PRIMARY SUBMISSION BY THE PUBLIC WORKS DEPARTMENT TO THE COMMISSION OF INQUIRY FOR THE PORT HACKING TOMBOLO AND ASSOCIATED PORT WORKS

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Dated: 1st July, 1988
Signed: __________________

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PREAMBLE

The Public Works Department began a study of the movement of sand shoals in Port Hacking in 1980. The study was commenced in light of increasing community concern about continued shoaling in the estuary and recognition on the part of Sutherland Shire Council and the State Government of the increasing cost and ineffectiveness of maintenance dredging. The objective of the study was to obtain a clear understanding of the processes causing the shoaling problem and to then determine options for its management.

The study involved an intensive data collection programme to provide comprehensive information about wave action, tidal currents and sediment movement. This information was used to develop a mathematical model of the processes operating in the estuary.

The mathematical model was used, in turn, to assess the effectiveness of a range of options for overcoming the problem.

The Port Hacking Marine Delta Management Options Report, which was released in mid 1986, described the results of the study and provided details of the options and the relative effectiveness of each option.

To encourage community discussion, the Management Options Report presented the study findings in a manner which could be generally understood without degrading the level of information for technical and other specialist readers. The detailed technical information upon which the Management Options Report is based is contained in volumes of technical mini reports, computer files and data charts held by the PWD.

As well as identifying alternative management options, the report sought to foreshadow the nature and extent of waterway improvement opportunities which could accompany each of the management options.

The report made no attempt to judge the desirability of any of these opportunities, but sought only to put relevant information before the community.

In light of feedback from the community and Council and having regard to the need for early resolution of the problem, the tombolo option was confirmed as the preferred option. The EIS is directed principally towards this option and provides full documentation of the impacts associated with its implementation, and in so doing, makes extensive use of the detailed understanding of the physical processes operating in the estuary which have been developed since 1980.

Since lodgement of the EIS in December 1987, the Department has proceeded with physical modelling to enable finalisation of a number of detailed design matters in relation to both the orientation of the training wall at the head of the tombolo, the beaches and the channel configurations. As a result, in June 1988, the Department indicated to Council its desire to modify the proposal.

The modified proposal was submitted to the same team of specialist sub-consultants who prepared the original environmental impact statement and they have reviewed their findings and conclusions in light of the revised proposal. These have been incorporated in an addendum to the EIS which was submitted to Council along with details of the revised proposal in June 1988. This primary submission combines elements of the original EIS, the addendum to that EIS, and the modified proposal as appropriate.
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1. THE PURPOSE OF THE PROPOSAL

The Cabbage Tree Point tombolo and its associated works will provide a permanent solution to the shoaling problems in Port Hacking.

The shoaling problems are most pronounced when sediment movement infills the main navigation channels in the estuary. Unlike many NSW estuaries the sediment is not being moved into the estuary from offshore by littoral processes. Rather, it is being reworked from a finite sand mass within the mouth of the estuary. This body of sand which now extends from the vicinity of Cabbage Tree Point to Lilli Pilli Point, is referred to as the Marine Delta.

Sand is being moved progressively from the seaward face of the marine delta under the combined action of waves and tidal currents into the estuary. The active seaward face of the delta is typically at a depth of 2-4 metres below ISLW along a line approximately joining Cabbage Tree Point and Hungry Point. While the delta sediments extend seaward of this point, depths are too great for significant sediment mobilisation to occur.

The proposed tombolo and its associated dredging has been designed to provide a permanent solution to the shoaling problem by significantly modifying existing sediment movement patterns.

This is achieved in the following ways:

* the tombolo will prevent the continued erosion of sand from the seaward face of the marine delta. Sediment movement will then follow the predominantly onshore/offshore movement associated with typical closed beach systems such as Hordern's Beach.

* the tombolo will reduce wave action and strong tidal currents in Simpsons Bay and thereby prevent the circulation of sand within the bay and the vicinity of Burraneer Point.

* the sand required for construction of the tombolo (some 420,000 cubic metres) will be taken from navigation channels, thus directly removing some of the sand responsible for shoaling.

* tidal velocities in the deeper, wider navigation channels will no longer be sufficient to transport large quantities of sand. As there is no nett infeed into the estuary, channels will stabilise at approximately their dredged profile.
2. THE DEVELOPMENT APPLICATION

The tombolo concept which was first outlined in the Port Hacking Marine Delta - Management Options Report formed the basis for more detailed investigation which provided the tombolo layout as described in the Development Application of December 1987. Changes to the tombolo from the concept outlined in the Options Report included alteration to the head of the structure to reduce the length of the rock wall and a significant reduction in the extent of dredging in Simpsons Bay so as to retain the shallow character of the Bay. The EIS (Section 9.4) foreshadowed the potential for further changes to the tombolo as a result of physical model testing. The model testing was being undertaken so as to optimise the position and orientation of the rock training wall and the alignment of the beach on the eastern side of the tombolo.
3. DEVELOPMENT OF THE MODIFIED PROPOSAL

Modification of the tombolo proposal has now been undertaken following detailed testing of the physical model. Regard has also been had to comments made in response to Council's public exhibition of the proposal and the independent review by the Centre of Environmental and Urban Studies at Macquarie University.

In the normal progression of any engineering project from concept to detailed design continual refinement is made to elements of the project. While the refinement of individual elements may be significant, it does not compromise the original concept. In the case of the Port Hacking tombolo, the original concept of the tombolo, dissipating wave energies and training tidal flows, remains.

Before outlining these modifications it is relevant to recapitulate on the manner in which the original dimensions of the tombolo and dredged channels were determined:

* The channel was fixed at a width of approximately 200 metres and a depth of 4 metres below ISLW. This ensured that tidal velocities were sufficient to achieve self-scouring but not so great as to present a hazard to navigation.

* As a result the length of the tombolo sand mass was fixed at some 500 metres.

* The position of the tombolo eastern beach was determined by considerations of stability under storm-generated wave attack.

* The height and width of the tombolo sand mass was determined principally by storm demand but also by consideration of beach amenity.

* The width of the tombolo sand mass and the nearshore zones determined the length of the rock training wall.

The modifications to the proposal are as follows:

* The length of the tombolo sand body has been reduced from 500 metres to approximately 400 metres. As a result, the northern end of the sand mass is some 140 metres south-west of its initial location.

* A short spur wall will extend approximately 50 metres south-west from Hungry Point. The wall will have a crest elevation of approximately 1.0 metre above ISLW (i.e., mid tide level).

* The dredging configuration has been varied. The channel between Hungry Point and the tombolo will be on average 240 metres wide at a depth of 4 metres ISLW. No dredging will be undertaken in the area south of Burraneer Point Channel.
The rock training wall at the northern end of the tombolo has been reduced in length by approximately 15 metres (to a length of 225 metres) and the crest height over the western-most 70 metres has been reduced from 4.5 metres above ISL W to 3.5 metres above ISL W. The height over the central 15 metres has been increased by 0.5 metres.

The crest height of the dune at the northern end of the tombolo has been increased by 0.5 metres. The crest level at the southern end is unchanged at 6.0 metres above ISL W.

Considerations which led to the modifications are as follows:

A zone of flow separation extends for up to some 50 to 80 metres north of the training wall and over its full length. This zone displaces tidal flows onto the northern side of the main channel with potentially adverse consequences for the stability of the southern margin of the Gunnamatta Bay shoal. The physical model revealed that between the training wall and the northern extent of the zone of separation, there existed an area of "dead" water within which negligible flow occurred. This effectively reduced the width of the channel for flow purposes.

Consequently, peak velocities within the main channel increased to above the design level and approximated those currently experienced between Burraneer Point and Deeban Spit.

Review of a range of alternatives showed a training wall running approximately east-west was most effective from a wave reflection/dissipation viewpoint. Further flow behaviour could be best modified by widening the channel between the tombolo and Hungry Point.

 Concurrent with the relocation of the training wall the beach design was modified with regard to average, as well as extreme storm conditions.

A spur wall from Hungry Point at half tide level was included to deflect tidal flows displaced by the zone of separation to ensure there is no significant erosion of the Gunnamatta Bay shoal.

The results of the modifications can be summarised as follows:

The channel between the tombolo and Hungry Point is now on average some 240 metres wide. After allowance is made for the zone of separation (within which there is no significant flow) the effective width of the channel remains similar to that proposed in the EIS. As a result, velocities in the channel accord closely with those predicted in the EIS.

The widening of the channel allows a major reduction in the overall size of the tombolo.

The reduction in the size of the tombolo reduces the overall amount of dredging.

The stability of the Gunnamatta Bay shoal is ensured.
THE ENVIRONMENTAL IMPACT STATEMENT

The development application made to Sutherland Shire Council was accompanied by an Environmental Impact Statement prepared by Planning Workshop with the assistance of a team of specialist subconsultants.

The EIS was prepared in three parts, described as follows:

* Part A comprised a description of the existing environment surrounding the site of the proposed works.

* Part B described the features associated with the proposal, including the need for the proposal, an examination of any alternatives to the proposed works, and the design features of the proposal.

* Part C detailed the likely environmental impacts of the proposal.

Following amendments to the scope of proposed works, an addendum to the EIS was prepared in June 1988. The addendum detailed the changes to the proposed development and re-evaluated the environmental implications of the amended proposal.

The following is a summary of the EIS incorporating the changes made to the proposal since December 1987. It is not intended to be exhaustive but to briefly outline the contents and findings of the EIS. Reference is frequently made to the EIS document and addendum quoting section numbers and pages.

4.1 The Need for the EIS

The Director of the Department of Environment and Planning in issuing the specifications for the EIS determined that the proposal was designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulations, 1980 and advised that an EIS must accompany the development application to the Sutherland Shire Council.

Accordingly, the EIS was prepared under Part IV of the EPA Act in accordance with Clauses 34 and 35 of the EPA Regulation, 1980 and the specifications issued by the Director of the Department of Environment and Planning. The specifications issued by the Director and his determination that the proposal constituted designated development were included as Appendix I of the EIS.

4.2 The Site

The existing environment of the site and surrounding areas is described in detail in Part A of the EIS, and the PWD refer the Commissioner to Section 1 (page 2), in which describes the site of the proposal. Section 2 (page 4), which describes the marine environment, and Section 3 (page 29), which describes the terrestrial environment, likely to be affected by the proposal.
Section 4 of the EIS (page 50) describes the planning controls that apply to the site noting that the Port Hacking waterway is zoned Waterways 7(a) under the Sutherland Planning Scheme which permits (with Council consent) various marine-related activities including reclamation. The site is also within the land to which Sydney Regional Environmental Plan No.9 - Extractive Industry applies under which extractive industry is permissible with Council consent.

Other plans that apply to the site are the Draft Sydney Regional Environmental Plan (Botany Bay) and Sutherland Shire Council's Code for Waterfront Development. Land within Royal National Park is subject to the Park Plan of Management. It was also noted that Sutherland Shire Council has recently prepared and exhibited a Draft Management Plan for Port Hacking.

4.3 Description of the Proposal

The proposed development was described in detail in Part B of the EIS. The need for the proposal was outlined in Section 5 (p.58), the objectives of the proposal in Section 6 (p.81) and Sections 7 to 10 (pp.83-103) contained the project description. The construction programme and energy requirements were outlined in Section 11 (p.105). A short summary of these sections will follow.

4.3.1 Need for the Proposal

Shoaling and Waterway Use

Port Hacking has a long history of shoaling, dating from well before European settlement of Australia. The principal shoaling area responsible for the majority of conflict with the waterway use is the area bounded by the middle ground shoal, Burraneer Point and the Burraneer Bay shoal. Navigation is also affected by shoaling at Lilli Pilli Point, between Burraneer Bay and Lilli Pilli Point and at the entrance to Gunnamatta Bay, Fishermans Bay and South West Arm.

