

Environmental Management of the Construction and Operation of a Sand Bypassing System at the Tweed River Entrance

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Abstract

In December 1999, the State Governments of NSW and Queensland awarded contracts to a private consortium headed by McConnell Dowell Constructors (Aust.) Pty. Ltd. for the financing, design, construction, and long-term operation and maintenance of a permanent sand bypassing system at the entrance to the Tweed River. Construction of the permanent sand bypassing system commenced in February 2000 and full-scale operations commenced in May 2001.

Environmental planning approval for the project required the development and implementation of environmental management plans that addressed ongoing monitoring and risk management of significant environmental issues associated with the construction and long-term operation of the system.

Contract specifications for the sand bypassing system, required the development of separate Environmental Management Systems for the construction and operations stages of the project that were prepared in accordance with the Australian Standard AS/NZS ISO14000 series.

This paper outlines the potential environmental impacts identified, the structure and implementation of the Project's Environmental Management Systems, monitoring programs, and results from monitoring during the construction phase.

1. Project Background

The Tweed River is located in NSW near the NSW/Queensland border just south of the Gold Coast (see Fig. 1). The Tweed River Entrance Sand Bypassing Project (TRESBP) is a joint scheme of the NSW and Queensland Governments which was set up to establish and maintain a navigable entrance to the Tweed River and restore and maintain beach amenity along the southern Gold Coast beaches.

In December 1999, contracts were awarded to a consortium led by McConnell Dowell Constructors (Aust) Pty Limited for the design, construction, operation and maintenance of a permanent sand bypassing system until September 2024. Construction of the permanent system commenced in late February 2000 and was commissioned in early May 2001.

The permanent system comprises a 450 metre long sand collection jetty constructed across Letitia Spit beach about 250 metres south of the southern Tweed River breakwater (see Fig. 1). The jetty extends into ocean water depths of about 5 metres. Eleven submerged jet pumps are suspended from the jetty structure and sunk into the beach and seabed. Operation of the pumps forms a trough in the sand bed beneath the jetty to form a sand trap.

Sand collected from the sand trap by the jet pumps is discharged through a 400 mm diameter buried pipeline to feed beaches north of the entrance.

The purpose of the jetty system is to collect as much as possible of the net northerly moving coastal sand before it reaches and accumulates in the entrance area, thereby maintaining a clear navigation channel at the entrance. The majority of sand collected by the jetty system will be delivered to the primary placement area of Snapper Rocks East. To provide flexibility in the sand delivery by the system, discharge outlets have also been established at Duranbah Beach, Snapper Rocks West and Kirra Point (see Fig. 1).

The jetty system has been designed to deliver on average 500,000 m³ of sand each year. Under normal operation this will typically occur over about eight hours each night. The system has the

reserve capacity to deliver at higher rates to clear the jetty sand trap during events such as storms.

Outflanking of a jetty system during severe ocean storms and flooding in the Tweed River, may deposit sand in the entrance area and compromise navigation conditions. The contract agreements make provision for McConnell Dowell to undertake supplementary dredging to clear the Tweed River entrance should this become necessary. Dredging would be carried out using a trailer suction hopper dredge. The dredge would deposit this sand in placement areas along the southern Gold Coast beaches to provide nearshore nourishment (see Fig. 1). Dredging campaigns would typically remove and deposit in the order of 200,000 to 300,000 m³ of sand.

