. Recognising that each river needed to be considered individually, Shellshear believed that the key to success in resolving this problem involves; *The close observation of physical features and effects, and the adoption of means to assist the operations of Nature instead of opposing them.*"

Richmond R. Entrance, Ballina

These principles were applied by the New South Wales Public Works Department to the Richmond River entrance at Ballina. The works were constructed over a period of 20 years beginning in the 1890s.

Even before their completion the depth of water over the bar had been significantly increased and the entrance had been transformed from being dangerous and frequently impossible to navigate into one of the most easily accessible on the coast.

Sixty years later in 1968, in one of the earliest Australian papers presented to an International Conference on Coastal Engineering, Cyril Floyd reviewed the behaviour of the various New South Wales river entrances and concluded that, while the training works had improved conditions for navigation, they had not resulted in any appreciable increase in bar depths, since the bars had eventually reformed seaward of the training walls. His final comment on these river entrances was both understated and prophetic –

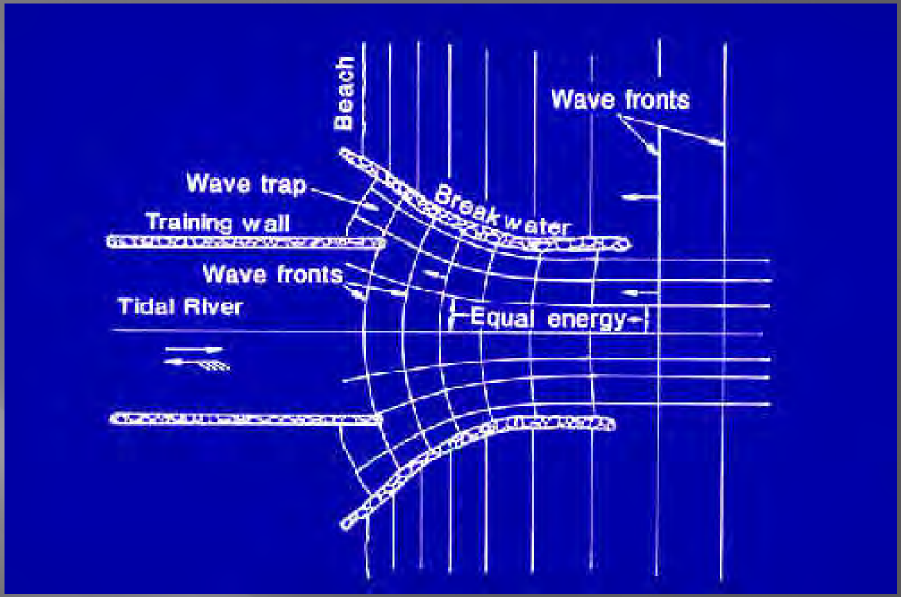
"Detailed examination of littoral drift behaviour in areas adjacent to the entrances where bars have been removed would probably reveal some interesting information."

Cyril Floyd

Training works were constructed at most river entrances in northern New South Wales although the construction of the north coast railway in the 1920s resulted in the collapse of the coastal shipping trade using them.

Only at the coal and steel city of Newcastle was major port development required. Here, the effects of both the alignment of the coastline and the location of the river mouth in the lee of a headland combined to produce wave exposure from the south and sand transport from the north. There was also a rock bar restricting the channel depth.

The breakwater system was developed to overcome these problems. A feature of the completed harbour works at Newcastle and other river entrance works in New South Wales was the use of wave traps to dissipate waves propagating up the entrance channel.



wave traps

Fremantle Harbour

Fremantle Harbour

On the western side of the continent major gold discoveries were made in the 1890s. The Western Australian government embarked upon a large scale programme of public works. Chief among these works was the construction of a new harbour at Fremantle, the entry port for southwestern Australia and the nearby capital city, Perth. Sir John Coode, fearing significant alongshore sand movement, had recommended a harbour formed by an offshore breakwater with an open jetty (pier) connecting the wharves to the mainland. However, Charles O'Connor, the newly appointed Irish born Chief Engineer and recently arrived from New Zealand, decided that sand movement was not significant at this site and instead proposed locating the harbour in the mouth of the Swan River.

His proposal was approved and he duly completed this major project, involving construction of two new breakwaters, removal of a rock bar, dredging and provision of wharves.