The shoaling of the waterway restricts the use of the waterway not only for recreational purposes, but also for transportation, commercial purposes and tourism. In summary, the shoaling of the waterway:

* creates navigational problems for the Cronulla-Bundeena commuter ferry service;
* renders the estuary inaccessible to craft during adverse weather conditions;
* causes loss of important seagrass beds;
* may lead to a reduction in water quality in the estuary; and
* restricts movement within the estuary for certain craft.

The community has long recognised the need for a solution to the shoaling problem. The vast majority of public submissions to the PWD have advocated a permanent solution to the shoaling problem, and that navigation in the estuary be maintained.
Traditionally, the shoaling problem of the estuary has been addressed by maintenance dredging of navigation channels. In recent years however, the effectiveness of maintenance dredging has been increasingly questioned due to the recurring costs annually, disposal problems, and the need to redredge at frequent intervals to maintain the navigation channels.

4.3.2 Alternative Options for Managing the Shoaling Problem

Following five years of data collection and review, the PWD produced the "Port Hacking Marina Delta Management Options" Report. This report identified shoaling processes within the waterway, and discussed management options to alleviate the shoaling problem.

The Options Report was released:

* to allow the community to understand the shoaling mechanisms in Port Hacking;

* to present, in reasonable detail, a range of management options for Port Hacking which would solve the shoaling problem;

* to clearly and simply describe how these options would work, how well they would work, what effects they would have, and how much they would cost;

* to allow comparisons to be drawn between the options, and preferences to be decided; and

* to encourage interested parties to express their preferences and to participate in the consultative process.

The Options Report was therefore essentially a discussion document, presenting information and asking for comment. To achieve this aim, the PWD used six specific options which were representative of the full range of feasible solutions. These were:

"No adjustment to the natural processes"

A minimum-scale maintenance dredging approach, which provides for maintenance of the Cronulla-Bundeena ferry route only.

Maintenance dredging of the channels

A maintenance dredging approach, wholly funded by the Government.

Commercial sand extraction to maintain channels

A maintenance dredging approach undertaken within the Private Sector.
Engineering works to stabilise channels

A stabilisation approach which provides permanent solutions. For evaluation purposes two different sub-options were considered:

* Deeban Spit Training Wall and Lilli Pilli Groynes
* Cabbage Tree Point Tombolo and Lilli Pilli Groynes.

Major commercial sand extraction

A large-scale permanent removal approach.

The background research for the Management Options examined the practicality of numerous options in their varying permutations and combinations. This is of particular relevance to the evaluation of major commercial extraction proposals where relatively minor variations in the rate or method of extraction or disposal methods have been championed by various proponents as unique proposals worthy of evaluation on an independent basis. The research included indicative costs and feasibilities, a preliminary assessment of major environmental impacts, and other considerations. It also provided the basis for the review of other specific alternatives which were put forward during the discussion period, which followed release of the Options Report.

These main options, together with various sub-options that were put forward to PWD following release of the Options report were discussed in the EIS (pages 63-75) as the alternatives to the proposed development.

4.3.3 Justification for the Proposal

Selection of the proposal over other alternatives considered for solving the shoaling problem is based on the consideration that the proposal best meets the two principal waterway management objectives for Port Hacking, namely:

* to provide a permanent solution to the shoaling problem that will eliminate the need for ongoing maintenance dredging; and
* to provide a solution that will maximise social and environmental values in the waterway having regard to cost.

Justification for the proposal is based on the following social, environmental and economic considerations:

* The proposal provides a permanent solution to the shoaling problem which is recognised by a wide cross section of the community to be a problem which requires a management solution.
* The proposal will provide permanent navigable channels in the waterway for the movement of all recreational craft without tidal restrictions.
The proposal provides a large area of sheltered waterway in the lee of the tombolo which can be utilised for a variety of water-based recreational pursuits.

The proposal is the only management option which protects the long term integrity of Deeban Spit and the shallows west of Deeban Spit.

The proposed tombolo provides an extension of Horderns Beach and Bonnie Vale Beach, allowing additional areas for the high level of use placed on these beaches during the summer months.

The proposal removes the need for ongoing dredging in the waterway and does not require the presence of large dredges in the waterway over a long time period (as the commercial sand extraction option would require).

The proposal will stabilise the shoals within the estuary, allowing for the establishment of seagrass beds.

The protection offered to Simpsons Bay by the tombolo will provide for the spreading of existing seagrass beds.

The proposal will provide a marginal increase in the degree of tidal exchange, ensuring the existing high water quality levels are maintained and even slightly enhanced.

The proposal, with a total value of $6.4 million will be a positive addition to economic activity in the region.

The proposal has a lower capital cost than the Deeban Spit engineering works and provides additional benefits for the users of the waterway due to the shelter offered by the tombolo, the safer, deeper entrance to the estuary and the ecological benefits for Simpsons Bay.

The proposal has a greater cost than the options considered which do not involve engineering works. Justification for the expenditure is based on the following benefits of the proposal over the alternatives which have been considered:

- the proposal is a permanent solution to the shoaling problem;
- maintenance dredging is likely to have latent cost escalations and cannot necessarily be undertaken immediately it is needed;
- the proposal offers significantly improved access to the estuary during adverse weather;
- the proposal will maximise the number of self-maintaining navigable channels within the waterway;
the proposal employs the sand resource for public benefit rather than wasting the resource by deepwater or offshore disposal;

- the proposal does not sterilise the sand resource in the estuary, rather it improves accessibility to the resource;

- the proposal provides a solution which can be implemented without having to rely on market demand for the sand resource;

- the proposal does not involve the establishment of a semi-permanent extractive industry within Port Hacking, either on the waterway or on the foreshores of the waterway;

- the tombolo will provide new beaches and a recreation area for public use;

- the shallow character of Simpsons Bay will be maintained;

- the project will provide direct employment for some 45-60 people during construction;

- the proposal will provide the opportunity for the development of a water-based tourism industry in Port Hacking with larger cruise craft able to navigate in a significantly increased area of the waterway.

Justification for the proposal on environmental grounds is further based on the conclusions of the consideration of each of the major environmental issues addressed in Part C and the overall conclusions of the EIS.

4.3.4 Consequences of not Proceeding with the Proposal

The consequences of not proceeding with the proposal are as follows:

* The waterway will continue to shoal and navigation difficulties will worsen with channels liable to sudden closure.

* There would be no improvement to the accessibility of the estuary during adverse weather.

* The current practice of maintenance dredging to maintain navigation in the estuary for the commercial ferry would need to be continued on a long-term basis. Pressure for extended dredging would be expected to increase.

* New sites for the disposal of dredge spoil will be required to be found, thereby increasing the annual costs of maintenance dredging.

* The community benefits from the creation of a new length of foreshore would not be realised.
4.3.5 Objective of the Proposal

The principal objective of the proposal is to provide a long-term solution to the shoaling problem in Port Hacking and so provide permanent navigation channels in the waterway. A statement of issues relating to this objective was included in Section 6 of the EIS (pages 81-82).

4.3.6 Proposed Dredging Works

Dredging in Port Hacking is required as part of the engineering works to stabilize the existing navigation channels and the marine delta shoals, and to improve navigable access to areas of the waterway. The dredging works have been designed in conjunction with the training works to concentrate and direct tidal flows and improve existing navigation channels in the estuary.

Dredging will be undertaken in two main areas, the lower estuary near the mouth of Port Hacking, and the upstream area in the vicinity of Lilli Pilli Point. Dredged material from the lower estuary will be used to construct the tombolo and that from Lilli Pilli will be used to construct the Lilli Pilli works with surplus material from the Lilli Pilli shoal discharged into deep water north of the shoal.

To provide minimum water depths for safe navigation, dredge depths have been specified to accommodate both passenger ferries and large recreation craft into Gunnamatta Bay and to accommodate only recreational craft upstream of Burraneer Point. Recreational craft with a draught to 3.0 metres will be able to enter Burraneer Bay and craft with a draught of 2.0 metres will be able to navigate upstream of Burraneer Bay to Lilli Pilli Point at all tides. A dredge slope of 5:1 (horizontal:vertical) has been adopted to maintain stability.

The widths of the navigation channels will vary between 40 and 240 metres. The estimated volume of dredge material is 422,000 cubic metres from the lower estuary and 71,000 cubic metres at Lilli Pilli.

It is proposed that the dredging will be undertaken by both a large and a small cutter suction dredge which will discharge the dredged material by pipeline to the tombolo (lower estuary dredging) or the Lilli Pilli spit, and north of the Lilli Pilli shoal (Lilli Pilli dredging).

4.3.7 The Proposed Tombolo

The proposed tombolo would consist of a sand body extending approximately 400 metres in a northerly direction from Cabbage Tree Point. The length of the tombolo is fixed by hydraulic considerations which determine the cross-sectional channel area needed between Hungry Point and the end of the tombolo. This is necessary to ensure that tidal velocities are sufficient for the channel to be self-maintaining. A training wall would be located at the northern end of the tombolo to maintain a stable navigation channel at the mouth of Gunnamatta Bay. The tombolo would consist of sandy beaches and beach berms on both the western and eastern sides and a vegetated dune system.
The design of the tombolo and training wall has been based on the following criteria:

* The tombolo sand body and training wall will remain stable under design wave conditions represented by a 6 hour duration storm with a return period of 50 years.

Under the design conditions there will be no overtopping of the tombolo dune. For very extreme storm events with a return period greater than 50 years the tombolo dune is to sustain only minor overtopping that will not result in any back beach erosion or damage to any proposed tombolo landscaping.

The width of the tombolo dune to be sufficient to meet the storm erosion demand of three 50 year return period design storm events in succession, assuming no intervening beach recovery. (Note: this represents an event with an extremely low probability of occurrence.)

**Tombolo East Beach**

Based on an analysis of the beach response to wave attack the optimum equilibrium design beach profile determined for the tombolo east beach is as follows.

- **Nearshore slope** - from elevation 2.4 metres above ISLW to 2.0 metres below ISLW - 1:15 (vertical:horizontal)

- **Offshore slope** - from elevation 2.0 metres below ISLW to the existing seabed elevation - 1:40 (vertical:horizontal)

A beach berm 30 metres wide at a nominal elevation of three metres above ISLW would be provided as a beach amenity.

**Dune System**

A vegetated dune system is proposed to run generally north-south along the centre of the tombolo. The dune would be a minimum of 12 metres wide at a crest height of 6.5 metres above ISLW and the northern end tapering to six metres above ISLW at the southern end. Slopes of 1:5 (vertical:horizontal) would apply to the beach berm on both sides of the dune. The dune crest height and width have been selected so as to prevent wave overtopping under storm conditions.

**West Beach**

The slope of the west beach has been determined at 1:10 vertical:horizontal from an elevation of three metres above ISLW to the existing seabed elevation. This slope not only represents a stable beach profile for the wave climate in the lee of the tombolo, but would also provide a shallow beach slope for recreational use. A beach berm with an average width of 30 metres at an elevation of three metres above ISLW would also be provided at this location.
4.3.8 Tombolo Training Wall Rock Gabion Wall and Hungry Point Spur Wall

The training wall would be approximately 225 metres long, oriented in an east-west direction and would comprise quarried rock to form a conventional rubble mound wall and armoured slopes. A clear distance of 260 metres would be retained between the eastern tip of the rubble mound wall and the Hungry Point spur wall to the north east.

Training Wall Plan Configuration

The plan configuration of the training wall has been designed so as to follow the tombolo sand body section profile both for the equilibrium design beach profile and the anticipated erosion beach profiles under design storm conditions. To minimise the potential for alongshore drift on the western side of the tombolo and to minimise rock quantities, a small rock gabion wall would be constructed and a small beach would be formed on the tombolo north west corner.

Training Wall Sections

The crest elevation of the training wall has been established as the minimum that would facilitate construction and follow the design sand body beach profiles. The west end of the rubble mound wall would be nominally at an elevation of 3.5 metres above ISLW and would rise to an elevation of 6.5 metres above ISLW over the central 15 metres (to match the dune height). The eastern end would be nominally at 4.5 metres above ISLW.

