DURANBAH BEACH – COMMUNITY INVOLVEMENT IN MANAGING A COMPLEX ENVIRONMENT, AN ADAPTIVE APPROACH

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Introduction

Duranbah Beach is the most northerly beach along the New South Wales (NSW) coastline, located adjoining the NSW and Queensland (QLD) border. The regional coastline is highly valued for its natural, built and recreational assets. Duranbah Beach has national and international recognition as a highly valued surfing site.

Beach and surfing conditions have been subject to the influence of coastal works for more than half a century, as well as being fully exposed to high-energy ocean wave conditions. In particular, over the last decade, the previous coastal sand supply to Duranbah has been impacted by the operation of the Tweed River Entrance Sand Bypassing Project (TRESBP).

This scheme is a joint project of the NSW and Queensland Governments that artificially bypasses the coastal sand drift around the entrance to the Tweed River. This has improved navigation at the river mouth and maintained a continuous coastal sand supply to QLD beaches north of the river entrance. Sand is also delivered by the scheme to Duranbah Beach for nourishment of the beach and/or nearshore shoals.

This paper describes the changing coastal landscape, sand delivery operational issues, the state and local government partnership in the nourishment works, and community stakeholder shared involvement in Duranbah Beach coastal management.

Duranbah Beach

Duranbah Beach is located in Tweed Shire in NSW, and sited between the mouth of the Tweed River and the NSW/QLD State border (Fig. 1). The beach is bounded by the northern river training wall on the southern side of the beach and the rocky headland of Point Danger on the northern side.

A backbeach reserve, road and rocky escarpments are found along landward side of the beach, with a rock seawall along the northern portion of the beach. The beach is about 350m in length. A vegetated dune extends for about 200m along the beach, being the widest in the centre of the beach (20m) and narrows towards the ends of the beach.

Duranbah Beach is a very popular surfing beach and has been used to stage events for the Quicksilver professional surfing contest together with the nearby Snapper Rocks surfing site.

The beach faces east and is exposed to high wave energy and high longshore sand transport rates. The predominant wave direction is from the southeast but waves may approach from all seaward directions. There is significant seasonal and annual

variability in wave conditions. Median significant wave heights are in the order of 1.3m, with severe ocean storms in excess of 6m and an annual storm recurrence in excess of 4m significant wave height, as monitored since 1995 at a nearby Tweed Waverider buoy (stationed in a water depth of about 25m).

There is an estimated net northerly longshore sand transport within the region in the order of 500,000 m^3 per year. The annual net longshore transport has been estimated to vary from about 250,000 to 1,000,000 m^3 per year (Hyder et al).

The natural sand supply to Duranbah Beach is primarily the northward movement of coastal sand along Letitia spit (located on the southern side of the river) and across the Tweed River entrance to Duranbah.

The bathymetric condition of the offshore entrance bar influences the degree of natural bypassing of the entrance and hence the pattern of sand supply to Duranbah Beach. The sandy upper beach is very dynamic with shoreline fluctuations in the order of up to 60m as a result of severe storm erosion and onshore recovery but also as a result of variability in the longshore sand supply, influenced by the degree of natural bypassing across the river entrance.

This complex natural environment is further complicated because of the impact of coastal works on the natural processes affecting Duranbah Beach.

Tweed Shire Council commissioned WBM Oceanics Australia to produce the Tweed Shire Coastline Hazard Study, completed in 2001. Duranbah Beach was excluded from this study due to the involvement of the TRESBP and proposed artificial nourishment of the beach and nearshore by the project.

Figure 1 General setting of Duranbah Beach
Aerial photograph June 2007

Impact of Coastal Works: 1960s to mid 1990s

Long-term beach recession or advancement depend on the imbalance between the available sand supply and longer term longshore transport potential through a beach compartment.

Shallow offshore bars are the mechanism for natural sand bypassing of river entrances along coasts exhibiting significant net longshore sand transport. Entrance works such as the construction of training walls or dredging will impact on the natural sand bypassing until there is sufficient rebuilding of the offshore bar to permit sufficient wave break induced transport along the bar across the entrance.

Duranbah Beach surfing conditions have been subject to the influence of coastal works for more than half a century. Up until the early 1960s Duranbah Beach was relatively narrow with little dune system and the foreshore was protected by a rock seawall (Fig. 2).