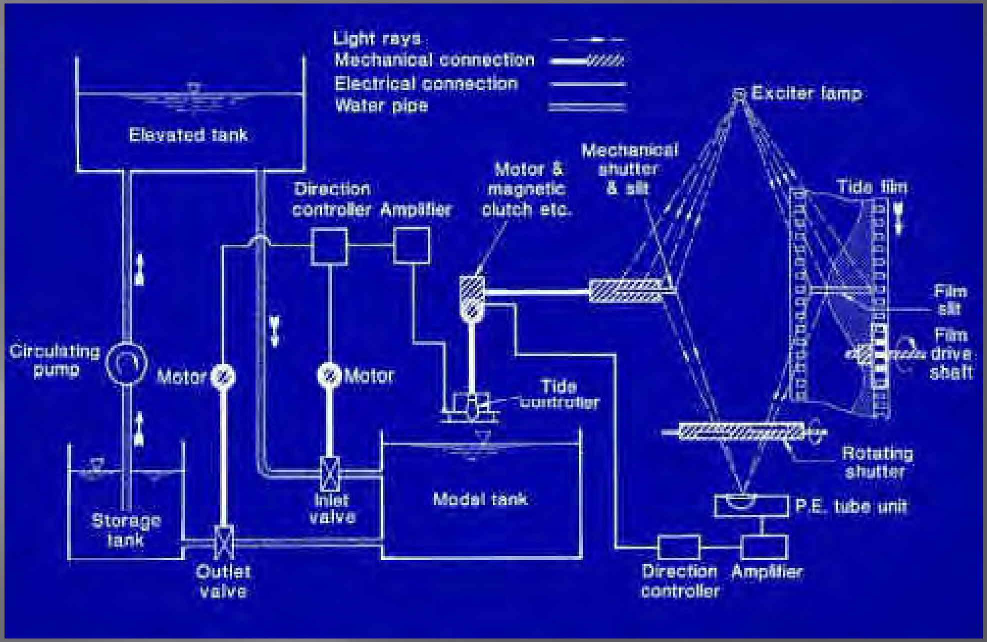
O'Connor is unique among Australian engineers for, despite his being in the country for only eleven years, there is not only a statue at Fremantle, commemorating him and his work, but also a C.Y. O'Connor museum devoted to his greatest project, the 565 km long water supply pipeline to the gold fields at Kalgoorlie. This unusual recognition is probably a consequence of the fact that, because of the stress brought on by political pressure and public criticism, O'Connor rode out on the beach near Fremantle harbour one morning a few weeks before the opening of the gold fields pipeline and shot himself.

O'Connor memorial

Hydraulic Models Era

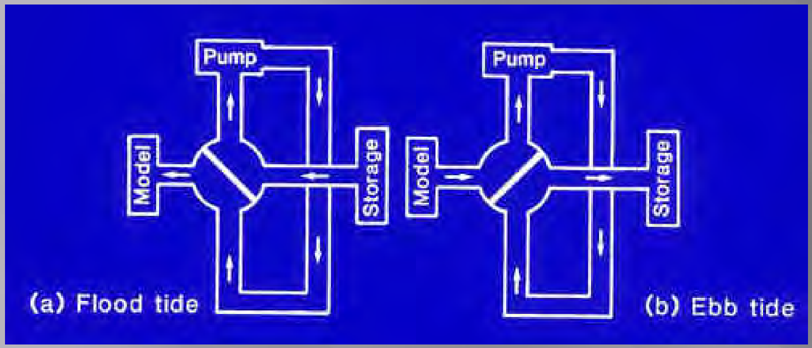
Estuarine Ports

During the 1930s difficulties were experienced in maintaining navigable channels for various Australian estuarine ports. The Tamar estuary in northern Tasmania provided access to the port of Launceston. Larger ships and difficult tidal currents required improved navigation conditions and the Marine Board of Launceston built the first estuarine hydraulic model in Australia in 1939-40.



Tide generator

No results were produced because of World War II but very advanced electrical and electronic technology was developed locally in Australia to generate, control and measure the model tides. This model was the forerunner for the development of various facilities for coastal and estuarine hydraulic models in Australia during the 1950s. Not all were funded as generously as the Tamar estuary model and considerable ingenuity had to be employed by Australian engineers to develop appropriate wave and tide generating equipment and associated measuring instruments.