The east and west ends of the training wall for a total length of approximately 170 metres would comprise a rubble mound wall with a crest width of approximately 10 metres and side slopes of 1:2 (vertical : horizontal).

For approximately 90 metres at the mid section of the tombolo sand body the training wall would comprise an armoured slope placed directly against the sand fill. Quarry run bunds would be used to establish a fill slope of 1:2 (vertical:horizontal). A two layer rock armour system would then be placed against the quarry run. The two layers would comprise a rock underlayer and primary layer of the same thickness and rock size, as for the rubble mound wall design. A synthetic filter fabric would be required between the sand fill and the quarry run bunds to assure full containment of the sand with no leaching through the armour layers.

Rock Gabion Wall

The rock gabion wall would comprise well graded rock with a median size of approximately 10 kilograms placed in prefabricated wire cages. These cages would then form individual components used to construct the rock wall. The gabion wall would be placed on the sand fill and would be approximately 60 metres long and follow the design beach profile. The wall would vary up to two metres in height but would not protrude above the design beach profile by more than one metre.
Hungry Point Spur Wall

A 50 metre long wall is to be built in a generally south westerly direction from Hungry Point. The wall will have a crest level of 1.0 metre above ISLW (approximately half tide level) and will be built entirely of five tonne armour stone. The wall would have a crest width of approximately three metres and side slopes of 1:2 (vertical:horizontal).

Rock Quantities

Based on the design plan configuration and cross sections for the training works as outlined above the total quantity of rock to be used in the construction will be 51,000 tonnes.

Method of Construction of Tombolo Sand Body

The tombolo sand body would be constructed from sand dredged from navigation channels and areas of the waterway in the vicinity of the tombolo site. Sand would be pumped directly from cutter suction dredges and deposited on the tombolo. In summary the sand would be deposited at Cabbage Tree Point and filling would progress in a northerly direction, the dredge pipeline would be laid on top of the fill area above high water level.

The dredged sand would be placed at or near the final fill elevation of three metres above ISLW. Sand would be discharged from the pipeline at the top of the advancing fill slope. A bulldozer would be operating continuously during the filling operations to ensure there is no ponding behind the advancing fill slope. By this method it is possible to achieve a high degree of fill consolidation and ensure that the fill is adequately drained. Finally, the dune system would be constructed from material stockpiled on the tombolo.

Above low water level the tombolo would be graded by bulldozer to form the required design profile. Below low water, sand would be placed by a flexible pipeline attached to a floating pontoon with a down pipe discharging at the seabed. The pipeline would be moved to ensure an approximately even distribution of sand at the required location. Wave action will then reshape the profile to a stable configuration. The northern end of the sand body would be filled to a stable slope, to allow construction of the tombolo training wall.

Method of Construction of Tombolo Training Wall and Rock Gabion Wall

Tombolo Training Wall

The construction of the training wall would commence following substantial completion of the tombolo sand body. The northern end of the tombolo sand body would be filled to a stable slope. The construction of the training wall would take place in two parts; the armoured slope and the rubble mound wall sections.
Armoured Slope Section

All quarry run and rock armour would be carted to site by trucks. A short access bund of quarry run material, running from the top of the sand fill slope in a northerly direction, would initially be constructed by end tipping. The quarry run bunds running in an east-west direction would then be constructed from the access bund again by end tipping from trucks.

For the armoured slope section of the training wall a quarry run bund would be constructed from the existing seabed to approximately mid tide level at the final alignment of the training wall. Sand fill would be placed behind the quarry run bund to the top of the bund. A second quarry run bund would then be constructed to the finished training wall elevation. Once again sand fill would be placed behind this bund to the required fill elevation.

The quarry run bund would then be armoured with the rock underlayer and primary rock armoured layer.

The armoured slope underlayer comprising 0.5 tonne rock would be tipped from trucks down the slope and graded with an excavator. The five tonne primary armour layer would be placed by end tipping from trucks at the top of the slopes.

Rubble Mound Wall Section

Following construction of the armoured slope section of the training wall the rubble mound wall sections extending to the east and west would be constructed. Again, all rock armour would be carted to the site by trucks. The walls would be constructed by end tipping the quarry run core from trucks. The core would then form a base for trucks that would end tip the underlayer and primary layers. These layers would be placed on the wall slopes as the core was extended. Following completion of the core the underlayers and primary layers would be placed at the head of the wall. The primary armour on the wall crest would then be placed by end tipping from trucks working progressively from the head of the wall back towards the middle of the tombolo.

Following completion of construction, sand fill would be placed adjacent to the walls to the required beach profile.

Rock Gabion Wall

The rock gabion wall would be placed following construction of the tombolo sand body including the grading of the beaches. Individual gabion units would be constructed by filling wire cages using an excavator or a small grab on a crane. The gabion units would then be placed by crane at the required location to form the required wall configuration.

Hungry Point Spur Wall

For the construction of the Hungry Point spur wall, armour rock would be placed directly from a barge which would be loaded from the tombolo site. No land based plant or land access would be used on the Hungry Point site.
4.3.11 Truck Access

Construction vehicles would gain access to the tombolo through Bonnie Vale and along a new gravel road to be constructed onto the tombolo. Following completion of the construction works, the road would be retained for maintenance, service and emergency vehicles only.

4.3.12 Stabilisation

The dune of the tombolo will be vegetated within a succession of dune vegetation consisting of primary species (marram grass and spinifex), secondary species (acacia, leptospermum and casuarina) and tertiary species (banksia and eucalyptus). The location of the different species on the tombolo would be related to the degree of exposure to sea breezes. Planting time for the secondary and tertiary species would follow the establishment of the primary and secondary plantings.

A temporary fence would be constructed during the planting and establishment period of the vegetation. Paths and signposts would be provided for visitors.

4.3.13 Proposed Lilli Pilli Works

The works at Lilli Pilli would comprise a curvilinear sand spit constructed on the Lilli Pilli shoal to form a training wall to the navigation channel. The spit would comprise sand dredged from adjacent navigation channels and stabilised by rock gabion walls at each end and at two locations along its length. The spit would not be connected to the land at any point.

The groynes would be constructed from rock gabion units of sandstone placed in prefabricated wire cages. Sandstone would be obtained from quarries in the Menai area. The total quantity of rock required is estimated to be 1,500 tonnes. Rock would be transported to the tombolo site by truck and from the tombolo site to Lilli Pilli by barge.

The Lilli Pilli spit would be stabilised within the same primary species as the tombolo (marram grass and spinifex). No fences or other structures are proposed.

4.3.14 Construction Programme

Construction would be undertaken in two distinct areas, the lower estuary and at Lilli Pilli. The construction works which are to occur are summarised as follows:

Lower Estuary Works

Stage 1 - Dredging

Dredging in the lower estuary would be undertaken by a large and a small cutter suction dredge which would dredge the lower estuary. It is estimated that the large dredge operation would be complete in 18 weeks. A small cutter suction dredge would then be used for a further six weeks for the trimming of dredged slopes and high spots.
Stage 2 - Construction of Tombolo Sand Body

The Tombolo sand body would be constructed from sand dredged from the lower estuary. The total construction time, including placing of all sand fill and grading is approximately 39 weeks.

Stage 3 - Construction of Tombolo Training Wall

The construction of the Tombolo training wall, the rock gabion wall and the Hungry Point spur wall would take place following substantial completion of the Tombolo sand body. It is estimated that construction of the walls would be complete in 30 weeks.

Stage 4 - Tombolo Landscaping

This would be undertaken in 5 phases over a 5 year period. These phases include a period in which the tombolo is left to desalinate itself, followed by a soil enriching period and initial planting. The following phases involve maintenance, repairs, fertilisation, and the planting of other species of grasses, shrubs and trees.

Lilli Pilli Works

The following works would be undertaken at Lilli Pilli:

Stage 1 - Dredging

Dredging using a small cutter suction works would commence following the dredging of the lower estuary. Its completion period is estimated as 16 weeks.

Stage 2 - Construction of Lilli Pilli Spit and Rock Gabion Wall

The Lilli Pilli spit sand body would be constructed from sand dredged from around Lilli Pilli. Construction time is estimated at 8 weeks. The rock gabion wall for the spit would be prefabricated at the Tombolo site, and transported to Lilli Pilli by barge.

Stage 3 - Landscaping

The landscaping of the spit would be undertaken in 3 phases over a 4 year period. The initial landscape works would commence upon the completion of the training wall, and would take approximately 3 weeks to complete. Further planting would take place 6 months later. Replanting and maintenance would be undertaken for the following 3 years ensuring plant establishment on the spit.

4.3.15 Alternatives to the Construction Process

In implementing the proposal, a number of alternatives relating to the landscape design of the proposal, the access route to the Tombolo, the mode of transporting rock to the Tombolo, and the size of dredges to be used. These alternatives, together with the reasons for choosing the preferred alternative, are briefly described below.
Alternatives to the Dimensions of the Tombolo

As stated, the length and width of the tombolo were fixed by engineering design requirements. However, three options were evaluated which varied the profile of the tombolo.

The preferred option is the one which adopts the minimum elevation that can be achieved on the tombolo. It was chosen because it had least visual impact, and retained views across Port Hacking. The other 2 options involved raising the elevations of various parts of the tombolo, resulting in partially obscured views across the waterway.

Alternative Access Routes

Vehicular access to the Tombolo is required during the construction period, and afterwards for maintenance. Access options included via Simpsons Road, or via Bonnie Vale through the Royal National Park along an existing access road. On balance, it was decided that the latter option was most appropriate as it was associated with less disruptive occurrences.

Alternative Dredging Methods

Options for dredging the sand to form the Tombolo were using two small dredges, or one large dredge. Using two small dredges would have resulted in a longer construction time; and using one large dredge would not have resulted in optimal dredging efficiency. For this reason, the use of a large and small dredge was considered to be the most appropriate.

Alternative Method of Training Wall Construction

Training wall construction may be either from land or from water. It was considered that the land band option was most suitable, as it would have a shorter construction period, and would be less costly.

It would be possible to construct the Hungry Point spur wall using land based plant, and this would be marginally less expensive than the proposed water based method. As water based plant will be on site for the construction of the Lilli Pilli groynes, it will also be employed for the Hungry Point spur wall.

4.4 Compliance of the Proposal with Statutory Planning Instruments

The proposal's compliance with statutory planning instruments and policies is as follows:

Local Planning Instruments

The proposal falls within the definition of extractive industry and reclamation. The proposed use for reclamation is permissible with consent from Council within the Waterways 7(a) zone. The proposed use for extractive industry is not permissible under the Sutherland Planning Scheme, but is permissible under Sydney Regional Environmental Plan (SREP) No.9 - Extractive Industry which overrides the local planning scheme.
Regional Planning

Sydney Regional Environmental Plan No.9

The general aim of this plan is to ensure the future viability of the extractive industry by protecting deposits of regional significance, and to ensure that any extraction is carried out in an environmentally acceptable manner.

The proposal generally complies with this objective. It sterilizes some 2 per cent of the total resource in the construction of the Tombolo, and the clearing of navigation channels shall result in improved access to the remainder of the resource for extraction purposes, should this be necessary.

Draft Sydney Regional Environmental Plan (Botany Bay)

The proposed development is in compliance with the objectives of this plan, having regard to its regional objectives for air quality, water quality and environmental heritage, and is generally in compliance with regard to its objectives relating to wetlands, foreshores and waterways and extractive industry.

Royal National Park Plan of Management

The proposal is outside the Royal National Park, with the exception of the access road through Bonnie Vale, and a temporary storage compound. An application for a licence will need to be made to the National Parks and Wildlife Service for permission to temporarily use and occupy these lands.

Draft Port Hacking Management Plan

The proposal complies with the objective of this plan, with the exception of the provision of an all weather ferry service to Bundeena.