In 1962 to 65 the Tweed River training walls were extended seawards into deep water by up to about 400 m. This impacted on the Duranbah beach conditions initially because of the reduction in littoral supply of sand northward past the training walls but over time contributed to beach and nearshore accretion due to the sheltering of the walls and regrowth of a large offshore bar extending through the Duranbah nearshore zone (Fig. 2).

By the early 1990s, an estimated 4 million m^3 of sand had built up along Letitia spit south of the training walls (Hyder et al). A further 3 million m^3 of sand accreted within or offshore of the river entrance (including Duranbah), to restore the natural sand bypassing at the entrance. During the later decades of this period, there was significant beach accretion including development of a dunal system seaward of the rock wall along Duranbah Beach.

Development of the crescent plan form of the offshore bar and extension of the northern lobe into the Duranbah compartment contributed to nearshore shoals that promoted high-quality surfing conditions.

Focusing of wave energy across the offshore bar formation and development of inner nearshore shoals conducive to peeling wave breaks contributed to a powerful surfing break along the beach side of the river training wall and in the centre of the beach.

Duranbah Beach became recognised nationally and internationally as a consistent powerful high-quality surf break for both board and boogie board riders.

EIS studies for the project (Hyder et al) indicated that by the mid-1990s sand was still accumulating in the offshore entrance bar and Duranbah shoals at a rate of about 150,000 m^3 per annum suggesting that full entrance sand bypassing to the northward past Duranbah still had not stabilised after more than 30 years.

A wider beach and vegetated dune system, fuller nearshore shoals that formed part of the northern lobing of the shallow offshore entrance bar and popular surfing breaks became features of Duranbah Beach that were readily accepted by the general community.

However redevelopment of the shallow entrance bar during the 1970s to mid 1990s resulted in adverse navigation and safety issues at the entrance and there was a large sand deficit along the depleted southern Gold Coast Beaches associated with the interruption of the littoral drift to Queensland that was continuing to worsen.

Figure 2 Comparison of Duranbah Beach and Tweed River entrance conditions at the start of river training wall extensions in 1962 and some 30 years later in 1995
Aerial photograph 1962 **Aerial photograph 1995**

The Tweed River Entrance Sand Bypassing Project

The Tweed River Entrance Sand Bypassing Project (TRESBP) was established in 1995 as a joint initiative of the NSW and QLD Governments to improve and maintain navigation conditions at the Tweed River entrance and to replenish and maintain a nourishing sand supply to the southern Gold Coast Beaches.

The project is administered in accordance with the *Tweed River Entrance Sand Bypassing Act (1995)* in NSW, and the *Tweed River Entrance Sand Bypassing Agreement Act (1998)* in Queensland, which ratifies the project's interstate Deed of Agreement.

The project has been carried out in two stages:

- Stage 1 Initial Dredging and Nourishment Works. These works were carried out over the period April 1995 to May 1998 and involved the initial dredging of the Tweed River entrance and nourishment of the southern Gold Coast Beaches between Pt Danger and Kirra. A total of 3 million m^3 of clean marine sand was removed from the offshore entrance bar and delivered to the nearshore zone along the southern Queensland beaches.
- Stage 2 involved the implementation of a sand bypassing system to maintain the improvements achieved during Stage 1. This included bypassing sand consistent with the net littoral drift together with the delivery of additional sand that had accreted on the Tweed River bar since the completion of the first phase of Stage 1. Since 2000, a total of 7.7 million m^3 of sand has been captured and delivered (bypassed) to the beaches north of the river entrance to June 2010.

McConnell Dowell Constructors (Aust) Pty Limited commenced construction of the fixed jetty-based system in February 2000. The completed system was commissioned during March and April 2001. The Tweed River Entrance Sand Bypassing Company (a subsidiary company of the McConnell Dowell Corporation) commenced full-scale operation of the sand bypassing system on 4 May 2001, in accordance with a 23 year operation and maintenance contract.

The Stage 2 operation comprises two sand delivery methods:

(1) Pumping by jet pumps mounted on a jetty south of the Tweed River entrance and through a network of buried pipelines to four separate discharge outlets north of the Tweed River entrance (Fig. 3); and

(2) Supplementary dredging of the Tweed River entrance area by floating dredge and deposition in designated nearshore areas north of the Tweed River 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 is delivered to the primary placement area of Point Danger from where natural coastal processes transport the sand around Snapper Rocks and along the southern Gold Coast beaches. To provide flexibility in the sand delivery, discharge outlets have also been established at Duranbah Beach, Snapper Rocks West and Kirra Point.