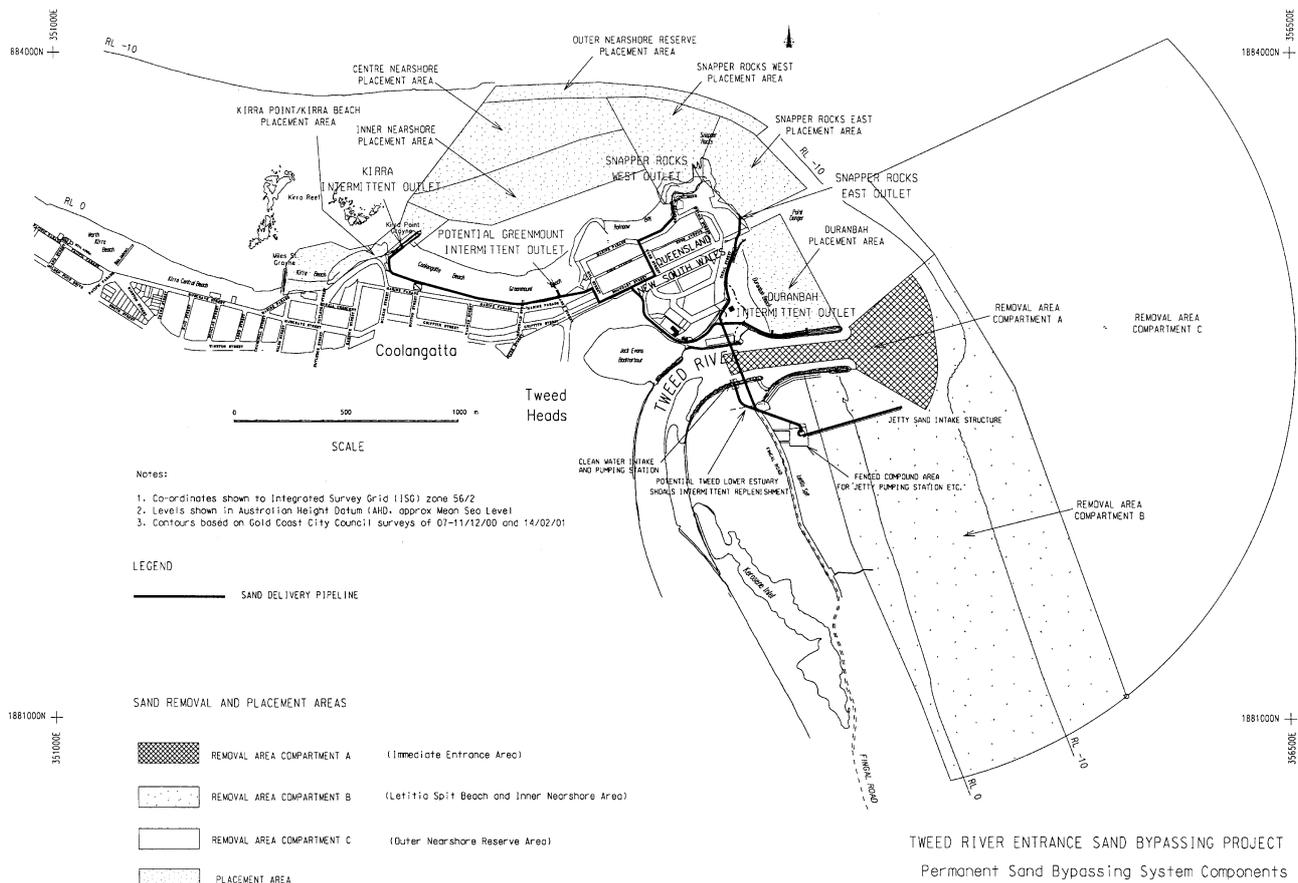


Figure 1 Locality Plan

2. Environmental Planning Approval

An Environmental Impact Statement / Impact Assessment Study (EIS/IAS) of the project was carried out in accordance with the planning requirements of both states (Hyder et al 1997). The environmental planning approvals completed in

mid 1998 are subject to a range of conditions for the design, construction and operation of the works. At the core of these conditions is the requirement for the development and implementation of project specific environmental management plans that address risk management of significant environmental issues associated with

construction or operation of the system. Effective risk management requires a strong commitment to ongoing monitoring of environmental aspects and the implementation of appropriate preventative and mitigation procedures to meet performance objectives.

