

CHAPTER 340

Tweed River Sand Bypass: Concepts and Progress

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ABSTRACT: The objectives of the Tweed River Entrance Sand Bypassing Project on Australia's east coast are to establish and maintain a navigable entrance to the Tweed River and to enhance and maintain the southern Gold Coast beaches, with the objectives to be achieved in perpetuity. The joint project of the New South Wales and Queensland State Governments with the support of the Gold Coast City Council offers the opportunity to achieve this co-operatively in partnership. Agreements have been established. The environmental impact assessment of the first stage (initial dredging and nourishment) has been completed, and the first component of these works involving over 2.2Mm³ of sand was successfully completed in August 1996. Environmental impact assessment and design studies for the second stage (the permanent bypassing system) are in progress. The paper describes the overall project and its key features, the investigations and analyses undertaken to date, the identified impacts, the initial dredging and nourishment works, and the issues being investigated for the permanent system.

INTRODUCTION

The Gold Coast-Tweed Heads region (28°S, 153.5°E) on Australia's east coast is a major international and national tourism destination, and a significant growing recreational and residential area, with a unique coastal environment. The beaches are subject to cyclonic(hurricane) and storm waves, and are characterised by a

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predominantly northwards longshore sand transport averaging 0.5 million cubic metres (Mm^3) per year net, which is driven mainly by the predominant easterly and south-easterly waves (median significant waveheight: 1.4m, median peak period 9s). The beaches are composed of clean fine-grained quartz sand with median diameter of 0.22mm. Mean spring tidal range is 1.3m.

The Tweed River entrance which influences the continuity of the natural littoral system has been plagued by mobile sandbars which have endangered navigation since the early 19th century. Entrance training walls (rock jetties) started in 1890 offered only short-term relief. From 1962 to 1965, the training walls were extended seaward 380m to aid navigation of the entrance. These walls reduced sand transport past the entrance, Letitia Spit to the south of the entrance accreted (total accretion to 1995 of over $7Mm^3$ has filled the walls), and the downdrift southern-most beaches of the Gold Coast experienced erosion (Macdonald and Patterson, 1984). Major beach nourishments totalling over $6Mm^3$ have been successful in substantially offsetting the erosion of these beaches (Murray et al, 1993 and 1994).

Following separate and joint studies by the responsible authorities, and complex negotiations with four jurisdictions, agreement was concluded between the State of New South Wales and the State of Queensland to undertake the Tweed River Entrance Sand Bypassing Project which impacts on both States. It is being supported by the local city, the City of the Gold Coast (Murray, Brodie et al, 1995).

The project agreements are:

- (a) the Heads of Agreement signed on 31 March 1994 by the Premiers of New South Wales and Queensland; and
- (b) the formal legally-binding Deed of Agreement signed by the responsible Ministers on 2 March 1995.

The New South Wales Parliament has enacted ratifying legislation (the *Tweed River Entrance Sand Bypassing Act 1995* (NSW)), and similar legislation is proposed in Queensland.

OBJECTIVES, PRINCIPLES, AND BENEFITS

The objectives of this joint project (to be achieved in perpetuity) are to:

- (a) improve and maintain the navigability of the Tweed River entrance (in New South Wales); and
- (b) improve and maintain the southern Gold Coast beaches (in Queensland).

The project comprises two inter-related components:

- (a) an initial dredging of the bar and entrance area and beach nourishment; and
- (b) an artificial sand bypassing system, to operate in perpetuity.

The benefits are anticipated to include:

- (a) the improvement in the safety of navigation of the river entrance with the consequent benefits to recreational boating, tourism, property values and the fishing industry;
- (b) improved tidal flushing of the river estuary, improved water quality, and mitigation of flooding; and
- (c) the restoration, widening and long-term maintenance of the beaches, with associated benefits to tourism, recreation, property values and the reduction of erosion threats.

To achieve early benefit, initial dredging and nourishment was scheduled to be undertaken while permanent bypassing system options and impacts were being investigated and assessed.