Figure 3 Jetty-based sand bypassing system components

The development of a deeper entrance to improve navigation by dredging or artificial sand bypassing, impacts on the natural sand supply to Duranbah on the downdrift side of the entrance.

To address potential impacts on Duranbah, provisions were included in the TRESBP interstate agreements allowing up to 10% of the annual quantity of bypassed sand to be delivered to Duranbah Beach to "*provide a usable beach, including nearshore shoals*".

The TRESBP Stage 2 Environmental Impact Statement (EIS) identified Duranbah Beach as the only beach north of the Tweed River Entrance that would be likely to experience long-term adverse impacts from the project due to the reduction in natural sand supply across the improved and maintained deeper entrance.

It predicted that as a result of project operations, Duranbah Beach would return to a condition similar to that seen in 1965, at the time of construction of the Tweed River training walls.

Based on the scenario of entrance bar removal and a deep entrance channel being maintained, the following potential impacts might occur:

- Reduced net sand supply to Duranbah and depletion of the offshore profile at a rate of approximately 130,000 m³ pa decreasing over the longer term,
- Upper beach retreat of about 50m and potential realignment to a more south-east facing alignment with up to 65-73m retreat in the centre of the beach and up to 80-90m retreat at the southern end of the beach depending on the reduction of the offshore entrance bar and nearshore shoals, but Duranbah Beach should retain good recreational beach amenity,
- Retreat of the dune system to a 1965-type condition that was observed soon after completion of the extension of the Tweed River breakwaters,
- Changes to surfing conditions, and
- Increased beach erosion during the retreat phase.

However, there was some uncertainty in the predicted impacts at Duranbah Beach, as they would depend on the extent of reduction of the entrance bar and natural northward bypassing of sand across the entrance under the actual operation of the system.

Project Management and Community Consultation Processes

Working Group

The project is coordinated by the NSW Land and Property Management Authority (LPMA) on behalf of the two states. In Queensland, the project is managed by the Department of Environment and Resource Management (DERM). An interstate project Working Group is responsible for the overall implementation of the project. The Working Group membership includes representatives from LPMA, DERM, Gold Coast City Council and Tweed Shire Council.

As part of the Working Group's planning and management role, annual sand delivery programs for scheduling of sand delivery to the beach outlets are developed and periodically reviewed. Dredging placement strategies are also determined in the event of the requirement for maintenance dredging at the Tweed River entrance.

Tweed Shire Council and Gold Coast City Council manage the beaches within their respective local government areas. Advice is provided by Tweed Shire Council and

Gold Coast City Council at the Working Group level concerning their beach management issues, including local community feedback. This assists in the development of the project's sand delivery program or potential need for modification over the annual period to respond to changes in beach or entrance conditions.

The importance of community input and involvement in the project is clearly recognised by the Working Group and direct input into operational decisions are sought from the local community through various means including the project's community-based Advisory Committee.

Advisory Committee and Community Consultation

The Advisory Committee (AC) comprises Tweed Shire Council and Gold Coast City Council representatives, community representatives that cover various key stakeholder groups from entrance users, surf and beach users, and general community groups, and LPMA and DERM project team members.

An AC meeting including open forum formats, where other stakeholder representatives or the general public can attend and participate, are held typically on a three-monthly basis.

Regular local stakeholder group representative reports are also prepared following consultation with the following typical groups:

- 8 surf lifesaving clubs from Fingal Head through to Tugun Beach,
- 3 Surfrider clubs from Tweed Coast, Snapper Rocks and Kirra,
- Kirra community action group,
- business and tourism organisations and chamber of commerce,
- 4 local real estate agents,
- Fingal community progress association,
- Volunteer Marine Rescue Point Danger,
- New South Wales Maritime, and
- boat charter groups and marine industrial organisation.

Community group representatives provide verbal or written feedback for presentation at AC and WG meetings.

Comprehensive presentation and discussion of the latest monitoring results of coastal changes and environmental studies, sand bypassing system operations, wave and sand transport conditions, beach and entrance community stakeholder feedback reports, review of the sand delivery program and proposed activities, and AC member feedback on beach, surfing and entrance boating conditions from community perspectives, is undertaken at AC meetings and reported to the Working Group for consideration.