4-way valve circuit

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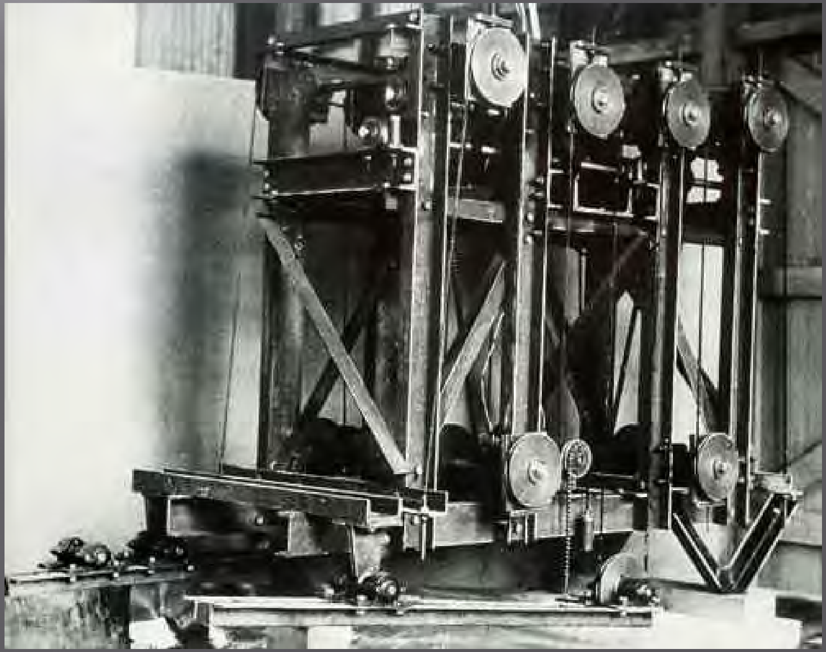
An early post World War Two example was the Fitzroy River model for the port of Rockhampton in Central Queensland, which was constructed in Brisbane by Gordon McKay and Dick Watkins of the University of Queensland.

The tide generator was unique, employing a servo controlled 4 way valve to divert water in and out of the model.

The valve itself was controlled by a mechanical tide synthesiser similar in principle to the mechanical tide prediction machines used before the advent of the digital computer.


Tide synthesiser

Waves and Coastal Processes

Port Kembla and Portland Harbours

Coastal engineering developed as a distinct branch of civil engineering following the second World War. New and more complete understanding of ocean waves; - their generation, propagation and transformation in coastal waters – had been gained during war time research in USA and UK on the marine conditions affecting the numerous amphibious landings in Europe and the Pacific. The new techniques of meteorological analysis, wave hindcasting, refraction analysis and later wave recording now were available for the design of harbours and the understanding of coastal processes.

Port Kembla ca 1950

One of the first Australian application of this new coastal engineering expertise was a study of wave penetration and ship-ranging problems at Port Kembla harbour, which services the steel works and coal fields in the vicinity of Wollongong, 75 km south of Sydney. The outer harbour was constructed during the first quarter of the 20th century. During the late 1940s ship-ranging, that is horizontal movement of moored ships in response to long period waves, became a problem. On an average of 10 or 11 days a year vessels had to leave their berths and either anchor in the harbour or put to sea.

Port Kembla model

In 1951 a wave penetration model of Port Kembla harbour was constructed by the New South Wales Public Works Department at Manly Vale in the northern suburbs of Sydney. It was the Department’s first coastal model.

A second distorted scale model was used to study the natural periods of oscillation of both the existing outer harbour and the then proposed inner harbour. The facilities constructed for this investigation provided the nucleus for the development of what is now the Manly Hydraulics Laboratory of the New South Wales Department of Public Works and Services.

In 1957 the University of New South Wales established its Water Research Laboratory on the opposite side of the creek at Manly Vale, both laboratories using water from the old Manly water supply dam located a short distance upstream.

Doug Foster

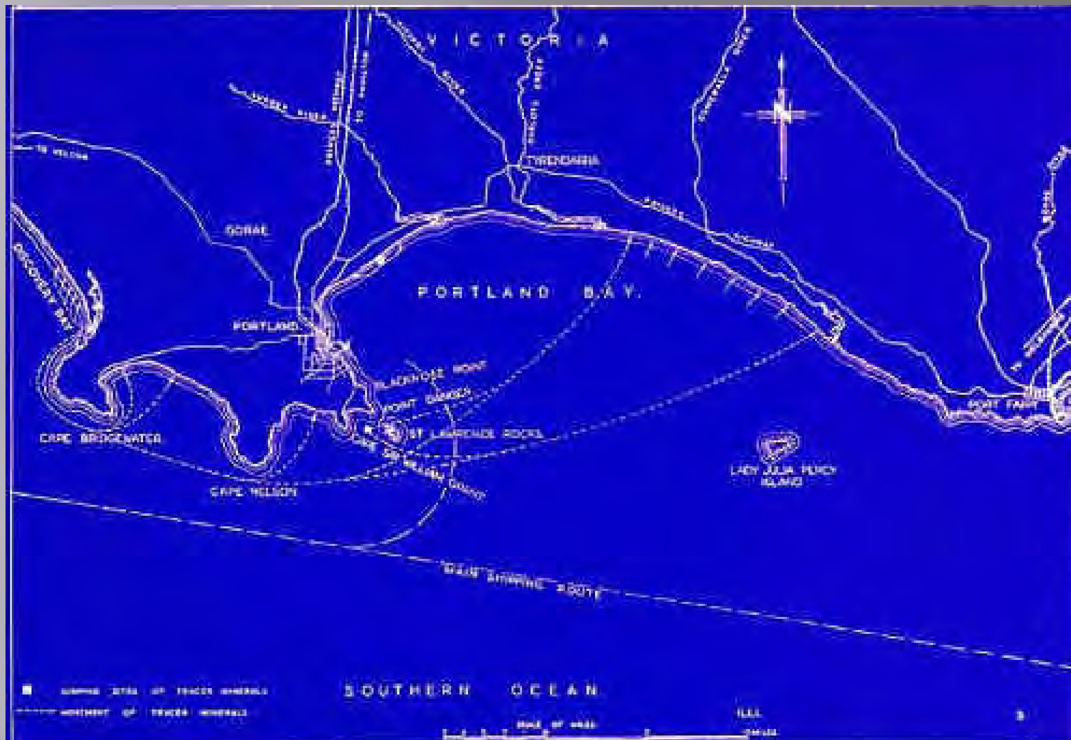
Doug Foster, who had previously been at the Public Works laboratory, was the first engineer at WRL, continuing there as it developed and becoming its first Director, a position he held until his retirement in 1987. The two Manly Vale laboratories and their various coastal engineering research and investigation projects have provided a focus for coastal engineering in New South Wales and also the facilities for both post graduate research and continuing professional development for many of Australia’s coastal engineers. While not the only person involved, Doug Foster’s contribution to the development of coastal engineering in Australia has been uniquely outstanding.