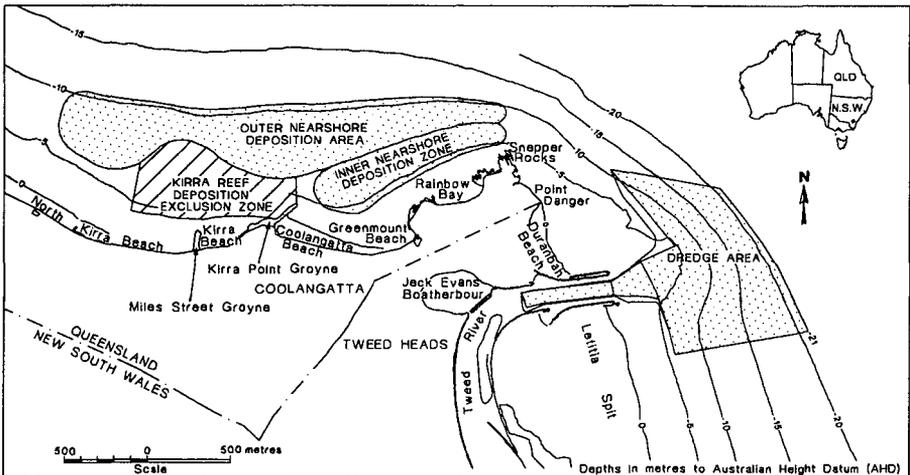


Figure 1: Location diagram, showing approximate dredging and nourishment areas

INITIAL DREDGING AND NOURISHMENT (STAGE 1)

The initial dredging and nourishment involves about 2.5Mm³ of sand to be dredged from the entrance and placed on the beaches. The environmental impact statement (EIS) was prepared to comply with the requirements of both States. Following exhibition of the document, public meetings and the receipt of twenty-six submissions, an EIS Submission Review Report addressed the submissions received and made recommendations for actions, monitoring and an Environmental Management Plan.

Impacts and issues identified included:

- (a) increased operational window for fishing trawlers traversing the bar;
- (b) improved ability of beaches of Rainbow Bay, Greenmount, Coolangatta, Kirra and North Kirra to withstand storm erosion;
- (c) improved flushing of the lower estuary, to result in improvement in water clarity, nutrients and bacterial loads;
- (d) restoration of nearshore bathymetry to a condition similar to pre-1960s (pre-wall extensions) condition enhancing conditions for beach users;
- (e) slightly increased tidal range in the estuary (high waters increased by up to 0.04m with possible impact on saltmarsh habitat and roosting and nesting sites for birds, and low waters lowered by up to 0.12m with possible impact on seagrass areas);
- (f) erosion of up to 75m from the previously accreted shoreline at the northern end of Letitia Spit;
- (g) changed surfing conditions;
- (h) concern regarding possible effects on the rocky reef community of Kirra reef if the nourishment produced conditions outside the natural range of seabed fluctuations;
- (i) potential disturbance by noise from booster pumps and mechanical equipment during upper beach nourishment; and
- (j) possible wrecks in the dredge area.

Each of these issues has been considered in detail and, where appropriate, modifications have been made to the scope and extent of the work (Brodie et al, 1995).

The lowest of six tenders(bids) from Australian and international companies for the first part of the initial dredging and nourishment (Stage 1A) was accepted. Dredeco undertook the work using three dredgers in successive campaigns from 26 April 1995 to 20 August 1996, transferring over 2.2Mm³ of sand.

The greater proportion of the work was carried out by the (144m long) *Pearl River*, the world's then largest trailing suction hopper dredger. In a six week campaign, it dredged up to approximately 9,000m³ of sand each load in typically four sweeps. The original design slope was modified to allow bench dredging to a similar volume and shape. The *Pearl River* dredged the bar and entrance area to the limits set by its draft. It deposited 0.93Mm³ through the bottom-opening doors to a predetermined profile in the outer nearshore deposition area with an upper level of minus 7m Australian Height Datum (AHD, approximately mean sea level). A further 0.59Mm³ was pumped onto the upper beaches through a single point mooring connected to a 750m long, one metre diameter submerged pipe, which came ashore at Kirra Point, and linked to alongshore pipelines which extended from Kirra Point to the limits of beach nourishment at Rainbow Bay and North Kirra.

The shallower bar areas were dredged by the smaller trailing suction hopper dredger, the *Ngamotu* which has a length of 61m, draft of 3.5m fully laden and a hopper capacity of 490m³. The *Ngamotu* established a channel through the bar, increasing the ruling depth over the bar from less than 4m AHD to more than 6m AHD, thus allowing access by larger dredgers. During suitable conditions from May to November 1995, it dredged 0.17Mm³ and placed this sand in the inner nearshore deposition area to an upper level of minus 4.5m AHD.

Subsequently, in two campaigns in January/February and July/August 1996, the 2,300m³ capacity split-hull trailing suction hopper dredger, the *Krankeloon*, removed a further 0.56Mm³ and placed this in the inner nearshore deposition zone (0.12Mm³), the outer nearshore deposition zone (0.39Mm³), and an eastwards extension of the nearshore deposition zones around Snapper Rocks (0.05Mm³).