This forum has proven to be a very effective means for exchange of information, community review and feedback on sand delivery programs and entrance navigation conditions, and opportunity to discuss any competing needs or potential change in sand delivery strategies.

The project also maintains a website (www.tweedsandbypass.nsw.gov.au) that provides information on project activities and entrance and beach conditions, as part of the project's community consultation process. The project is currently developing a schools package that will be made generally available, but it is also proposed that a website-based package be made available.

The University of New South Wales Water Research Laboratory operates an Argus coastal imaging system on behalf the project. This system provides up-to-date information on entrance conditions and upper beach and shoreline changes for community information through a public website (http://ci.wrl.unsw.edu.au/public/tweed/).

Adaptive management of Duranbah sand delivery

Sand delivery to Duranbah Beach has been undertaken by the project since 2001 through an ongoing *Duranbah Beach Sand Delivery Program* developed in consultation with Tweed Shire Council and the project's Advisory Committee to provide a useable beach berm width and maintain inner nearshore shoals.

Sand has been delivered typically twice a year (routinely March/April and November), via temporary overland pipes extending up to 180m in length from a valve pit located on the training wall pathway, near the southwest corner of Duranbah Beach.

Until 2005, sand placements were made from the northern training wall directly into shallow water (near the low tide shoreline), with the main focus being on building beach width and delivery of sand to the inner nearshore shoals.

In 2004, WBM Oceanics Australia prepared the *Duranbah Beach Dune Management Plan* on behalf of Tweed Shire Council. Public submissions and community consultation during the preparation of the management plan indicated that there was strong support that the existing amenity and landscape character of the area be preserved where possible including:

- Remaining mature dune vegetation and backbeach public reserve.
- Existing beach access and foreshore pedestrian walkways.
- Avoidance of the potential exposure of rocks, logs and the Tyalgum historic wreck underlying the beach berm, ie from potential ongoing landward movement of the beach profile as predicted in the EIS.

In April 2005, the project responded to a request from Tweed Shire Council and the local community to modify the setup location of the temporary sand placement outlet at Duranbah Beach. This trial was supported by the AC and the project agreed to test new delivery locations from the back of the Duranbah Beach dune.

In April/May 2005, a trial upper beach sand placement was carried out in partnership with Tweed Shire Council, from the edge of the dune in the centre of the beach using Council dozers to build up and reshape the dune slope for some distance along the dune from the sand delivery outlet. This was undertaken to assess the practicality and effectiveness of dozing, and capability of pumping high density sand slurry to retain sand on the upper part of the beach profile.

Following the successful replenishment and contouring of the upper beach and foredune areas, Tweed Shire Council prepared a *Duranbah Beach Nourishment Strategy 2006/7*. The objectives of this strategy were as follows:

- *Maintain/reinstate the beach and dune width to an alignment that protects (through the establishment of a transient foredune of approximately 10 m) the existing woody vegetation and beach amenity.*
- *Maintain sand cover over the second level rocks and wreck.*
- *Maintain surf quality and consistency. The optimum state for surf at Duranbah is agreed to be the maintenance of characteristic 'A-frame' peaks at a number of locations along the beach, breaking as powerful, hollow waves.*

- *Maintain the existing park behind dunes.*

This trial was extended at the request of and in partnership with Tweed Shire Council, with the support of the AC, to carry out a 2 year trial under the *Duranbah Beach Sand Delivery Program 2006-2008*. The trial under the program included sand discharge from backbeach outlet locations within the reach of existing pipework in place of discharge from the training wall for one of the scheduled sand placements each year.

The extended trial has been largely successful in protecting dune vegetation from beach erosion, however no ocean storms of greater severity than about 1 in 1 year ARI occurred over the review period.

A review of the trial concluded that existing sand allocations of the project's interstate Deed of Agreement and operational contract (typically 50,000 m^3 pa) were adequate for providing protection of the dunal system from storm erosion, while balancing the needs of sand delivery for surfing shoal and beach width nourishment, under the storm and nearshore shoal conditions observed during the trial period.

The trial required minor adjustment of the delivery program to include backbeach outlet positions at Duranbah Beach within the reach of existing pipework and is considered a cost-effective strategy to provide increased protection of the dunal system as requested by Tweed Shire Council, the AC and the community. This strategy now forms the basis of the project's 3 year *Duranbah Beach Sand Delivery Program 2009-2012,* carried out in partnership with Tweed Shire Council undertaking associated dune contouring works as required, subject to annual review of outcomes.