4.5 Environmental Impact Assessment

Part C of the EIS assessed the impacts that would arise as a result of carrying out the proposed development as previously described. The following discussion takes into account the conclusions of the reassessment of the proposal following the design changes. The reassessment is contained in the addendum to the EIS.

4.5.1 Physical Impacts Upon the Water Body

The proposed works will slightly increase the tidal range and the tidal prism upstream of the works. The proposed works, by design, will involve significant changes to the existing tidal currents, wave environment, and sediment movement within the waterway. These changes are necessary in order to achieve a long-term solution to the shoaling problem.

No adverse impacts on existing physical processes are envisaged as a result of the works. Localised changes will occur along the dredged channels, due to stirring action by waves and increases in tidal velocity. However, any such changes will be limited and will not affect the stability of the channels or the adjacent shoals.
The tombolo will modify the near-surface wind fields, by creating a local wind shadow area, but these effects will be restricted to a relatively short distance of approximately 80 metres downwind of the tombolo.

The tombolo has been designed to satisfactorily withstand a sequence of extreme storm conditions. Major sediment movement will be onshore/offshore movement associated with this storm activity. Erosion of the seaward face of the tombolo during storms will be followed by a period of beach recovery, characteristic of all sandy beaches exposed to ocean waves, including nearby Horderns Beach.

The proposed works will provide navigation channels which are wider, more stable and, in some areas, deeper than has historically been the case in Port Hacking. Tidal velocities through the new entrance will be increased from existing values, but will be about half of the current velocities which are experienced at Burraneer Point and comparable to those of other major recreational boating waterways. Moreover, wave steepness will be less at the new entrance than for existing entrance conditions. Overall, the proposed works will considerably improve existing navigation conditions.

Construction of the tombolo will create a large protected waterway in Simpsons Bay, suitable for a wide range of recreational activities. The tombolo will also provide approximately one kilometre of protected and semi-protected sandy foreshore and beach suitable for recreational activities including wading, swimming, sunbathing, picnicking, fishing, and sailboarding. These represent substantial positive impacts of the works.

The construction of the tombolo would also be expected to necessitate some modification of existing surfing and sailboarding practices.

No other impacts arise from the amendments to the proposal.

4.5.2 Water Quality

The proposed works will have an insignificant impact on the water quality of Port Hacking. The velocities in Simpsons Bay will be greater, and the residence time is therefore shorter than under the original proposal, and hence Simpsons Bay will continue to have satisfactory tidal flushing and water quality. The lower velocities and longer residence time predicted for Simpsons Bay for the original proposal will not arise under the modified scheme. The tombolo would affect oxygen levels in Simpsons Bay, but the expected changes will be minor and are likely to be considerably less than natural variations in oxygen concentration within the Bay. A slight improvement in water quality could occur in the deep layers of the upper bays due to the very small increase in tidal prism and channel depth.

No other impacts arise from the amendments to the proposal.
4.5.3 Impact Upon the Marine Environment

The proposed tombolo and associated works will have a very significant impact on the marine ecology of Port Hacking. The most important beneficial impacts that have been identified include:

* stabilisation of sandy, unvegetated shoals which is likely to lead to increased abundances of fish on their shoal tops;
* creation of a large subtidal artificial reef (i.e. the tombolo training wall) at the entrance to Port Hacking, which is likely to attract and support a valuable rocky reef fauna;
* prevention of possible infilling at the Shiprock Aquatic Reserve, which will help to preserve the deeper reefs of the Reserve, including the reef pinnacles;
* a likely increase in the total area of seagrasses occupying the marine delta, particularly in Simpsons Bay, on the shoal top at Burraneer Bay and on the shoal top at Lilli Pilli;
* creation of an additional sandy and rocky shoreline around the tombolo, and of a small island at Lilli Pilli for birds to utilise;
* creation of additional shoreline and sheltered waters for recreational anglers;
* creation of a beach along the eastern side of the proposed tombolo which could be suitable for commercial beach hauling, if the present closure boundary is re-aligned.

The negative impacts of the project include the loss of sandy subtidal habitat at the reclamation sites and the possible changes to fish migration patterns due to the narrowing of the estuary entrance. While the loss of this habitat will be partly compensated by the creation of new habitats on the tombolo and spit, the nature of changes to fish migration patterns cannot be determined without further, more intensive study. A long term potential consequence of the proposed development is the likely increased recreational activity in the waterway. An increase in such activity is likely to occur irrespective of the management option adopted because of the improved navigation, the increase in Sydney's population, the increase in leisure time, and the popularity of water activities. Future management strategies should take into account the effect of increased boating on the marine ecology of the estuary. The management of recreational boating in the waterway has been addressed in the Draft Port Hacking Management Plan, 1988, prepared by Sutherland Shire Council.

4.5.4 Air Quality

The proposed works have minor potential to affect the air quality of Port Hacking from the time of commencement of dredging until the sand body is fully planted and stabilised against wind erosion. The impact is therefore short-term.
All construction equipment and road trucks would need to meet the requirements of the Clean Air Act, and therefore such emissions would be controlled to acceptable standards.

Dust is likely to be raised during the training wall construction period, but can be effectively controlled by the watering of the tombolo access road.

No changes to these conclusions arise from the amended proposal.

4.5.5 Noise Impacts

Potential Sources of Noise

Noise impacts arising from the tombolo are limited to its construction period. Potential noise generating agents include the following:

* Dredging in which the noise is generated by diesel engines or associated hydraulic pumps; or by impulsive noise produced by metal to metal contact.
* Trucking operations involved in transporting materials to Cabbage Tree Point.
* The use of a bulldozer and cranes which is required for the construction of the Lilli Pilli spit.
* The use of a barge and crane to construct the Hungry Point spur wall.
* Noise associated with the construction of the tombolo.

The residential areas bordering on Port Hacking currently experience a relatively quiet environment. The majority of the operations associated with the proposal will generate noise which conforms to the latest environmental criteria recommended by the State Pollution Control Commission for major public works, provided appropriate precautions are taken.

Any potential noise impact may be minimised by selection of appropriate equipment and by undertaking specific engineering noise control on the noisiest equipment. However, it will still be necessary to limit the hours of operation of specified classes of equipment, the most significant classification in terms of potential acoustical impact will be the bulldozers. It is also recommended that trucking operations should not be permitted before 7.00am, nor after 6.00pm.

The problem of dredging noise and its potential impact on the residential areas can be satisfactorily resolved by the limitation on the use of dredges to daylight hours.
4.5.6 Visual Impact

The Tombolo

The tombolo has a visual impact on all views looking from, or towards Cabbage Tree Point, especially panoramic views. The views most affected by the tombolo are those which look down or up the length of the tombolo from Cabbage Tree Point, Burraneer Point, or Hungry Point. While the tombolo reduces the visual quality of these existing views, they will still be views of significant visual quality.

In terms of the levels of assessment undertaken, the following conclusions can be made regarding the visual impact of the tombolo:

* In terms of the overall scale and appearance of Port Hacking's visual catchment, the tombolo will not significantly alter the total visual environment. The tombolo's visibility will largely be restricted to lower Port Hacking, and in this context, it will alter the area's appearance chiefly by reducing its visual continuity. However, it will be sympathetic to the character of this zone. The only feature that makes the tombolo look man-made is the rock training wall, whose long, straight, uniform appearance does not relate to any of the surrounding landscape features. The tombolo will echo and extend the existing visual land units of lower Port Hacking in the same proportions and combinations as they presently exist. However, it will decrease the area of visible water. The tombolo thus will appear to be a natural extension of the landform of lower Port Hacking.

* Through its placement in the centre of lower Port Hacking, the tombolo will be of high visibility to residents and the public, and becomes the middleground focus of views of the area. It reduces the visual quality of most of the views of lower Port Hacking, especially views looking up or down the length of the tombolo. However, all views of lower Port Hacking containing the tombolo will still be of great visual appeal.

Lilli Pilli Works

The following conclusions can be made regarding the visual impact of the Lilli Pilli spit:

* The overall scale and appearance of Port Hacking will not be altered by the construction of the spit. The spit's visibility is mainly restricted to upper Port Hacking, being only marginally visible from middle Port Hacking. Being a relatively small structure placed on the boundary of the two broad visual zones, the spit will not alter the character of either zone. The spit will slightly decrease the area of water at Lilli Pilli Point, increase the area of visible sand, rock and vegetation, thus slightly altering the visual land units of upper Port Hacking, but not detracting from its overall appearance.
The spit will be visible to some of the waterfront residents of Lilli Pilli Point, and to a lesser degree, some of the residents of Willarong Point and Yowie Point. It will be plainly visible to recreationalists entering or leaving upper Port Hacking by boat. It will not be seen by as many people as the tombolo.

The spit will slightly decrease the visual quality of views looking directly from Lilli Pilli Point (rocky foreshore of reserve) and has a small, relatively insignificant impact on more distant panoramic views from Willarong Point and Yowie Point (ie. slightly decreases their visual quality).

Measures to Improve Visual Compatibility

The visual compatibility of the tombolo and spit in their proposed environments could be improved if the following measures could be implemented.

Both proposals would be improved by the rocks being more randomly placed along walls and gabions, especially at the edges where the larger rocks should appear "teased out". The use of sandstone on the tombolo would be a more appropriate surface material than basalt. Straight lines or rock should be avoided. All rock surfaces should consist of various sized rocks, randomly laid in a varied profile.

The tombolo relies largely on vegetation for its visual compatibility in lower Port Hacking. As vegetation requires time to establish, and is subject to fluctuations, it is suggested that the tombolo's surface profile, particularly at the northern end, be given a certain amount of moulding and variety. This surface modulation would improve its overall visual compatibility in Port Hacking.

The conclusions of the visual assessment remain unchanged as a result of the amendments to the proposal.

4.5.7 Traffic and Parking

The traffic and parking implications of the proposal fall into 2 groups - those resulting from construction and those resulting from the extended beach frontage.

Construction Implications

The primary traffic impact during construction of the tombolo will be the transport of rock to the site for the tombolo training wall, and rock gabion walls. In this respect, the greatest load would occur in the period commencing at the fifth month of the project, until the end of the eleventh. The material will be transported by trucks of various sizes.

During this period there will be about 130 truck movements per week to and from the site. These will split 75/25 between the northern and southern approach routes. These trucks will only represent about one to two per cent of average daily flows. Whilst any increase in truck movements in the environs of the National Park is likely to be noticeable, the fact that they will not operate at weekends, and that the construction will occur over a defined period, should make it an acceptable impact.
Increased Attraction on Completion

Once the tombolo is completed, its main traffic impact will relate to the increased attraction of the extended beaches. This will have the effect of attracting more people to the beaches, particularly in summer, thereby increasing the number of cars travelling to Bundeena and Bonnie Vale and seeking to park there once they arrive.

On the basis of survey data, it has been estimated that the number of people attracted to the beach would increase by no more than 5 to 10 per cent. This would result in an increase in the number of cars parked in the area of 25 to 50 cars on a busy summer Sunday. This would translate into an increase in traffic on the approach roads of one to five per cent of average flows. At other times, increases in traffic will be minor.

The amendments to the proposal will not increase the total number of truck movements during construction. Hence the conclusions of the traffic assessment are unchanged as a result of the amendment to the proposal.

4.5.8 Implications for the Royal National Park

Although the site for the proposed works extends throughout the lower and middle estuary, the main concentration of construction activity will be at Bonnie Vale and Cabbage Tree Point, within the Royal National Park.