Portland 3D model

Portland harbour in western Victoria was another of the early Australian projects designed using these new coastal engineering techniques. Portland was the site of the first European settlement in Victoria in 1834 and was well located to service the agricultural and pastoral development of western Victoria. Earlier proposals for constructing a harbour had not been implemented. The harbour is located in a relatively sheltered corner of an open coast which is subjected at times to severe storms and very large long swells. Meteorological data, wave hindcasting using the methods of Sverdrup and Munk, hydrographic surveys and graphical wave refraction diagrams were used to determine the design waves for the harbour. A float in a perforated well recorded long period waves at the harbour site. Both the wave recorder and its supporting pile were washed away in a storm "*while recording its last and greatest wave.*"

Three dimensional and two dimensional wave models were built in a building on site at Portland. In the three dimensional model pneumatic wave generators reproduced both short and long period waves and particular care was taken to build the model breakwaters with sufficient porosity to allow for wave transmission through them.

Breakwater stability was tested in the two dimensional wave flume. Tetrapods were tested for armouring the breakwater but were not used in actual construction since sufficient large armour stone was obtained from the nearby quarry.



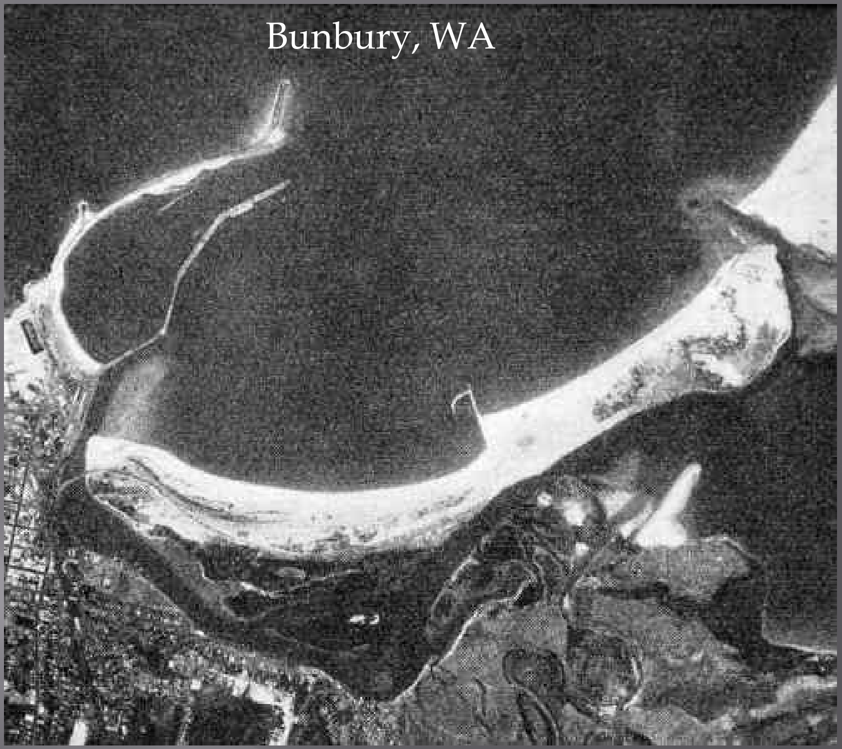
Portland map tracer study

Another harbour 75 km east of Portland had experienced severe sedimentation and geologists undertook tracer studies using heavy minerals to determine whether Portland would have a similar problem. These experiments showed a strong movement of sand from west to east but it bypassed the harbour site. It was concluded that there would be no sedimentation or coastal erosion problems.