A key factor in the success of the trial and ongoing programs has been the AC meeting consideration of the nourishment proposals together with the latest monitoring data to determine the placement objectives, and optimal placement locations, timing and quantities.

To finalise sand placement campaigns, meetings were held on site with the Project Advisory Committee and surfing community representatives and other stakeholder representatives, sand bypassing operator and Council officers prior to each nourishment campaign to discuss the state of the beach, surf conditions immediately prior to sand delivery, and how the sand placement can be best undertaken. The need for beach shaping by dozer was reviewed and planned, to achieve a smooth beach profile, satisfactory foredune profile and desired distribution of sand along the length and breadth of the beach and a work program arranged between the bypassing operator and Council staff.

This high level of community consultation and close working relationship between the project team, Council officers and sand bypass operator prior to and during works contributed to beach replenishment outcomes with wide community support. This helps Council to balance the diverse expectations of the community for beach, foreshore and nearshore management and increases the community's support for the project's Duranbah Sand Delivery Program.

TRESBP Duranbah Sand Delivery Operations and TSC Dune Works

Since 2001, Duranbah Beach has been artificially nourished with sand by the TRESBP to provide a useable beach berm width and maintain inner nearshore shoals consistent with the provisions of the Project's interstate Deed of Agreement. The quantity of sand delivered by pumping and dredge is equivalent to about 10% of the total sand quantity bypassed by the system since May 2001 (ie to June 2010).

On average, Duranbah upper beach has received about 60,000 m^3 of pumped sand per year. There has been a slight reduction in annual volumes pumped over the last 24 months, down to about 46,000 m^3 pa from July 2008 to June 2010.

Pumped placements have been generally limited to less than about 30,000 m^3 per month, because there is past evidence that larger placement volumes may have short term impacts on surfing amenity (Dyson 2001).

The Duranbah nearshore zone has received about 15,000 m^3 of dredged sand per year from 2002 to 2006. No dredging of the entrance bar and no delivery of dredged sand to Duranbah occurred in 2007, 2009 and 2010. A relatively large dredge placement of about 127,000 m^3 of sand was trialled in the northern Duranbah nearshore area in 2008 in response to community consultation for the purpose of storing sand in deeper nearshore reserves areas to delay the reworking of delivered sand northwards around Snapper Rocks.

The use of the temporary sand pumping outlet setup has provided flexibility for varying discharge locations to address changes in the sand nourishment needs over the year and provides an effective mechanism for achieving the objectives of the sand delivery under a primarily twice-a-year placement program.

It has been found that different discharge locations were better suited to achieve certain outcomes:

- Discharge from the training wall into the intertidal zone tends to more readily restore beach width with sand reworking along the shoreline as well as nearshore shoal build up along the training wall to form or enhance a 'surfing bank'.
- Discharge from the southwest corner of the beach provides immediate replenishment of localised erosion of the foredune/upper beach profile without the need for supplementary dozing for shaping of the beach profile.
- Discharge from 3 to 4 backbeach locations achieves replenishment of the foredune sand store with little or no dozing required to reform the desired beach/foredune profile, if pumping is carried out using relatively high density sand slurry.

An annual target quantity for pumping of up to approximately 50,000 m^3 has been adopted, based on the following program:

Nominal Placement Date	**Indicative Quantity**	**Placement Locations**	**Purpose**
March/April	30,000 m^3	Various outlet points along beach from seaward edge of dune	Build up sand reserves on the upper beach and dunes to provide a storm buffer of approximately 25m width in the centre of the beach leading into the winter months
November	20,000 m^3	From training wall into inter-tidal zone	Provide quantity of sand for natural reworking along beach and offshore to help maintain recreational beach width and surfing banks

Sand is pumped to the backbeach outlet locations generally under high density sand slurry conditions to retain as much as possible the discharged sand on the upper beach; to build up the sand store as effectively as possible within the target sand volume allocation; reduce the period of delivery and hence reduce disturbance to beach usage; and reduce the extent of dozing required to profile the beach and thus minimise the cost of mechanical reworking. The delivery of less dense sand slurry leads to a substantially greater proportion of sand discharge into the intertidal zone.

The mechanical reworking of sand over distances greater than 75 m away from the outlet is time consuming and increases the costs for plant time and potential hazards to beach users requiring increased security services to manage beach operations. It is cost effective to discharge from 2 or more locations along the beach to provide a more even sand distribution compared to a single outlet location.