Impact of Increased Road Traffic Upon the Flora and Fauna Within the Park

This impact relates to the potential for the accumulation of heavy metals into the metabolism of roadside flora and fauna; and the potential for collisions between vehicles travelling through the park, and wildlife. In terms of the former, it is felt that there is little potential for significant impact from this source. Regarding the other potential source, it should be noted that trucks travelling to and from Bonnie Vale will pass along well-established roads that already carry a relatively high number of vehicles and therefore, the potential for collisions with wildlife from the increased number of vehicles during construction would only increase the degree of existing potential. The restriction of truck movements to daylight hours will reduce the potential impact, and the imposition of a temporary truck speed restriction during the construction period would be advisable. Additional signposting at potential wildlife collision locations should also be considered.

Effect on Park Visitors Generally

In a general sense, the proposed works will have an insignificant effect upon the users of the Royal National Park due to the localized nature of the developments in comparison to the large area of National Park.

The actual effects on users of the Park would occur during the construction period. These impacts would be of short-term duration, and would be minimal, due to the truck movements being confined to the weekday periods when Park visitation is not at peak. There is a greater likelihood of conflict between Park users and truck movements during the summer school holiday period, and a suspension of rock deliveries may be necessary at this time of the year.
Effects on Bonnie Vale

Short-term impacts on Bonnie Vale will be associated with a temporary construction compound and the effects of truck movements. Longer-term impacts include road upgrading and construction, and the effects of increased visitation. With regard to the latter, the Public Works Department has made a commitment to assist financially with the redevelopment of Bonnie Vale to provide facilities for future visitors. Such redevelopment would aim to improve facilities for passive recreational use of the area, and would be undertaken under the terms of the Plan of Management for the Royal National Park, taking into account the real increase in visitation and associated management problems. Increased parking at Bonnie Vale as a result of tombolo visitation is estimated to be in the order of 25 to 50 vehicles on peak days.

Aboriginal Archaeology

No items of Aboriginal archaeological value are to be affected by the proposed works on the southern foreshore of the Port. A disturbed midden is likely to be covered by fill and consent to destroy the site will be sought from NPWS prior to work commencing on the tombolo.

Archaeological investigations of the site of the Hungry Point spur wall have not identified any archaeological evidence that may be affected by the proposed works.

No other impacts have been identified as a result of the amendments to the proposal.

Impacts on Land and Waterway Use

The proposed development will have effects upon the existing use of adjacent land, and the use of the waterway for recreational and commercial purposes.

Adjacent Land Use

The impact of the proposal on adjacent land use would result from noise during the construction period, and from the visual impact, and increased visitation upon completion of the works. Residences most likely to be affected would be those on Cabbage Tree Point, and on peninsulas in the lower estuary.

Waterway Use

The proposal would have a net beneficial effect on foreshores in the estuary as existing foreshores would generally be unaffected and the tombolo will double the length of existing beaches on either side of Cabbage Tree Point. Waterway users most likely to be affected by the proposal would be surfers and windsurfers, from the loss of waterway, the effects on wave climate and the wind shadow effect of the tombolo. Small boat users would benefit from the sheltered waterway behind the tombolo, as would windsurfers and junior sailors. Benefits to larger craft will be considerable due to the improvements in navigation.
The proposal is likely to increase the demand for recreational boating facilities in the waterway, yet the expression of such demand will be limited by the capacity of existing boating facilities. The provision of additional facilities is expected to be addressed in Council's forthcoming Draft Port Hacking Management Plan.

The changes to the proposal will reduce the area of waterway lost and increase the width of waterway available for boating at the main entrance channel. The amended proposal will not involve any dredging of Simpsons Bay, hence the existing recreational activities within the Bay will be unaltered as no larger craft will be capable of entering the shallow bay.

4.5.10 Socio-economic Impacts

Community Impact Generally

It was concluded that the proposed development would have an impact on local communities in the vicinity of the proposed works. However, such impact is unlikely to affect the composition of the community, total population, or cause community severance. The construction impacts will be experienced by residents who have frontage to the waterway and those at Lilli Pilli and Bundeena that would be subject to noise from construction vehicles and equipment. These impacts would be of short-term duration.

The main long-term impacts would include visual impacts and the effects of increased visitation to Bundeena during peak summer and holiday periods. The local community, which is recognised as being water-oriented, will benefit from the improvements to navigation in the waterway. The local community of Bundeena and Maianbar would also benefit from the increased area of open space, the increased length of local beaches, and the potential created to meet other local recreational needs in the future.

Obviously, the fulfillment of goals for the regional resource of the waterway will have an impact on the local community. However, this community benefits from its proximity to the regional resource and improvements to the resource for the benefit of both the local and regional community should not be overly compromised by local impacts, providing those impacts are of an acceptable magnitude.

Overall, there will be benefits from the proposal to a wide range of existing and potential users of the waterway and its foreshores over the long term future.

Economic Considerations

The proposed development would be undertaken at a cost of $6.4 million (1987 dollars), which would be expended on:

* engineering and landscape design;
* dredging works;
* construction equipment;
* quarry rock;
* landscaping works;
* fences, signs, etc.
The improvement to navigation in the estuary will benefit recreational users of the waterway. The increased confidence in the navigation channels is also likely to result in a renewed interest in commercial cruise craft operations on Port Hacking, and possibly to a similar interest in ferry services to upstream locations.

No known local business in the local area or Port Hacking region is expected to be adversely affected by the proposal, and the expected increase in interest in recreational boating on the waterway would have positive implications for small business in the marine industry. Employment during the construction of the project will average 45 to 60 people.

The visual impact of the proposal will have a direct impact on the value of a limited number of waterfront properties, particularly those on Cabbage Tree Point. The magnitude of the impact on the Cabbage Tree Point properties will, however, be lessened by the high elevation of these properties in relation to the tombolo.

The existing views of the waterway will be altered from immediate water views to more distant water views over a landscaped open space (the tombolo). Houses north of Crammond Avenue will retain a continuous view over landscaped parkland and the more distant waterway of Port Hacking, and will not overlook roads or any buildings. Their privacy and general ambience will largely be retained.

Based on advice from professional valuers, the values of sites north of Crammond Avenue are likely to exhibit a significant decline in existing values. The degree of such change in land values is, however, dependant upon individual preferences for views over parkland as opposed to views over water. It is also relevant to note that the existing properties generally do not have direct access to the water due to their elevation above the tombolo site, hence the change in views rather than the loss of direct access to the waterway is likely to be of greater significance. It is noted that other options which involve engineering works would also affect properties in a similar manner and such solutions are far less desirable, having regard to other economic and environmental costs.

The solving of the shoaling problems and assumed improvement in boat access provided by permanent deep navigation channels, together with the creation of additional beach areas for recreational use can be expected to enhance values generally throughout the estuary in the long term.

No changes to the socio-economic assessment arise from the amendments to the proposal.

4.5.11 Environmental Safeguards

Environmental safeguards that were identified in the environmental assessment were outlined in Section 24 of the EIS (pages 209-211).
Conclusion of the EIS

This EIS assessed the likely environmental impacts of the Port Hacking Tombolo and associated works at Lilli Pilli. The EIS found that proposal will provide a permanent and long term solution to the shoaling problems presently existing within the waterway, and will have considerable benefits for users of the waterway and its foreshores in the short and long term future. The EIS stated that it was likely that certain adverse impacts would arise during the construction period. However, such impacts will be acceptable in the short term with the adoption of the recommended safeguards.

Specifically, the EIS concluded that:

* the proposal will provide a permanent solution to the shoaling problems of the estuary;
* the proposal will cause no significant undesirable changes to the hydraulic regime of the estuary;
* the proposal is a permissible use, with Council consent, and is compatible with regional planning policies;
* short-term impacts on Royal National Park and residential amenity will be acceptable with the implementation of recommended safeguards;
* the proposal will have a net positive impact on recreational use of the waterway and its foreshores;
* the tombolo will result in a change in visual quality of the lower estuary;
* the Lilli Pilli spit will have a minor impact on visual quality of the middle estuary;
* the proposal will have a number of positive impacts on the marine ecology of the estuary and undesirable impacts would be minimised by the monitoring and control of dredging activities in the sensitive areas of the estuary;
* the proposal will improve navigation and provide a safe entrance channel to Port Hacking; and
* the implementation of the planting programme will protect the proposed works from wind erosion and will contribute to the visual compatibility of the works.

The conclusions of the EIS remain unchanged following the assessment of the amendments to the proposal as detailed in the EIS addendum.
5. REVIEW OF SUBMISSIONS MADE IN RESPONSE TO THE EXHIBITION OF THE APPLICATION

5.1 Overview of Submissions

A total of 444 submissions were received in response to the public exhibition of the Port Hacking Tombolo Environmental Impact Statement, between 18th January 1988 and March 25th 1988. These submissions represented the views of both government authorities, community groups, and individuals who were both supportive and opposed to the tombolo.

5.1.1 Submissions from Government Authorities

The following government authorities provided comments on the EIS, in particular, on those sections of the EIS relevant to their statutory responsibilities.

- Department of Agriculture, Division of Fisheries
- Crown Lands Office
- Department of Environment and Planning
- Department of Main Roads
- Department of Mineral Resources
- Maritime Services Board
- Australian Museum
- National Parks and Wildlife Service
- Soil Conservation Service
- State Pollution Control Commission
- Sydney County Council
- Telecom Australia
- Urban Transit Authority

The issues raised in the 13 submissions from these government authorities and the PWD's response to these issues is discussed in Section 5.2 of the primary submission.

5.1.2 Submissions from Community Groups

The following nine Community Groups lodged submissions in relation to the proposal.

- Port Hacking Protection Society
- The National Trust
- Friends of the Hacking River
- NSW National Parks Association (Southern Sydney Branch)
- The Sutherland Nature Conservation Council
- The Oatley Flora and Fauna Society
- People for Port Hacking
- Real Friends of Port Hacking
- Coast and Wetlands Society Incorporated

A summary of the issues raised by these groups and the PWD's responses to these issues raised in their submissions appears in Section 5.3 of the primary submission.
5.1.3 Submissions from Private Citizens

The remaining 422 submissions were lodged by private citizens, residing both within and outside the Bundeena/Maianbar area.

A broad geographical breakdown of the source of the private submissions opposed to the tombolo is as follows:

<table>
<thead>
<tr>
<th>Reside within Bundeena/Maianbar</th>
<th>Reside elsewhere within Sutherland Shire</th>
<th>Reside outside Sutherland Shire</th>
</tr>
</thead>
<tbody>
<tr>
<td>233</td>
<td>94</td>
<td>87</td>
</tr>
</tbody>
</table>

Furthermore, of the 414 private submissions opposing the development, 285 were written on form letters, and therefore there were only 129 individual letters of objection to the development. Of the individual letters of objection, 72 were received from residents of Bundeena/Maianbar, 32 from elsewhere within the Sutherland Shire, and 25 were received from people residing outside Sutherland Shire.

The PWD's response to these submissions will be made on an issue basis in Section 5.4.

5.2 Responses from State Government Departments and Authorities

Copies of the development application and accompanying Environmental Impact Statement were sent to several government departments and authorities by Sutherland Shire Council. These bodies have generally commented on those aspects of the application which relate to their statutory responsibilities. A notable exception is the SPCC, who have offered comment outside their area of responsibility. Their comments and the PWD's response to their comments are as follows.

5.2.1 Department of Agriculture

Their letter in response to the application mentioned the following main points:

* The proposal would most likely result in significant changes to fisheries, which could involve both positive and negative consequences. The Department acknowledged however that the likely net effects can only be established from long term studies.

* The Department has assisted Sutherland Shire Council in the preparation of the Draft Port Hacking Management Plan. The Department believes that any decision on the tombolo is premature until the Draft Port Hacking Management Plan is complete.

The PWD remains confident in the assessment of the marine environment, which appears in Section 15 of the EIS, and which identified significant benefits to the aquatic environment as a result of this proposal. The PWD acknowledges that certain impacts cannot be
determined without more intensive study however such investigations would require many years of research which may well be beyond the time frame for the EIS. Importantly, it was considered that any potential negative impacts of the proposal on the marine environment were not of sufficient magnitude to recommend against the development proceeding.