Planning approvals for this project were granted to the Joint Proponents being the NSW Minister for Land and Water Conservation and the Queensland Environmental Protection Agency (QEPA, formerly the Department of Environment). As such, the ultimate responsibility to ensure compliance with all conditions of approval rests with the Joint Proponents.

However, the party that is responsible for a particular activity that may potentially lead to adverse environmental effects is best placed to most effectively manage risks associated with that particular environmental issue. Alternatively, there may be adverse impacts that may occur as a result of the carrying out of the project as a whole, rather than an impact of a specific project activity or action carried out by a particular party. Consequently, as part of the development of contractual agreements, the parties considered the separation of environmental risk management obligations arising from the conditions of approval and assigned responsibility to either the McConnell Dowell consortium or to the NSW Department of Land and Water Conservation (in its role as co-ordinator of the Joint Proponents) and QEPA. This division of contractual obligations for the management of environmental issues is incorporated in project specific Environmental Management Systems that were jointly developed and are being implemented by the parties on behalf of the Joint Proponents

3. Environmental Impacts

A significant part of the project relates to environmental enhancement. The environmental assessment studies predicted the following environmental effects resulting from the delivery of the project :

- Improvement in the safety of navigation of the river entrance, and better tidal flushing and improved water quality within the river estuary,
- Restoration, widening and long-term maintenance of the southern Gold Coast beaches, with reduction in erosion threats and improvements to surf quality,

- Development of a new reef-like fish habitat on the sand collection jetty piles,
- Beach recession along the northern end of Letitia Spit beach,
- Reduction in beach width, change in beach alignment and changes to surfing conditions at Durambah Beach (immediately to the North of the entrance),
- Increased exposure of entrance training walls to storm wave attack,
- Increase in the time taken for Tweed River lower estuary shoals to recover if scoured following severe flood events,
- Disruption to shorebird habitat at the northern end of Letitia Spit because of infrastructure or foreshore retreat,
- Potential noise impacts,
- Potential spillage of contaminants from plant,
- Potential exposure of acid sulphate soils during construction earthworks,
- Reduction in the size of Kirra Reef,
- Potential disturbance to historic shipwrecks or relics,
- Potential disturbance to artifacts of significant aboriginal cultural heritage,
- Insignificant changes to tides, floods and storm surge propagation in the Tweed River,

4. Environmental Management Systems

Environmental management for the project has been addressed by two comprehensive project specific Environmental Management Systems (EMSs). An EMS-Delivery was developed and implemented to cover environmental management of the construction and commissioning of the permanent sand bypassing system, including early dredging and nourishment works. An EMS-Operations is currently being implemented for environmental management of the operational phase of the sand bypassing system.

The EMSs were prepared in accordance with Australian Standards AS/NZS ISO 14001:1996 and 14004:1996 (Standards Australia 1996), and are based on the obligations arising out of the EIS/IAS and conditions of approval. They document responsibilities, procedures, processes and resources for achieving and reviewing the environmental objectives and strategies for the project.

4.1. Structure of the Environmental Management Systems

The Australian Standards 14001 series detail the elements of an EMS as outlined below :

- (i) **Commitment and Policy**
 - Environmental Policy
- (ii) **Planning**
 - Environmental Aspects
 - Legal and Other Requirements
 - Objectives and Targets
 - Environmental Management Programs
- (iii) **Implementation**
 - Resourcing
 - Training, Awareness and Competence
 - Communication
 - Documentation
 - Operational Control
 - Emergency Preparedness and Response
- (iv) **Checking and Corrective Action**
 - Monitoring and reporting
 - Preventative, Nonconformance and Corrective Action
 - Records and Information Management
- (v) **Review**
 - Audit
 - Management review

In addition to incorporation of the above elements, the Project's EMSs have been structured to more effectively manage key environmental and performance issues by the inclusion of issue specific environmental management sub-plans. These sub-plans provide a framework for the particular controls, mitigating measures, monitoring activities and auditing procedures for each key environmental issue. These sub-plans are listed in Table 1.