The maximum sand volume that can be placed at a single backbeach outlet location under generally dense sand slurry delivery conditions varies from about 5,000 to 10,000 m^3 per occasion depending on pre-existing beach level, because of the limited available height for discharge stockpiling (unless the discharge is elevated on a separate additional temporary structure).

Active management of Duranbah Beach was not fully considered within the development of the Tweed Shire Coastline Management Plan (TSC, 2005) due to the uncertainty of the response of the beach compartment to TRESBP operations. Following the successful trial of combined sand delivery and dune works, the ongoing management of Duranbah Beach can be incorporated by Tweed Shire Council in the next review of the Tweed Coastal Zone Management Plan with a greater level of certainty on management objectives.

Figure 4 Post May 2009 severe storm

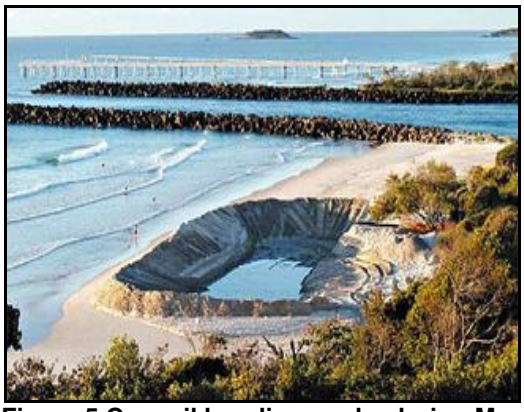

Figure 5 Council bunding works during May 2010 pumping (source: Tweed Daily News)

Figure 6 June 2010 Post-Nourishment

Monitoring Results

Monitoring data is continuing to be analysed to assess the effectiveness of the current strategies. Some of the key conclusions emerging from the analysis of coastal changes to date include:

- The project's maintenance of a moderately deep entrance bathymetry and the retention of a residual convex bar shape bathymetry in deeper waters that focuses wave energy at Duranbah Beach, as opposed to an overly deep entrance, has reduced impacts on Duranbah surfing amenity and beach alignment.
- Partial regrowth of the entrance bar from time to time and maintenance of a moderately deep entrance channel providing for some natural bypassing of the entrance, sand delivery by pumping and dredge, and possibly some southerly movement of sand into this area have contributed to a smaller reduction of the Duranbah shoals compared to the EIS predictions.

Upper Beach Changes

- Shoreline retreat of 40 to 50m occurred prior to the commencement of sand pumping operations, due to a number of severe storms from 1997 to 2001. The project's Duranbah sand delivery has been successful in preventing further significant retreat.
- Ongoing beach nourishment by the system has replenished and maintained recreational beach widths and limited shoreline retreat to generally fluctuate within the range of 20 to 50m. The average longer term retreated position of about 35m is less than the lower range EIS prediction of 50m.
- Dune retreat in the order of 45m was generally observed between completion of the EIS and the start of operations. The alignment of the vegetated dune was relatively stable from 2001 to 2004, with minor losses of 1 to 2m due to severe storms in 2004 and 2006. Sand delivery to the foredune area of the beach over the last 4 years has reduced severe storm impacts on the remaining vegetated dune and maintained dune alignment generally seaward of the 2001-2004 alignment (Fig. 7).
- A nourished foredune storage buffer of about 25m in width as a design profile condition for beach nourishment has been sufficient to accommodate the occurrence of severe storms and largely protect the existing woody dune vegetation over an annual period. Annual upper beach placements in the order of 30,000 m^3 pa have provided this effective protection to the vegetated dune.
- Pumping sand directly onto the beach from the dune crest has proved more effective at retaining a beach sand store to protect against dune erosion and has had less impact on surf quality than pumping larger quantities into shallow water from the northern training wall as was undertaken during early years of the operation.
- The seaward edge of the existing vegetated dune in the centre of the beach is about 20 metres to the east of the potential retreated alignment predicted in the EIS.
- Upper beach sand volumes reduced by about 55,000 m^3 from 1997 to late 2000, consistent with observed shoreline and dune retreat prior to the start of sand pumping to Duranbah in 2001. Since the start of Duranbah pumping, the upper beach sand volumes have fluctuated as effected by storm erosion and the project's pumped sand delivery, but shows overall relative stability (Fig. 8).