It should also be noted that Sutherland Council has now completed its Draft Management Plan for Port Hacking, and therefore Council can consider the tombolo in the context of this Management Plan as desired by the Department of Agriculture.

5.2.2 Crown Lands Office

The Crown Lands Office, in response to the application, suggested that a navigable channel should be dredged alongside the tombolo in Simpsons Bay, as this would provide "a safe mode of access to the National Park and environs for the recreational boating public". No other objections to the proposal were made by CLO.

Such a channel could not only provide access for recreational craft, but could also provide a route to an alternative wharf for use by the Bundeena ferry, when rough seas prevent use of the normal route. However, the prime purpose of the tombolo is to provide a permanent solution to the shoaling problem.

5.2.3 Department of Environment and Planning

The Department of Planning issued the specifications for the EIS and prepared the Regional Environmental Plans that apply to the site. The Department's only comments on the application related to a minor error in the EIS and to the need for Council to consider the application in the light of the Port Hacking Management Plan.

The PWD endorses their comments that Sutherland Council should consider the proposed tombolo in the light of the Draft Port Hacking Management Plan which has now been exhibited.

5.2.4 Department of Main Roads

The view of the DMR is that the potential traffic generation impact of the proposal upon the classified road system is not considered to be significant. This view supports the conclusions of the traffic assessment contained in the EIS (Section 20), which did not identify any significant impacts relating to traffic issues.

5.2.5 Department of Mineral Resources

The Department indicates that it would be opposed to any management options which involve the offshore dumping of sand dredged from the estuary. It is to be noted that the proposed tombolo is not associated with such use of dredged material.

5.2.6 Maritime Services Board

The MSB has indicated support for the proposal, as it will reduce shoaling problems, and offer improved navigation and better recreational boating opportunities in the estuary.
5.2.7 Australian Museum

The Australian Museum has commented on the marine ecological section of the EIS. It notes that this section of the report has been prepared to a high standard.

It also considers that the proposed tombolo will have substantial effects upon the Port Hacking ecosystem. The effects noted by the Museum are as follows:

* The destruction of benthic organisms by dredging. It is acknowledged that the dredging of the Port and spoil will affect disposal of benthic organisms. However, as acknowledged by the Museum, recolonisation will occur. It should also be understood that all other management options which have been presented (except the do nothing option) involve dredging and hence could be expected to affect benthic organisms. Once the tombolo is complete it will have a lesser impact upon the benthic organisms than options that require ongoing maintenance dredging.

* The migratory patterns of fish and invertebrate may be affected. They note and support the findings of the EIS that the stabilized sand shoals and enlarged sea grass meadows could enhance the density and diversity of benthic fauna and fish.

* The Museum notes that these beneficial effects on the marine ecology depend upon the tombolo having the expected effect upon the physical processes. In this respect, the PWD submits that the effects of the tombolo upon the physical processes have been derived from physical and numerical models which have been fully calibrated and verified. The results have been endorsed by independent specialists in coastal engineering.

* The Museum expressed a concern about intensification of boating activity as a result of the tombolo, and any possible adverse ecological affect. The Maritime Services Board has welcomed the proposal as a means of improving the potential of the waterway for recreational boating. The proposal will ensure that a greater accessibility throughout the waterway will result, thereby encouraging boats to avoid shallow areas of sea grass meadows. It should also be stated that regulation of boating activities in Port Hacking is an issue which can only properly be addressed in the Sutherland Council Management Plan for Port Hacking.

* Finally, the Museum expresses a desire to see monitoring of the effects of the tombolo. The EIS recommended (Section 24.8) that a long term monitoring programme should be undertaken of the marine community at the Shiprock Aquatic Reserve.
National Parks and Wildlife Services

The letter from the NPWS in response to the EIS notes that the proposal has unacceptable impacts on the Royal National Park. Several meetings were held between PWD and NPWS officers in an attempt to identify and rectify service concerns about the project. Following these discussions the tombolo proposal was modified to divert the access road away from the ranger's hut and the disturbed midden, and a commitment was made to financially assist the Service to redevelop the already inadequate facilities in the Bonnie Vale area.

Nevertheless the NPWS Environmental Appraisals Officer in response to the EIS notes that some objections to the proposal remain:

* Short term impacts, due to increased traffic, noise, disturbance to visitors and recreational areas of the Park foreshores.

In terms of short term impacts, in particular those arising from the construction of the tombolo, these have been assessed in the EIS (Sections: 18 - Noise; 20 - Traffic and Parking; 21.3 - Short Term Effect on Bonnie Vale).

All of these short term impacts were examined by specialist sub consultants, and in each case, the resulting impact was not considered to be significant, given the limited period of affectation, the minor degree of impact, and the precautionary and mitigation measures available.

The Service has provided no substantial evidence to support its contrary view.

* Potential for disturbance to wildlife.

The NPWS states that the EIS has not adequately assessed the likely effect of the tombolo upon migratory birds and marine mammals. The PWD considers that Section 16.6 (p.154) of the EIS adequately assesses the likely impact of the proposal on these species. It is noted in this section that the habitat of wading birds will not be directly affected by the proposal. In discussion with Service officers it was agreed that the proposed works would at no time be closer than 400 metres, and would more often be over 1km away. Any perceived impact on wading birds must be compared to that of the squatters and campers whose activities are regularly within 100 metres of the nominated area.

In the terms of the impact upon marine mammals, there is no evidence to suggest any adverse impact, this issue was adequately addressed in Section 16.6 (p.154) of the EIS.

* Possibility of marina and associated facilities being developed.

The application, which is the subject of this Inquiry, relates only to the means of resolving shoaling problems within the waterway and is not associated with any other proposal. As previously noted if any such proposals occurred in the future, they would be subject to the environmental planning process, and any development which may be designated would require the preparation of an EIS.
The tombolo would increase the recreational use of the Bonnie Vale area and foreshores, which would exacerbate existing environmental and recreational problems.

In a convoluted argument the Service claims that usage could dramatically increase, 'which would destroy the peaceful atmosphere, the primary reasons for visiting the Park. As a result NPWS proposes not to allow further expansion of facilities in the Bonnie Vale area. Such a decision prior to completion of a plan of management for the park and a decision on the future of the area occupied by squatters' huts would appear to be pre-emptive, somewhat inconsistent with advice given to council in relation to its plan of management and in direct conflict with earlier advice given to PWD.

It was estimated in the EIS that the increased visitation would be no more than 5 to 10 per cent of existing levels on a peak day (p.187). This was based on existing visitation statistics collected for the Service in 1987 which have subsequently been updated and confirmed. It was recognised that there would be additional demand placed on visitor facilities and accordingly, PWD agreed at the request of NPWS to contribute financially to the redevelopment of the Bonnie Vale area once future usage patterns are clearly defined.

The potential for increased traffic on roads through the Park and a greater number of accidents.

The Service has not advanced any substantial evidence contrary to the advice of specialist consultants. This matter was adequately addressed in Section 21.2 (p.184) of the EIS. It should also be noted that the submission from the DMR indicates that the classified road network can adequately cater for the expected increases in traffic.

Its visual impact in terms of the effect of the vistas from the Park, and onto the Park from the northern foreshores.

The visual impact of the proposal has been fully assessed in the EIS (Section 19). Whilst the tombolo will result in some changes to the existing environment, it will not be associated with a significant adverse effect. Views of the tombolo from the Park are very limited, partial, side views, whilst views of the Park from the northern shore are not affected by tombolo.

The Service's assessment once again is not and cannot be justified.

5.2.9 Soil Conservation Service

The SCS comments that it generally has no objection to the proposal, provided that erosion control techniques as outlined in the EIS are carried out.
The SCS further recommends that it provides on-site soil conservation advice throughout the construction and revegetation stage. The Department has enjoyed a close working relationship with the SCS over a number of years on dune stabilisation projects, and expects to continue this for the tombolo project.

5.2.10 State Pollution Control Commission

The comments of the SPCC and the PWD's response is as follows:

* No air pollution problems are anticipated to result from the proposed development.

The issue of air pollution is addressed in Section 17 of the EIS and a similar conclusion was reached.

* A concern that water pollution may result within the waterway, due to increased boat usage, or the construction of marina type facilities.

The PWD repeats that there are no marina type facilities associated with this development. The regulation of boating facilities within Port Hacking is addressed in Sutherland Council's Draft Port Hacking Management Plan.

* Lack of justification for the proposal

In terms of the justification of the tombolo, it is shown in Section 5 of the EIS that the tombolo is the only management option offering a permanent solution to the shoaling problems at reasonable cost.

* Concern that any habitat areas lost as a result of the proposal will not be replaced in the manner described in the EIS.

In terms of the loss of habitat areas, it is noted in the EIS (Section 16) that the overall benefits to the marine ecology are likely to be positive, due to the creation of new areas of habitat. It should be noted that the Australian Museum also accepted that providing the tombolo works as planned (a technical issue) it should result in the diversity of habitat and species that was described.

* The effect on the marine ecology of introducing a major structure into the waterway.

In terms of the environmental affects of the tombolo, the EIS identified no significant adverse impact that would result from the construction of the tombolo. Instead, the impacts were generally identified as being positive. Whilst respecting the comments of the SPCC, in the absence of any evidence to the contrary, the PWD must stand by the findings of its biological consultant in this regard.
That to safeguard against noise pollution certain standards should be adhered to, and precautions taken.

In terms of noise impact and safeguards, these have been identified in the EIS (Section 18), and as stated in response to other submissions, will ensure that the acoustical impacts are short term, and the guidelines of the SPCC.

5.2.11 Sydney County Council

The SCC indicates concern for their submarine cables and the effect on these cables due to dredging, or by bed scouring once the tombolo is complete. This issue was identified in the EIS (Section 1.5.1, p.3). The PWD undertakes to ensure that the tombolo will not result in any damage to these cables.

5.2.12 Telecom Australia

The comments of Telecom Australia also relate to concerns for their submarine cables, which may be effected by dredging or by bed scouring.

The PWD provides similar undertakings to Telecom as those to the Sydney County Council regarding the security of their cables.

5.2.13 Urban Transit Authority

The UTA expresses a concern that a tombolo may generate a "tidal race" adjacent to the tombolo, which may restrict the operations of the Cronulla - Bundeena Ferry. They seek an assurance that a tidal race will not be created and that existing ferry operations will be maintained.

Modelling of the expected velocities in the entrance channel has shown that such a tidal race will not be created and that tidal velocities will not affect the safe operation of the Cronulla-Bundeena Ferry.

5.3 Response to Submissions from Community Groups

This section of the document responds to the submissions received from community groups.

5.3.1 The Port Hacking Protection Society - Main Submission

A large submission of objection was received from the Port Hacking Protection Society. This submission also contained an Appendix consisting of supporting documentation.

A number of issues were raised in this submission all of which were addressed in the EIS. These issues are summarised and responded to below.

The Shoals are a Natural Element of the Port

This issue related to the role of the shoaling in helping to maintain the existing environment of the Port Hacking waterway.
Section 5 of the EIS documents the problems within the waterway caused by the shoaling. It is clear that the shoals impede the navigational use of the Port, and the responsibility for maintaining channels has historically rested with the PWD. It would be irresponsible of the PWD not to propose a long term solution in light of the acceptance by the State Government of the community demand for safe navigation within Port Hacking. The PWD rejects any argument which does not recognise the shoaling as a real problem in maintaining navigation within the waterway.

The People Who Use Port Hacking will be Adversely Affected

This section of the submission claims that several groups of people who presently use Port Hacking will be adversely affected by the proposal.

The EIS acknowledges that some recreational user groups (such as windsurfers and surfboard riders) will be affected by the loss of waterway, the wind shadow effect of the tombolo and the elimination of the bay surf. Passive recreational users of Bonnie Vale and Simpsons Bay will not be affected and will in fact benefit from the shelter offered by the tombolo and by the additional beaches and public open space.