4.2. Onsite Environmental Management

McConnell Dowell appointed a full-time Environmental Management Representative (EMR) responsible for on-site implementation of the EMS-Delivery. This role included facilitation of an environmental induction program, liaison with the community, supervision of on-site monitoring, environmental reporting on a monthly basis and compliance auditing. The appointment of a site EMR proved to be an effective means of ensuring that the on-site requirements of the EMS were satisfied and environmental performance objectives achieved.

Table 1 Environmental Management Sub-Plans

Environmental Management Sub-Plan	Incorporated in EMS-Delivery or EMS-Operations
Consultation Strategy Plan	Delivery and Operations
Community Information Plan	Delivery and Operations
Sand Removal and Placement Strategy	Delivery (for early dredging and nourishment works) and Operations
Noise and Vibration Management Plan	Delivery and Operations
Traffic and Air Quality Management Plan	Delivery and Operations
Sand, Soil and Water Quality Management Plan	Delivery and Operations
Infrastructure and Public Access Management Plan	Delivery and Operations
Waste Management Plan	Delivery and Operations
Letitia Spit Avifauna Habitat Strategy Plan	Delivery and Operations
Landscaping Management Plan	Delivery and Operations
Historic Shipwreck Management Plan	Delivery and Operations
Accident and Emergency Response Plan	Delivery and Operations
Cultural Heritage Management Plan	Delivery
Beach Management and Nourishment Strategy	Operations
Kirra Reef Management Plan	Operations
Duranbah Surf Quality and Beach Amenity Management Plan	Operations
Tweed River Entrance and Lower Estuary Management Plan	Operations

5. Monitoring Programs

The environmental planning approvals required that specific monitoring be carried out as recommended in the EIS/IAS. Environmental and performance monitoring is a key component of the EMSs and is used not only to assess the effects of the works on the environment but also to assist in the ongoing operational management of the system to ensure that the project objectives are achieved in an optimal manner that maximises the environmental benefits.

Monitoring activities carried out include:

1. Beach and nearshore bathymetric conditions, (including surveys and aerial photography)
2. Entrance bathymetric conditions
3. Surfing Quality and beach amenity (including video and photographic monitoring)
4. Nearshore wave climate
5. Longshore sand transport supply
6. Kirra Reef extent and habitat (including surveys of marine biota and surrounding seabed levels)
7. Change in tides in the Tweed River
8. Condition of the Tweed River lower estuary shoals
9. Saltmarsh and seagrass adjustments in the Tweed River estuary
10. Sand quality
11. Investigation of potential acid sulphate soils
12. Avifauna
13. Tweed River breakwater stability
14. Water quality (including plume monitoring)
15. Remote sensing for historic shipwrecks or relics
16. Wave penetration into the Tweed River
17. Noise levels

These activities are the subject of environmental monitoring reports that are issued by the project on a regular basis. The results of select monitoring activities are summarised below.

5.1. Beach and Nearshore Bed Surveys

Upper beach and nearshore bed surveys of the project area from Fingal (NSW) to Currumbin (Qld) are carried out by the TRESBP on an annual basis to monitor the progress and performance of the sand removal and placement strategy. The

surveys cover approximately thirteen kilometres of coastline and extend across the active beach zone to water depths of between 18 and 22 metres (see Fig. 2).

Upper beach and nearshore bed changes are analysed within coastal compartments that take into account the location of sand removal activities, sand delivery outlets and nearshore dredge placement areas. A summary of the volumetric change is presented in Figure 2 for the period from Feb./March 2000 (i.e. prior to the commencement of significant construction activities) to Nov. 2000/Feb. 2001. It is noted for the latter survey that the dredge area was surveyed in late Nov. 2000 and the placement areas in mid Dec. 2000. Coastal compartments further downdrift were surveyed in mid Feb. 2001.