Experience over the following thirty years showed this conclusion was wrong and a sand bypassing system was installed during the 1990s.

Littoral Drift and Crenulate Bays in Western Australia

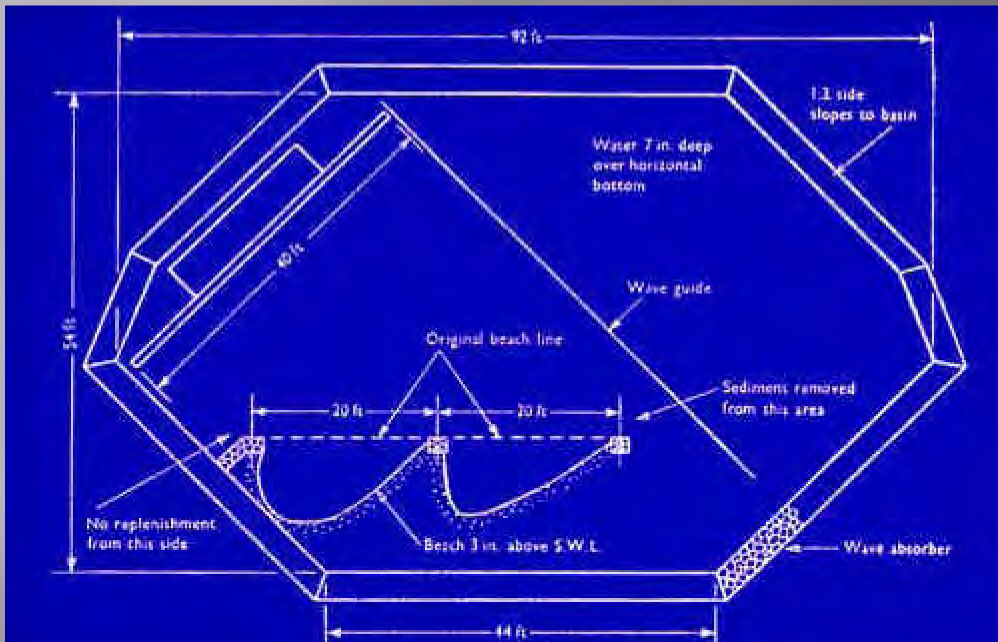
Alongshore sediment transport may not have been identified as important at Portland but at Bunbury in Western Australia it was another story. A jetty for general cargo handling was first constructed in the 1860s and progressively lengthened as more and larger ships visited the port. Thirty years later a breakwater was built to protect the jetty and both jetty and breakwater continued to be extended up to the early 1950s. A major reason for this was continuing sedimentation in the berthing area. The largest but not the only source of sediment was littoral drift from the south coming around the end of the breakwater. No satisfactory solution had been found for this problem and so it was referred to the Civil Engineering Department of the University of Western Australia where Dick Silvester commenced a series of wave hindcasting, refraction and hydraulic model studies to understand and hopefully solve the problems of Bunbury Harbour.


Bunbury, WA


Dick Silvester

Wave basin, wave generator and other equipment were designed and constructed locally. These facilities were used subsequently to study the location of a groyne at Cottesloe north of Fremantle harbour and to investigate the stable alignment of a coast between two headlands.

Later Silvester developed, with the assistance of Japanese colleagues, the concept of headland control for stabilising coastlines. However, apart from a few small scale applications like this one in Cockburn Sound WA, headland control has not been adopted by Australian coastal engineers. The results and applications of this research were brought together in his two volume text book "Coastal Engineering" published in 1974.



model basin

In the 1960s and 1970s Dick Silvester was a tireless advocate for coastal engineering research to be supported by both governments and the engineering profession in Australia and he was a foundation member and second chairman of the National Committee on Coastal and Ocean Engineering.

Breakwater Stability

One aspect of research undertaken at the Manly Vale laboratories concerned the stability of rubble mound breakwaters. Because of the availability of suitable quarry stone close to many ports on the Australian coast, rubble mounds have been commonly used for construction of harbour breakwater and river entrance training walls (jetties). Initially the technique simply involved construction of a railway line from the quarry to the breakwater site and the progressive dumping of sufficient rock to construct a mound of the required height and length. As the rock settled into the sand and the waves flattened the side slopes of the mound, continuing dumping of rock allowed the structure to be maintained. This work required a regular budget allocation for maintenance work and so ensured continuing employment for a certain number of persons in the local community.