In summary, the adverse effects on a small number of recreational user groups will be offset by the benefits to both passive recreational user groups and the boating public of the Shire and the wider southern region of Sydney.

Effects on Resident Groups

It is claimed that several resident groups will be adversely affected by the proposal. The PWD denies that resident groups will be significantly affected by this proposal. The PWD acknowledges that there will be some visual changes to the estuary and that certain short-term construction impacts will arise. To recommend against the proposal as a result of these impacts is not warranted given the potential benefits of the proposal for the wider community.

The Tombolo will be Inappropriate to the Visual Environment of Port Hacking

This part of the submission casts doubt upon the adequacy of the visual impact assessment due to the overall scale and the criteria used in the assessment. In response to this, it should be stated that it is considered completely valid to include a visual assessment at macro level, and the PWD stands by the findings of the Department's landscape consultant who noted that the tombolo will not significantly alter the total visual environment of Port Hacking's visual catchment at this level.

In terms of the comment that the EIS is based on limited visual criteria, it should be noted that in an issue such as visual assessment, there can always be questions about a methodology that has been adopted to assess a particular impact. However, the real test is that regardless of the methodology used, the visual impact assessment should be an objective part of the EIS process, which should alert the public and decision makers
to the consequences upon the visual environment of carrying out the proposal. The PWD believes that the visual assessment accomplishes this role and achieves its objective as part of the EIS. It should also be noted that the selection of viewpoints for the impact assessment was undertaken in consultation with officers of council, and members of the Community Liaison Committee.

The Proposed Development Conflicts with the Values which Should Govern the Port

The submission lists a number of "community values" which are considered to be important in determining the future use of the Port. Such values include naturalness, parklike uses, the unspoilt nature of the Port, the risks of failure of the tombolo, boat access, the community and the environment.

The PWD considers that there is no substantial conflict with these values. For example, the "naturalness" of the foreshore area and waterway will not be substantially interfered with. It should, in any case, be appreciated that the "naturalness" of the waterway has already been significantly affected by such things as houses around the estuary, such as at Bundeena and Maianbar, jetties, telecom cables, overhead power lines, sand dredging, shell grit mining and power boats. Consequently, claims that the proposal represents an unwarranted manmade intrusion into a natural area are unfounded. Objectors to the proposal frequently ignore the fact that the entire northern foreshore and part of the southern foreshore is developed and is significantly altered from its natural state.

In terms of facilitating present uses, it is stated in the EIS that the existing recreational uses of this area will not be fundamentally altered. The only way in which present users are likely to be disadvantaged would be through the short term construction impacts, and due to the loss of some areas of waterway and part of the "bay surf" due to the construction of the tombolo. It is not considered these are unacceptable impacts, given the overall benefits of this proposal.

Furthermore, the proposal does not embrace any associated commercial development. Any further development will still be subject to the planning processes and to individual consents for development applications which allow for public consultation and comment prior to approval.

The Needs Analysis Underlying the Proposal is Incorrect

It was submitted that the shoaling of the estuary is not a sufficient problem to warrant the proposed "solution".

This issue relates to those matters raised in Section 5 of the EIS, and the historical responsibility of the PWD in bearing the cost of maintaining clear navigation channels.
The Community Does Not Want the Tombolo

It is stated in the submission that the wishes and attitudes of the community are of greater significance than simply navigational or engineering concerns.

The PWD considers that it is rash to make the general statement that "the community does not want the tombolo". Such a conclusion was definitely not evident in any of the surveys and consultations undertaken by the PWD, and which are referred to in Section 23 of the EIS.

Whilst the Port Hacking Protection Society may not want the tombolo, the PWD believes this to be a parochial group who have never, at any time, been prepared to consider the proposal on a rational basis. Furthermore, as shown in this submission, the Society's reasons for not wanting the tombolo do not stand proper assessment and scrutiny.

Technical Evaluations Suggest Major Problems with the Tombolo Design Concept

This part of the submission raises 17 separate matters which the authors suggest indicated that the tombolo will not work as planned.

In response to all these issues it should be stated unequivocally that coastal engineering design is the preserve of the professional coastal engineer.

Any objections to the proposal must be tested in comparison with, and having regard to the following factors:

* The expertise of the engineers on the PWD's project team and the amount of data gathered and investigation undertaken by the PWD on the physical processes operating within the estuary.

* The development and use of state of the art numerical and physical models, calibrated and verified using actual field data before being used in the tombolo design.

* The impact assessment of the technical aspects of the proposal undertaken in Section 14 of the EIS.

* Reviews of the concept by qualified coastal engineers.

The PWD has ensured extensive evaluation of the technical aspects of the proposal throughout all stages.

In contrast, the apparent technical issues raised in the submission from the PPS can be categorised as follows:

* Those which rely on an inaccurate or incomplete understanding of the processes operating in the estuary; and

* Those which are based on interpretation of advice given by the supposedly expert consultancies, Longworth and McKenzie, Coastal Studies Unit, and Lewis and Duvivier.

The latter is discussed later in this primary submission.
The Tombolo is Likely to Cause Permanent Ecological Damage

The assessment of the marine ecology in the EIS (Section 16) identified benefits to the marine ecology arising from the proposal and failed to identify any significant reasons to recommend against the proposal from a marine biology viewpoint.

In support of this assessment it is noted in a letter to Sutherland Shire Council from the Australian Museum (signed by the Director) that provided the tombolo works as planned, it should result in an increase in the diversity and abundance of fishes and benthic species. The evidence of an employee of the Museum provided to the Port Hacking Protection Society is in conflict with the views of the Director of the Museum expressed to Council.

The PWD stands by the findings of the marine biological studies of the EIS that implied that the tombolo is not likely to cause any significant permanent ecological damage to the estuary.

Vegetation Impacts on the Proposal

Matters raised relating to this issue include the effects of the proposal upon marine vegetation, and also, the potential of the tombolo to sustain vegetation on a permanent basis.

The EIS found that the net impact on seagrass would be positive due to the failure of the proposed dredging to affect any significant beds and because of the stabilisation of mobile shoals in the estuary.

The vegetation proposals for the tombolo were developed in conjunction with the Soil Conservation Service who are well experienced in the establishment of vegetation on coastal sand dunes.

The Port is a Natural and Archaeological Laboratory which Should be Preserved

The PWD fully acknowledges the potential archaeological importance of Port Hacking and accordingly, an archaeological survey was undertaken for the EIS (see p.47 and p.187). No items of any significance were found.

Substantial Increases in Traffic Accidents are Probable

It should be noted that the consultants who prepared the traffic analysis for the EIS (Section 20) found that, during the construction period, the additional trucks on the road will only represent a 2% (maximum) increase above normal daily flows. Once the tombolo is complete, a peak additional increase of between 1% to 5% of traffic could be expected on the approach roads to Bundeena on peak summer weekends. Based upon these figures and upon the conclusions in the EIS, it is unreasonable to suggest that "substantial increases in traffic accidents are probable".
Furthermore, in a letter to Sutherland Council, the DMR expressed the view that the effect on the road system was not considered to be significant, with very minor increases to existing traffic volumes.

Costings of the Tombolo Option are Incomplete

The costing of the tombolo in this submission is $10 million. This claim is totally unsubstantiated. As stated in the EIS, the cost of the tombolo is approximately $6.4 million (1987 dollars).

The Development Establishes the Framework for Further Development

As stated in response to other submissions, this proposal relates only to a tombolo development, and not to any associated marina, or other marine related activities. If any future development were to be proposed, it would be subject to the normal planning process. Any marina development application for instance would need to be accompanied by an EIS.

This matter is predominant in Port Hacking Protection Society literature. By suggesting the future possibility of a marina, it would seem that the Port Hacking Protection Society is attempting to arouse emotions and to direct attention away from rational consideration of the merits of the proposal.

Community Involvement has been a Sham

The extent of public involvement has been documented in Section 23 of the EIS.

Subsequent to the EIS, the PWD agreed to an extension in the statutory period for exhibition of the development application and mounted a major exhibition of the proposal with emphasis on visual issues to enhance understanding by the local community.

Furthermore, that the EIS has proceeded to this stage of Public Inquiry is indicative of its high profile nature throughout the entire decision making process.

The Assessment of the Alternatives is Inadequate and Biased

The PPS notes that there is not a complete presentation in the EIS of the full range of impacts of each of the alternatives.

The full range of options had been previously assessed in the PWD report entitled Management Options, and these options were backed up by years of intensive study. It was not considered necessary to examine them in depth, especially given the fact that the alternative options were found to be fundamentally flawed to the point where their further consideration could not be justified.
The Director of the DEP in his specifications for the EIS stated that the EIS should examine "any feasible alternatives to the proposal including all alternative options considered in the Port Hacking Marine Delta options (PWD) and the reasons for choosing the latter". In the PWD's view, the consideration of alternatives in the EIS fully complies with the Director's specification and meets the requirement of Clause 34 of the Regulation to include "any feasible alternatives to the carrying out of the development and the reasons for choosing the latter".

**The Planned Development Does Not Comply with the Requirements of the Environmental Planning and Assessment Act**

The PWD rejects this assertion and in so doing, notes that neither Council nor the Department of Planning have raised this as an issue.

### 5.3.2 Port Hacking Protection Society - Technical Reports

This section of the review focuses on technical criticisms of the proposal, contained in the submission by the Port Hacking Protection Society. These are based on separate reports prepared by Lewis and Duvivier and the Coastal Studies Unit of Sydney University. Their work was co-ordinated by a non-executive director of Longworth and McKenzie, who provided an overview report. In this section, comments will be made separately on each of the above.

**Longworth and McKenzie**

The Longworth and McKenzie contribution is supposedly based on the two sub reports prepared by the Coastal Studies Unit, and Lewis and Duvivier.

At the outset it should be noted that both at that time and now, Longworth and McKenzie had no coastal engineering expertise in their own right. The Director's report (one page only) uses emotive language to exaggerate the findings in the sub-reports, using phrases such as, "delicate marine environment, unwarranted confidence, brave body, possible environmental damage, a significant chance of doing more harm than good".

The overview by the Longworth and McKenzie Director has failed to acknowledge comments by the Coastal Studies Unit such as, "the proposed works therefore appear to have a better than usual chance of meeting the stated objective without the risk of severe environmental repercussions or civil loss".

Neither the Longworth and McKenzie Director, nor the two sub-consultants, made any approach to the Department seeking information on study methodology, model development and verification, clarification of conclusions or access to data on which to base their considerations. The PWD considers such an approach should be fundamental when examining another professional's work. In fact, prudence should dictate such action when undertaking a relatively low budget commission reviewing work done by acknowledged practitioners over a considerable period and at considerable cost.
Finally, the Department has been advised by Longworth and McKenzie on its own initiative that, "there had been no technical input whatsoever from any Staff of Longworth and McKenzie, nor had the study been registered as an official job with this firm. The work had entirely been done by persons not connected with Longworth and McKenzie".

Coastal Studies Unit, University of Sydney

This appraisal is the most substantive of the three. It is therefore not surprising that it is also the most guarded in terms of its criticisms.

However, the Coastal Studies Unit (CSU) refers to the possibility of "significant and potentially catastrophic risks" existing with the project. These risks are identified as (1) shoaling of navigation channels; (2) long-term erosion of Horderns Beach; and (3) long-term sand loss from the tombolo itself. The Department considers such consequences would not rate as catastrophic events in themselves and considers that the CSU has been unnecessarily emotive in its description.

The report makes a quantitative assessment of the risk associated with the tombolo. This is in itself unfortunate because, in their own words, the quantitative measure of the risk levels is not possible to obtain. The report then disregards this statement and gives a subjective judgement of risk level.

The results of these judgements are not such as to raise concerns about the technical adequacy of the project. The CSU has indicated that it perceives a small but finite, say one per cent, probability of civil property loss as a result of the project. Significantly, the CSU has not nominated a level of civil property loss for the pre-tombolo condition. The PWD considers that the risk associated with the pre-tombolo condition would be considerably greater than that associated with the post-tombolo condition.