Further dredging and nourishment (Stage 1B) is expected to be carried out in late 1997 following monitoring of the results of this work and assessment of maintenance requirements.

PERMANENT BYPASSING SYSTEM (STAGE 2)

The permanent bypassing component consists of the design, manufacture, supply, delivery and commissioning of a sand bypassing system and the continuing operation of that system including replacement of the capital equipment. Its purpose is to facilitate the natural littoral sand movement processes by conveying past the river entrance the net littoral transport which occurs at the northern portion of Letitia Spit, so as to maintain a clear navigation channel of at least 4.5m AHD and maintain a continuing supply of sand to the beaches.

Artificial sand bypassing alternatives include jetty(pier)-based systems, mobile (jack-up) systems, floating plant, and traditional dredgers. A mobile system could overdredge a buffer during low transport periods to assist in intercepting some of the sand which would otherwise be missed. A mobile system should in principle be capable of bypassing 500,000m³ per year, even though some is missed from time to time. Fixed jet-pump bypassing system options (such as used at the Gold Coast Seaway 28km to the north where 4.5Mm³ has been bypassed in the first 10 years) would require fundamental modification or augmentation because there is no buffer sand trap at the project site as, for example, provided by the Seaway training walls (Coughlan and Robinson, 1990), and fixed systems rely on, and are limited by, natural processes in bringing sand to the intakes. No system can be totally effective in intercepting all of the sand transport, particularly during storm/cyclone events when operations may have to be curtailed and sand transport may be very high. Some allowance will have to be made for sand not captured by the system before it reaches the Tweed entrance or which escapes from the operational area of the system. (Robinson, 1993).

The delivery locations are expected to be Snapper Rocks (major quantity), Kirra Point (possible on demand capability), and Duranbah Beach (possible minor quantity capability). As natural sand transport around Snapper Rocks and across the Rainbow Bay and Greenmount/Coolangatta beaches is characterised by some slug-like spurts overlying a more regular transport, there are likely to be some beach management advantages if sand can be discharged on demand at Kirra, where local shortages of sand occur from time to time. However Snapper Rocks could be a sufficient discharge site, provided a suitable discharge mechanism was designed, and operation of the bypassing rate was managed in accordance with changing transport rates. The long term average net littoral transport rate is currently understood to be 500,000m³ per year, but analysis suggests that it can vary between 270,000m³ and 900,000m³ in any single year. The delivery of sand will match the long term average net littoral transport, but will take account of the annual variations in quantities of sand delivered by natural processes to Letitia Spit and the specific objectives of the project, including coastal process issues of the beaches and the entrance, beach usage and navigation requirements. If the long term average net littoral transport rate changes, the rate of delivery will be changed accordingly.

Other issues to be considered for the system include:

- (a) system reliability and safety in the high-energy, corrosive, abrasive environment;
- (b) outlet design;
- (c) water discolouration (though the sand is clean);
- (d) public safety (for beach and waterway users);
- (e) effects on beach usage (including swimmers, surfers, and anglers);
- (f) visual impact;
- (g) noise;
- (h) operational scheduling;
- (i) performance criteria;
- (j) commercial and contractual arrangements; and
- (k) operational management.

Actions already implemented include the assembly and evaluation of the performance of the Gold Coast Seaway and other existing and planned bypassing systems, a value management study, and the incorporation of data requirements for the permanent system in the current data collection and monitoring program. A comprehensive environmental impact assessment study is in progress, and is scheduled for completion in mid-1997.

CONCLUSIONS

The objectives of the Tweed River Entrance Sand Bypassing Project are to establish and maintain a navigable entrance to the Tweed River and to enhance and maintain the southern Gold Coast beaches, with the objectives to be achieved in perpetuity. The joint project offers the opportunity to achieve this co-operatively in partnership.

The project is located on an open high-energy coastline subject to variable natural forces, in a highly-valued environment, subject to intensive usage. Accordingly, it is recognised that the project must be designed, evaluated and implemented prudently using best practice and in an environmentally sensitive way, if the long-term benefits are to be effectively achieved.

The complex bar dredging and beach nourishment have provided initial benefits, have satisfied strict environmental criteria, and have received widespread public support. Extensive environmental monitoring and public consultation has been incorporated.

The significant engineering, environmental and contractual challenges facing the permanent bypassing system are being progressively addressed.

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