During the period from 1/4/2000 to 28/11/2000, 357,000 m³ of sand was dredged from the Tweed River entrance area. The dredge area infilled by 244,000 m³ over about nine months so that the net dredged navigation improvement was reduced to about 113,000 m³. This entrance infill rate is slightly greater than predicted in the EIS/IAS and monitored from 1995 to 1999. However, higher than average longshore sand transport was calculated for this period and would have contributed to the increased infill rates.

Within the southern Gold Coast placement areas, the dredge and nourishment works deposited about 397,000 m³ of sand over the period 1/4/2000 to 13/12/2000 in the area from Snapper Rocks East to Coolangatta (see Fig. 2). The net nourishment benefit in these placement areas was 310,000 m³ as a result of the loss of about 87,000 m³ of sand from these placement areas over this period. This loss is less than the ongoing losses (i.e. prior to the operation of the permanent system) predicted in the EIS/IAS and may be due to differences in longshore sand transport potentials along the coastline over this short-term period.

5.2. Survey of Tweed River Shoals

Survey of river bed conditions in the main arm of the Tweed River from the entrance to Barney's Point Bridge (i.e. channel length of about seven kilometres) and upstream along Terranora Inlet to Boyds Bay Bridge (i.e. channel length of about one and three quarter kilometres) is currently being undertaken by the TRESBP on a six monthly basis (see Fig. 3).