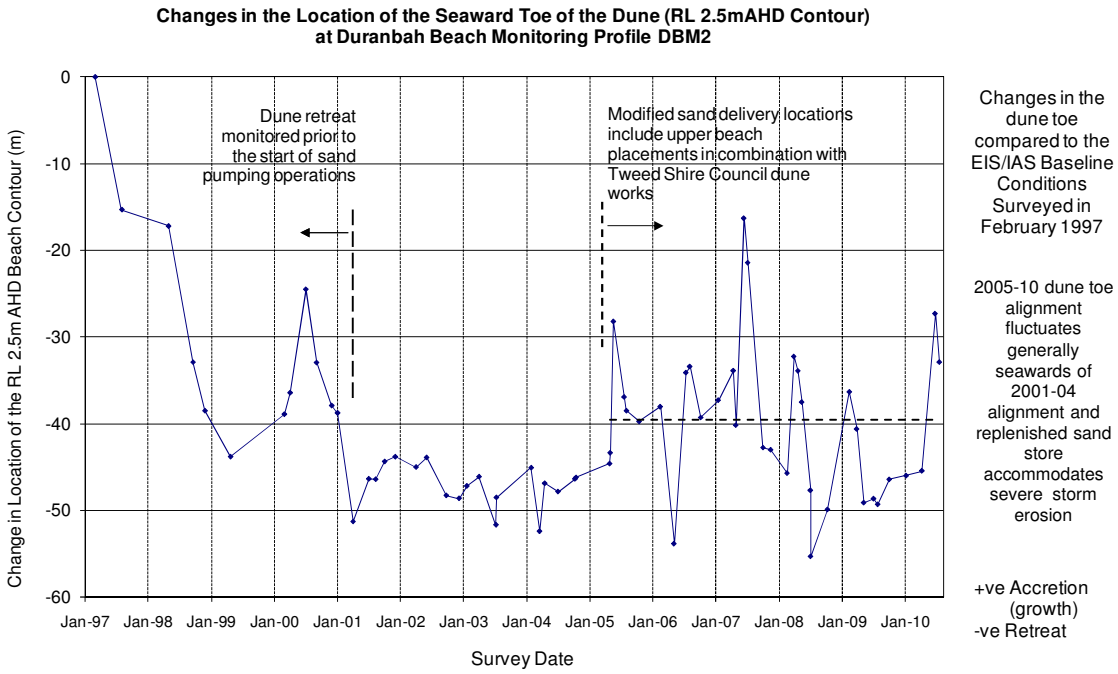

Figure 7 Change in location of dune toe at Central Duranbah Beach Monitoring Profile DBM2

Nearshore Changes

- Progressive inner nearshore sand losses in the Duranbah area totalling 180,000 m^3 from 1997 to 2005 (ie. 21,000 m^3 pa) are significantly less than predicted in the EIS (ie. 130,000 m3 pa reducing over the longer term). The inner nearshore sand volume has been relatively stable over 2005-2009 but still showing significant fluctuations in the order of about 180,000 m^3 ± 50,000 m^3 (Fig. 8). This potential stability may be short-term in nature.
- These fluctuations have highlighted the behaviour of the Duranbah inner nearshore profile in relation to changes in the bathymetry of the Tweed entrance channel (i.e. moderately deep channel vs further deepening due to dredging), and natural northward sand supply to Duranbah.
- Partial recovery of inner nearshore sand volumes from July 2007 to July 2008 can be associated with entrance partial infilling and increased natural bypassing of sand across the entrance, similar to the 2005/6 rebuilding phase.
- The outer nearshore profile has exhibited recovery from 1995 Stage 1A dredging offshore of Duranbah trending towards a condition expected to be more consistent with a long-term moderately deep entrance offshore bathymetry in water depths of 10 to 20m. Trialling of deeper water dredge placement of about 80,000 m^3 of sand in May-Sept 2008 supplemented this rebuilding trend (Fig. 8).
- Annual dredge placements of 10,000 to 20,000 m^3 pa from 2002 to 2006 and intermittent placement of 45,000 m^3 in 2008 have reduced inner nearshore sand losses on the northern side of Duranbah.
- It is not possible to establish whether the inner nearshore bathymetry at Duranbah has reached a stable state as yet; further monitoring is required to confirm stability.
- Ongoing surf quality monitoring and consultation with the local surfing community has not identified any significant long-term adverse impact on Duranbah's surf quality (Fig. 9).