Over time the exposed faces of major breakwaters were armoured with heavier rocks which reduced the amount of reconstruction required after storms and facilitated repairs or extension of the breakwater head.

In the 1970s various innovations were investigated such as composite breakwaters using both tribars and dolosse and self shaping berm profile structures formed from mining waste.

Rosslyn bay breakwater after Tropical Cyclone David

In 1976 a breakwater at Rosslyn Bay on the central Queensland coast was severely damaged during a tropical cyclone. Laboratory experiments at Manly Vale simulated the mode of failure and showed that, in locations where high tides and large storm surges cause overtopping, there is a critical combination of wave height, wave period and storm tide level which causes most damage to the breakwater.

In the 19th century open jetties (piers) were constructed in various places. Coalcliffe on the New South Wales coast south of Sydney was a coal loading jetty, while this one in northern Western Australia was used for handling general cargo.

These jetties were constructed using readily available Australian hardwood timbers, some of which are resistant to attack by marine borers.

In some cases the structures were very long – up to 2 km – because of very flat inshore sea bottoms. Construction was land based with the structure being progressively extended from the shoreline out to the required water depth. Shipping berths were located at the outer end.


Abbot Point coal loading facility

In the 1970s several offshore loading facilities for exporting coal or sugar were constructed in north Queensland with lengths from about 2 km to almost 6 km. Initially concrete piles were used but later structures used open ended thin walled tubular steel piles with diameters of the order of one metre.

Large wave heights, significant tidal ranges and potential storm surges of several metres make the worst possible conditions for these structures very severe. Careful assessment of risk was required when determining design wave and water level conditions.

COASTAL PROTECTION AND COASTAL MANAGEMENT

Coastal Erosion Problems

When European settlement began in Australia all lands were deemed to belong to the Crown. The indigenous inhabitants were not consulted about this and there has been consequent conflict since then concerning their rights to land ownership. Moreover, the colonial governors were directed to reserve lands fronting the coast and navigable streams for public purposes. This is still one of the main coastal planning principles applied today in Australia. Where freehold title does extend to the coast its seaward limit is high water mark. The beach remains in public ownership.

In Victoria there is a general reservation of 30 m width along 95% of the state's coastline. However, uses made of this reservation for public purposes included camping areas, private bathing boxes and boat sheds, amusement parks and car parks, toilet blocks and sporting facilities.

Hence, it is not surprising that coastal flooding and erosion problems were occurring in the 1930s along the eastern shore of Port Philip Bay where Melbourne's bayside suburbs are located. Similar problems occurred elsewhere, particularly after World War Two with the increasing use of motor cars and the movement of retirees from Melbourne and Sydney to new coastal developments in northern New South Wales and southern Queensland.

Adelaide Beaches

In South Australia a Beach Erosion Assessment study of the Adelaide City beaches was made at the University of Adelaide by civil engineer Bob Culver. His report, completed in 1970, concluded that the Adelaide beaches were running out of sand with a northward net littoral drift of 30 000 cubic metres per year and no major continuing replenishment at their southern end. The initial solution was to recycle sand from the downdrift northern beaches back to the eroding southern beaches using trucks. In the late 1980s a suitable offshore sand source was found and replenishment now is carried out biennially by trailer suction dredge.

Bob Culver

Waves eroding Brighton Beach

Bob Culver's work was not just technical. He advised the South Australian Government in the drafting of the Act setting up that State's Coast Protection Board, which was established in late 1972, and he was a long serving member and sometime chairman of it. He was the first chairman of the National Committee on Coastal and Ocean Engineering when it was established in 1971 and he has been widely honoured for his service to Government and Industry, to his University and to the Engineering Profession.

Southeastern Queensland

In southeastern Queensland rapidly expanding coastal developments were occurring on the Gold and Sunshine coasts, south and north of Brisbane, and beach protection became an important political issue in the early 1960s. The State government sought technical assistance from the Delft Hydraulics Laboratory which prepared a comprehensive report, known locally as the Delft report. It was completed in December 1970.

Beach erosion Gold Coast, Brian McGrath

Much of the detailed work in this report was done in the Netherlands by a young Queensland government engineer, Brian McGrath.

However, a series of storms, culminating in severe erosion all along the Gold Coast during 1967, had already brought action by the Queensland Government with the proclamation of the Queensland Beach Protection Act in July 1968, just six days after the death of its principal architect, chief engineer John Kindler. This Act set up the Beach Protection Authority (BPA).

Using the Delft report as a guide for their work, BPA engineers carried out comprehensive investigations of coastal processes for several other sections of the Queensland coast.