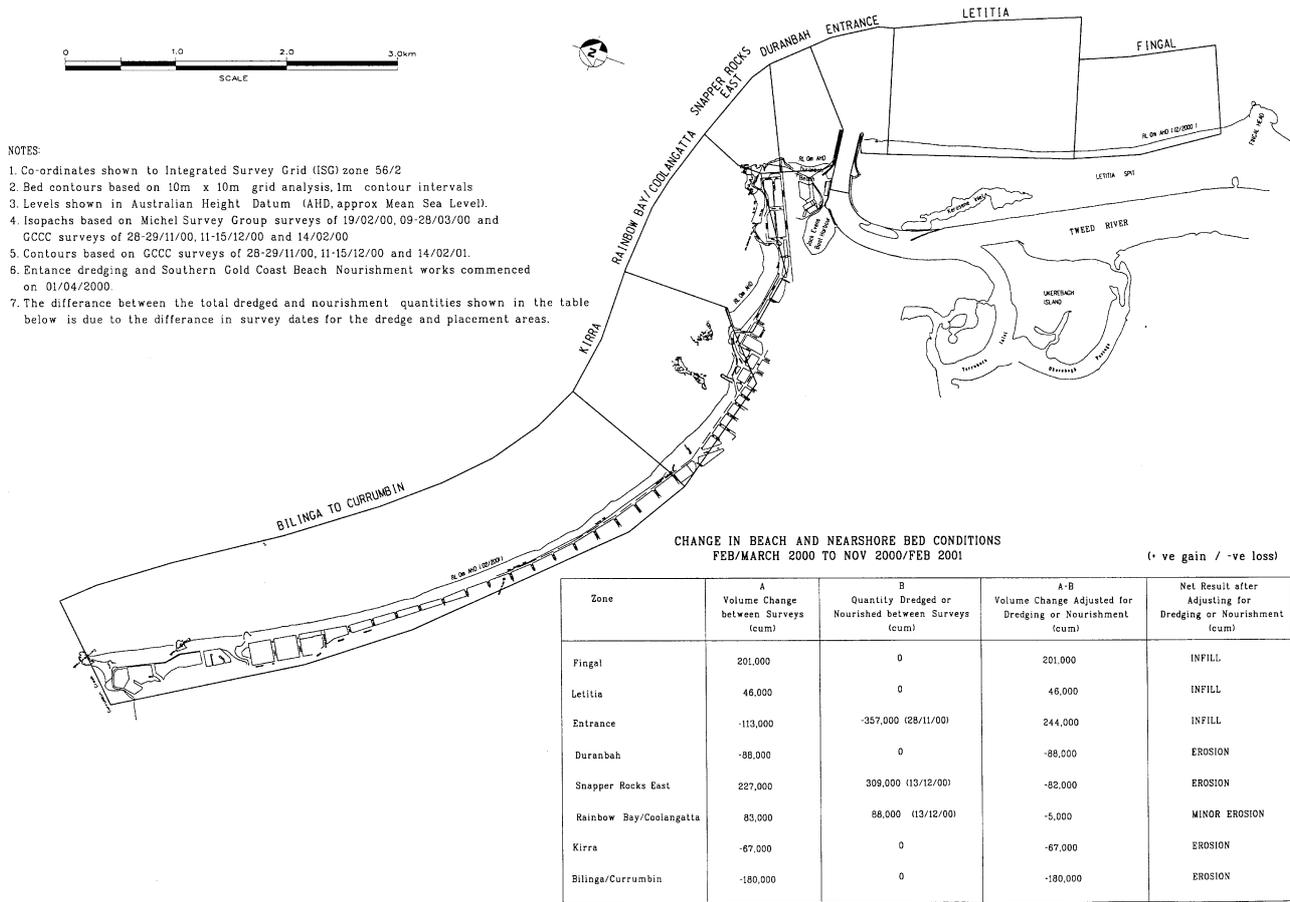


Figure 2 Beach and nearshore bed changes, Feb./March 2000 to Nov. 2000/Jan. 2001

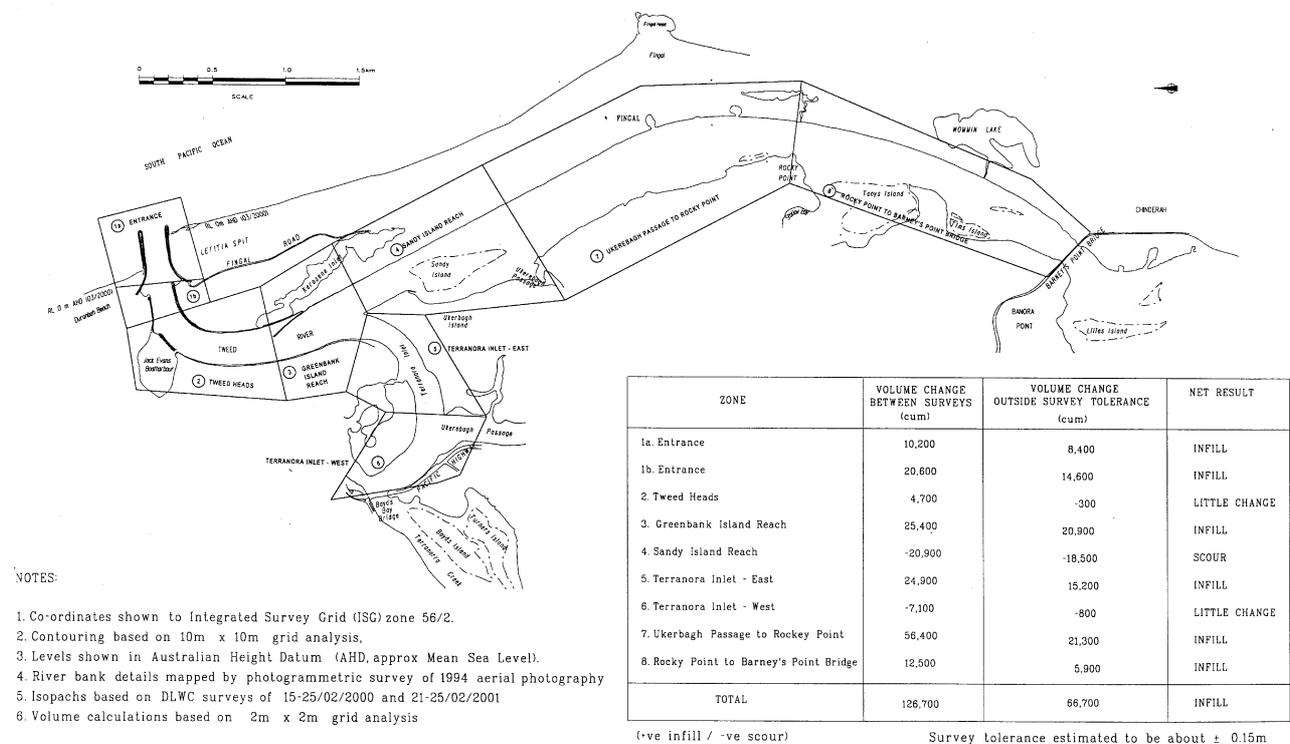


Figure 3 Tweed River bed changes, Feb. 2000 to Feb. 2001

Survey analysis indicates a net infilling in the lower reaches of the river over the period from February 2000 (i.e. prior to commencement of construction activities) to February 2001.

The EIS/IAS predicted that entrance improvement works would contribute to a reduction in the net marine sand infeed to the river which was estimated to be about 36,000 m³ p.a. prior to works. The increase in the sedimentation rate monitored by the surveys is likely to be the result of a combination of increased marine sand infeed due to estimated higher than average longshore sand transport along Letitia Spit feeding the entrance, and sediments deposited during flooding that occurred just prior to the survey of February 2001.

5.3. Survey of Seabed Levels Surrounding Kirra Reef

The EIS/IAS predicted that Kirra Reef would reduce in the extent of outcropping due to higher surrounding seabed levels associated with a restoration of southern Gold Coast beaches and sand supply conditions. It is expected that the reef would return to a condition similar to that exhibited in the pre-1960's, i.e. before the extension of the Tweed River breakwaters that interrupted littoral sand supply to these beaches.

Detailed bathymetric surveys and aerial photography are carried out in the vicinity of the reef by the TRESBP on an annual basis, to assess the impact on Kirra Reef. Baseline biota surveys have also been carried out on the reef habitat.

As part of the EMS-Operations, a placement exclusion zone has been established around the reef extending a minimum of 100 metres from the reef edge to prevent direct placement of sand in close proximity to the reef.

Bed changes within the Kirra Reef Placement Exclusion Zone over the period from May 2000 to February 2001 have been analysed. Infilling has occurred along the shoreward edge of the placement exclusion zone associated with re-establishment of a beach bar stretching from Kirra Point to Kirra Beach. No sand has been deposited by dredging and nourishment works within the nearshore placement areas close to the exclusion zone over this period. The calculated net volume change within the placement exclusion zone was a minor infilling of about 2,000 m³ across an area of about 300,000 m². It is expected that infilling will increase as nourishment sand deposited further

updrift is gradually reworked onshore and alongshore to promote a larger, more seaward upper beach and beach bar system from Kirra Point to Central Kirra Beach (see Fig. 1), replicating the conditions which would have occurred from time to time prior to the extension of the Tweed River breakwaters.

6. Conclusions

Society's growing demand for Ecologically Sustainable Development has contributed to the introduction of government policies aimed at the implementation of environmentally responsible practices in the construction industry and specifically in the delivery of major public infrastructure projects. The underlining requirement of these policies is the preparation of project specific environmental management plans.

The management of environmental risk through the implementation of the project's Environmental Management System-Delivery has helped achieve completion of the construction of the permanent sand bypassing system and associated dredging and nourishment works, without significant adverse environmental impacts.

The monitoring activities implemented by the project have contributed to the effective management of environmental aspects of construction and operation of the system to date. These monitoring programs also provide a valuable database of information to evaluate the progress and performance of the project, together with an increased understanding of local coastal processes.

The project's Environmental Management Systems have been audited by independent assessors and have been accredited in accordance with the relevant Australian Standards.

McConnell Dowell, as a major construction corporation, have recognised the need for a structured, systematic corporate approach to environmental management and have recently submitted their corporate EMS for accreditation in accordance with the Australian Standards.

7. References

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