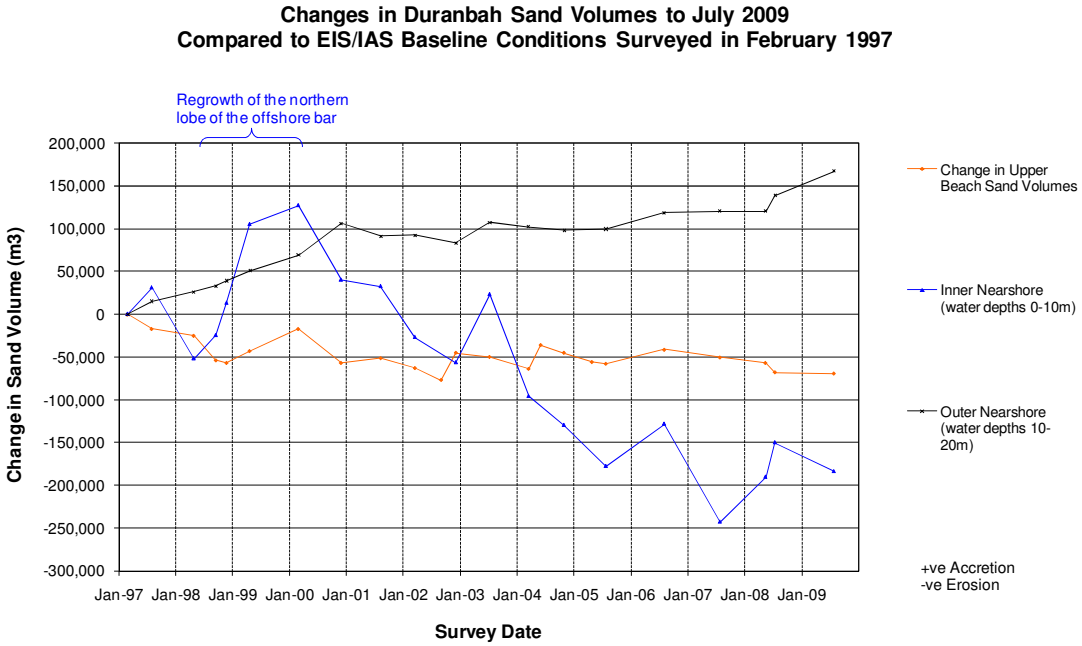

Figure 8 Change in Duranbah coastal sand volumes

2005 **April 2010**

source: www.coastalwatch.com website

Figure 9 Duranbah surf break

Conclusions

Duranbah Beach is highly valued by the local community for its landscape character, recreational amenity and high quality surfing wave breaks.

The beach, nearshore shoal and surfing wave break behaviour is complex in response to its exposure to variable high energy ocean waves and high longshore sand transport potentials at the site.

These natural processes are further complicated by operation of the sand bypassing jetty and intermittent entrance channel dredging, the variable degree of natural sand bypassing of the river entrance to Duranbah, storm events and sand delivery to Duranbah by the TRESBP.

The uncertainty of this environment requires an adaptive management strategy to respond to the dynamic and unpredictable beach, nearshore and surfing conditions.

The beach is managed by Tweed Shire Council. Council and TRESBP have worked together to integrate Council's beach management strategy with the sand delivery provisions by the TRESBP. This close working relationship, along with a high level of communication, assists Council to balance the diverse expectations of the community for beach, foreshore and nearshore management.

The TRESBP approach takes account of Council's strategy for beach nourishment through a flexible annually developed Duranbah Beach sand delivery program. This delivery program is adaptive in nature through the on-going review of proposed sand delivery quantities and timing, and the varying of discharge locations to address the unpredictable changing beach and nearshore conditions, and considerations from community consultation.

There has been commitment at the local government level through the allocation of budget and resources to the active management of Duranbah Beach. This is in recognition of the value of the current dune, beach and surf conditions to the community.

This collaborative process, together with the maintenance of a moderately deep entrance channel by the TRESBP have effectively managed upper beach, nearshore and surfing impacts associated with the operation of the TRESBP.

Ongoing surf quality monitoring and consultation with the local surfing community has not identified any significant long-term adverse impact on Duranbah's surf quality.

Community consultation has been effective in informing TRESBP project managers of Tweed Shire Council, surfer and beach user objectives for sand placement exercises and to report on the impacts of placement design on surf quality and beach conditions.

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