An extensive data collection network was set up with a state wide wave recording system using wave rider buoys and a network of storm tide recorders for warning of impending disaster from tropical cyclone–induced storm surges.

Rock wall Palm Beach

Beach erosion problems on the Gold Coast were the result of a combination of causes. In some places houses built on frontal sand dunes required construction of boulder walls to protect them with consequent loss of the beach in front of them.

Construction of training walls (jetties) at the mouth of the Tweed River by the New South Wales Government in the early 1900s and their extension in 1962 had had its inevitable effect on the downdrift beaches of the southern Gold Coast.

Public and political pressure for action to resist the continuing coastal erosion demanded the construction of physical structures such as groynes, despite engineering advice that such structures alone could not solve the Gold Coast's erosion problems.

Kirra Point groyne

In Australia beach protection works are generally the responsibility of the Local Authority under the overall direction of the State governments. The Gold Coast City Council commenced beach replenishment in the mid 1970s initially taking sand from estuarine sources. This was not always successful, nor was there sufficient sand available so offshore sources were sought and eventually during the late 1980s the southern Gold Coast beaches were partly replenished by large scale offshore dredging and sand pumping.

Detailed examination of the littoral drift behaviour along the coast up and downdrift of the Tweed training walls had, as Cyril Floyd had predicted, revealed "*some interesting information.*" Large volumes of sand were trapped updrift in New South Wales and there was an eroding shoreline downdrift in Queensland.

Accretion Tweed Entrance

Gold Coast Seaway

Hence, when it was decided to stabilise the northward–migrating entrance of the Nerang River at the northern end of the Gold Coast, a full coastal processes investigation, as well as the usual hydraulic and structural investigations, was made. An average but highly variable net northward alongshore sand transport of 500 000 cubic metres per year required the installation of a sand bypassing system with sufficient capacity and flexibility to cope with these conditions. The Gold Coast Seaway project was completed in 1986 and is one of Australia’s most significant coastal engineering projects.

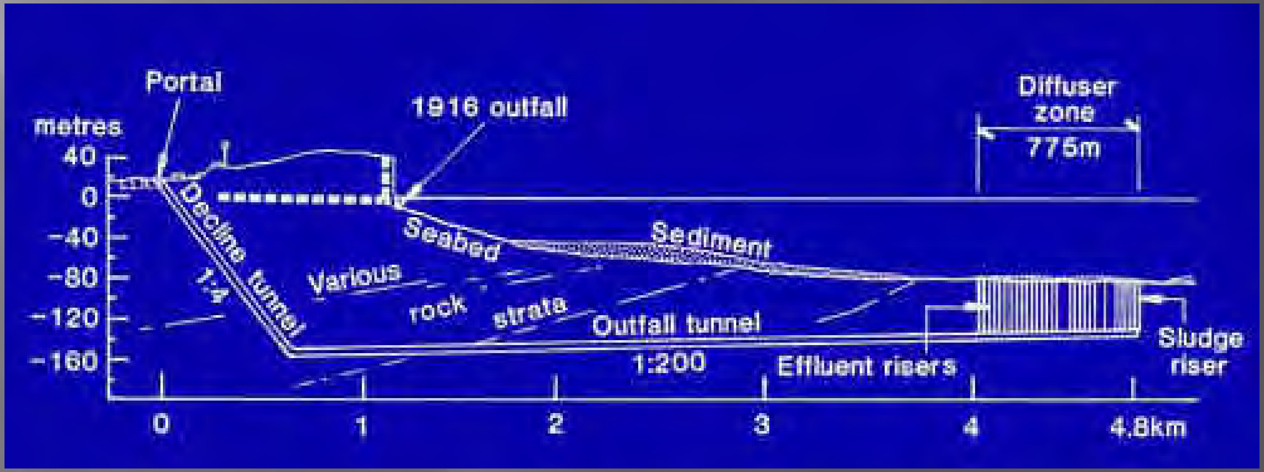
SUSTAINABLE USE OF THE ENVIRONMENT

The focus of our History of Coastal Engineering in Australia now turns to the sustainable use of the environment. As we all are still actively involved in doing this, I shall mention briefly only three projects.

In the 1970s a number of multidisciplinary studies of the marine environment were made in Victoria. Coastal engineers were active participants along with a wide range of scientists.

At the same time the environmental impacts of ocean disposal of Sydney's sewage were becoming of increasing concern and, after considerable investigation, it was decided to replace the three existing shallow water outfalls with deep water ocean outfalls involving the construction of tunnels up to 3.5 km in length. Much engineering expertise was required to implement this solution which was completed in 1991.

Malabar ocean outfall, Sydney



Dawesville Channel

In Western Australia the Peel-Harvey Inlet system, 70 km south of Perth became a major political and environmental issue during the 1980s. Excess nutrients from agricultural activities in its catchment had created eutrophic conditions and ultimately infestation by the blue green alga *Nodularia*. A significant component of the management strategy was the construction of a second channel connecting the inlet to the ocean so as to increase tidal flushing and enhance the marine character of the estuary, hence inhibiting the growth of algae.

Dawesville channel was a major coastal engineering project, including significant excavation, construction of breakwaters, training walls, a bridge and installation of a sand bypassing system. It was completed in 1994.

A Lesson from History

I began this address with an example of a successful coastal engineering structure- the light house at North Reef in the southern Great Barrier Reef – which still performs its original function today.

It has been said that *"the one thing we learn from history is that we do not learn the lessons of history."*

About 90 years after that light house was built, Australian government engineers designed a series of Automatic Weather Stations to be built in the Great Barrier Reef and adjoining ocean areas. One of these was located on a small grassed sand cay. In 1975, a few years after its construction was completed, an inspecting engineer reported –*"The cay is high level and grassed so piled foundations were not required."*

Gannet Cay, AWS 1975

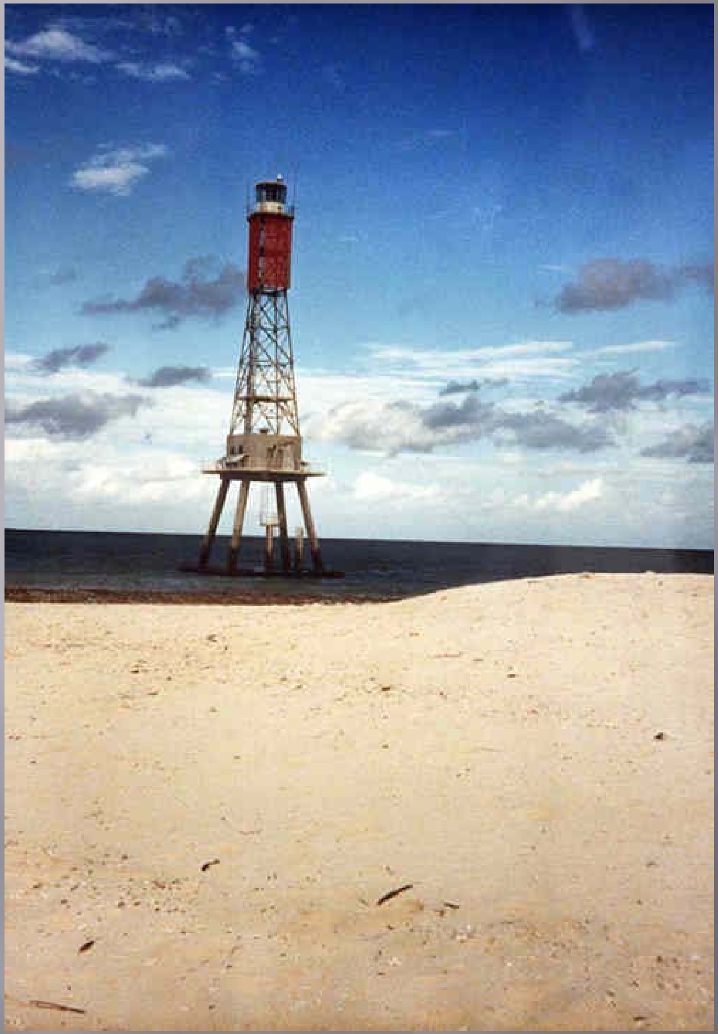
This comment no doubt told the administrators what they wanted to hear – no new expenditure was needed.

Gannet Cay, AWS early 1980s

However, in one of those unpredictable moods of the marine environment there was a shift in the dominant wind and wave directions during the late 1970s and the cay started to erode rapidly. The engineers were forced to redesign the structure supporting the weather station.

A new piled foundation structure was built and the weather station moved across onto it. Within a year erosion had progressed sufficiently for the old foundations to begin to subside until they rested on the reef flat.

A failure – clearly the designers of the original structure did not fully understand the coastal processes associated with small reef-top islands nor had they taken notice of the lessons to be learnt from the lighthouse which was firmly founded on the reef-top.



Creal Reef navigation aid

However, what concerns me and should concern all of us now is that the engineering organisation that designed these structures no longer exists, having been restructured, downsized and finally outsourced. Its experienced staff have been dispersed and its records either archived or possibly destroyed.

Who now will pass on the lessons of history, or even record that history, for the benefit of future coastal engineers?

For further information see:

- Coltheart, L (1997). Between Wind & Water – A History of the Ports and Coastal Waterways of New South Wales. Hale & Iremonger, Sydney, 208p.

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