It is apparent that the major difference between the CSU and the Coast and Rivers Branch of the PWD is that as civil engineers, the PWD studies processes and problems with a view to identifying and implementing solutions, while as academics, the CSU simply studies processes with a view to categorizing them, teaching students, and advancing scientific knowledge. Both positions are quite appropriate, but they are also quite different and result in quite different appreciations of issues.

The scientific rather than engineering approach to the proposal is amply demonstrated in the remainder of the CSU report. The report uses and references, "the results from scientific work in progress and as yet unpublished". In one section, the CSU concludes that Horderns Beach will have a chronic long-term erosion problem due to sand moving north under the influence of tidal currents, while in a later section they argue that a significant realignment of the tombolo would occur to "widen and therefore preserve the existing Horderns Beach".
Before further discussion and comments of the CSU, it is relevant to note that the EIS document was written as a general information document and does not therefore contain detailed scientific analysis of the coastal processes at the level suggested by the Coastal Studies review. This should not however be taken to imply that such analyses have not been done.

The CSU appraisal argues that there will be reworking of sand in the vicinity of the tombolo head and Burraneer Point. Although not referred to directly in the EIS, the Management Options report acknowledges the formation of terminal lobes at the end of the channel and the requirement to dredge these until the channels reach equilibrium. It is the Department's view that this will occur during the course of the construction and due allowance has been made in the programme for limited redredging as necessary.

The two-dimensional model studies show that the direction of tidal currents will be predominantly northwards along the tombolo. The CSU has used this fact to imply that shoreline transportation of sand to the north will occur. However, detailed examination of the currents from the physical model shows them to be very small and insignificant in terms of their effect on the predominant wave-generated sand movement. This therefore refutes the suggestion that there will be significant loss of sand to the north.

The CSU acknowledges the importance of waves in the movement of sand along the tombolo beach and examines the likely beach type in terms of reflective, intermediate and dissipative modes.

The appraisal then shows that the tombolo beach will be dissipative only during periods of severe storms and it will be reflective for 80 per cent of the time. This appraisal is totally in agreement with the position taken by the PWD, notwithstanding claims by the CSU to the contrary. When designing the tombolo, reflective beaches such as Horderns and Jibbon, were used to determine the most likely stable beach profile. However, during the design 50 year storm event, the tombolo will behave in a dissipative mode and therefore absorb wave energy.

The most significant of the remaining views put by the CSU is in relation to the formation of mega-rips along the tombolo/Horderns Beach system. Such formation is considered to be most unlikely and the Department has no record of any such features forming on semi-exposed beaches such as existing Port Hacking.

Lewis and Duvivier

The comments made by this firm would seem to indicate limited capacity in the field of estuarine processes and an almost total lack of familiarity with Port Hacking.

It would appear that in preparing its report, Lewis and Duvivier have not examined the 1986 Port Hacking Marine Delta Management Options Report. This, notwithstanding the fact that the preamble of the EIS refers readers specifically to that document and its associated mini
reports for the full technical details of the estuarine processes, modelling, data collection, etc. That Lewis and Duvivier can be critical of the EIS without bothering to review the available material is an indictment of its methodology in this commission and the validity of the outcome.

Its report simply presents a grab-bag of theories which appear to have been taken from coastal engineering texts.

Its failure to recognise the validity of numerical modelling as a powerful and well established coastal engineering tool and statements such as, "it is only possible to provide an assessment of the way it, (the tombolo and training wall) will work" fails to recognise the expertise that exists within specialist coastal engineering consultancies and within the PWD.

Its claim that the PWD's analysis is, "inevitably fundamentally (and unavoidably) inadequate" because it is not possible to design the tombolo in the same sense as a reinforced concrete building, fails to recognise that the methods used by the PWD are the same as those used by the Dutch in designing their latest Oosterscheldt Project. (This is the largest coastal estuary protection project undertaken this century. It involves the final and largest closure of the exposed Dutch lowlands so as to afford protection to a vast number of coastal communities and valuable commercial lands and industries).

In summary, the PWD believes that Lewis and Duvivier have demonstrated a lack of understanding of both the field of technical specialty involved and the specific processes in Port Hacking. Consequently, its views must be summarily dismissed.

5.3.3 The National Trust

A 31 page submission from the National Trust was received in objection to the tombolo.

Issues raised in this submission and the PWD's response to them are summarised as follows:

* The Trust notes that it has previously called for a Regional Environmental Study of the Hacking River to determine what types of recreational activities the area is most suited to, and that this proposal is premature until such a study is complete.

In the PWD's view, the concerns of the National Trust will be met by the Draft Port Hacking Management Plan prepared by Sutherland Shire Council.

* The Trust refuses to accept the shoaling of the waterway as a problem and considers that the tombolo has been nominated as a forerunner for intensive marine associated development.

As has been stated previously, in response to similar assertions, shoaling is a real problem in the waterway. There is no associated development as part of this proposal.
The Trust advocates an option based on maintenance dredging, and dumping the spoil in the deep water areas.

As stated previously in response to this issue, this option has been canvassed as part of the maintenance dredging option. The difficulties associated with this option include the fact that it is not a permanent solution and it is becoming more expensive and less efficient at keeping the channels clear. The tombolo solution, on the other hand, has none of these problems, and employs the sand resource for public benefit. The option favoured by the Trust has been evaluated and rejected by the PWD as discussed in the EIS and the Management Options Report.

The submission claims the EIS has a number of deficiencies:

The PWD rejects this claim and submits to the Inquiry that the EIS is adequate for the purposes of the Environmental Planning and Assessment Act and more than adequate to demonstrate to the community and Government what the likely environmental consequences of the development are likely to be.

The Trust claims that stabilisation and landscaping of the tombolo will be unlikely to be achieved in five years.

As stated in response to a previous submission, the responsible authority - the Soil Conservation Service - generally does not dispute the proposed landscaping plan, provided the precautions as outlined in the EIS are followed.

The Trust selectively quotes and misquotes from a report prepared by the Coastal Studies Unit, University of Sydney which states that "the likelihood that the proposed tombolo and associated navigation channel will work as planned is probably 40% at best."

The report states that, "the likelihood that the proposed tombolo and associated navigation channel will work exactly as planned is probably 40% at best". The report goes on to acknowledge that the consequences of not exactly working as planned are, overall, inconsequential.

5.3.4 People for Port Hacking

A submission of objection was received from "People for Port Hacking". Their grounds for objection are:

* "The proposed works are not environmentally, technically nor financially sound".

* "The EIS is incomplete, defective and selective".

* "There is insufficient consideration of alternatives to the problems".
The first two of these grounds of objection are vague and imprecise. Specific ways in which the proposed works are not sound, or ways in which the EIS is defective are not mentioned, and hence it is not possible to give an in depth response to these points.

In terms of the alternatives, it has already been stated that these have been adequately examined both in the EIS, and in the Management Options Report.

5.3.5 **Sutherland Nature Conservation Society**

A submission of objection to the tombolo was received from the Sutherland Nature Conservation Society. The issues raised in this submission, and the PWD's response to them are as follows:

* The Society claims to have developed a model of the shoaling processes operating in the estuary which is different to that of the PWD and hence doubt the validity of the PWD designed solution.

In response to this it should be noted that the competent analysis of coastal processes is the preserve of coastal engineering and hence, this organisation is commenting outside its field of expertise.

Furthermore, the Society's comments trivialise the vast amount of work undertaken by the PWD in respect of this matter, and which has been favourably reviewed by other coastal engineering authorities. The Department would be irresponsible to ignore its own studies, and accept this view of the shoaling process and of the implications for the management of the shoaling problems.

* The submission states that "as an interim measure", sand could be dredged and deposited into Burraneer Bay.

Their solution to the shoaling problem is simplistic and is not founded on any scientific study of the shoaling process. Furthermore, a fundamental aspect of the proposal is that the tombolo offers a permanent solution, not an interim solution to the shoaling problem.

5.3.6 **The National Parks Association of NSW, Southern Sydney Branch**

A submission in objection to the proposal was received from the above group. The issues raised, and the PWD's responses to them are as follows:

* No Consideration of Other Alternatives.

Extensive investigation into all alternatives has occurred in the Management Options Report, and in the EIS (Section 5.3) and it is conclusively demonstrated that the tombolo is the only option which can offer a permanent solution to the shoaling problem.
As an alternative option, the NPA advocates large scale dredging with the dredged material being dumped in the deep water basin west of Lilli Pilli.

Several other options involving large scale dredging and deep water disposal in the estuary have been assessed, both in Section 5 of the EIS, the Management Options Report, and as a result of the public exhibition of the Management Options Report. All of these however, were found to be infeasible on either economic or practical grounds.

5.3.7 Oatley Flora and Fauna Conservation Society

A submission of objection was received from the Oatley Flora and Fauna Conservation Society. Their specific grounds for objection and the PWD's responses are as follows:

* The construction would be "a monstrosity in what is now a peaceful scenic area".

This is purely emotive and adds nothing to intelligent debate about the proposal. It should be summarily dismissed.

* "Considerable disturbance to the foreshores must occur during the construction".

This argument is vague and imprecise as the actual impacts which are expected to occur are not specified. The EIS did not identify any significant impacts which were associated with the construction. Furthermore, several measures were suggested which would further ameliorate any potential impacts which may arise.

* Several adverse environmental affects are noted, including visual impact, effect on the land and water environment, traffic and parking impact, and the possibility of associated development. All these matters have been fully addressed in the EIS, and were not found to be associated with a significant adverse impact.

* The Society advocates a dredging option, but as has been stated, the investigations of dredging options have found them to be inappropriate means of addressing the shoaling problem.

5.3.8 Coast and Wetlands Society Incorporated

A submission of objection was obtained from the above organisation. Issues raised in this submission, and the PWD's responses to them are as follows.

**Navigation Problems for the Bundeena Ferry**

It is stated that the EIS does not address the affects of the proposal on the Cronulla-Bundeena Ferry. This is incorrect, as the implications of the tombolo upon the ferry are addressed in Section 22.2.4 (p.194) of the EIS. It is stated in this Section that the proposal will improve the navigation conditions for the ferry, by providing permanent channels.
Furthermore, in response to related comments, the MSB has indicated support for the proposal. The UTA has only indicated a concern that there will be no "tidal race" created off Cabbage Tree Point which could affect the ferry service. Modelling of expected tidal velocities has demonstrated that no such tidal race will be created.

**Loss of Seagrass and Water Quality**

As stated in response to other submissions, the EIS determined (Sections 16.5) that there will be no significant impact from the tombolo on seagrasses or on water quality.

**Changes to the Environment**

Matters raised under this heading include the loss of the Cabbage Tree Point Rock Platform, and changes to Simpsons Bay.

These issues were addressed in the EIS and any changes which may occur were not found to be significant. The loss of the Cabbage Tree Point platform was addressed in Section 16.4.1 of the EIS. It was concluded that in terms of habitat, the loss of the rock platform would be compensated for by the rock training wall of the tombolo. It is also considered that the social benefits associated with the tombolo will outweigh the loss of the rock platform in terms of its use for educational and recreational purposes. The effect of the proposal upon Simpson Bay is addressed in several sections of the EIS, and no impacts which were likely to result in the silting of this Bay were identified.

**Traffic and Road Damage**

Section 20 of the EIS determined that the traffic impacts of the proposal were not significant. This submission suggests that the Traffic Authority should be approached on the question of traffic safety. The PWD would welcome the comments of the Traffic Authority on this matter.

**Management of the Tombolo**

The ongoing management of the tombolo is addressed in Section 21.5 of the EIS, in which it is noted that it may involve the preparation of a local management plan for Bonnie Vale, and co-ordination with the Crown Lands Office regarding future management. As the future management of the tombolo is a matter for the Crown Lands Office to determine a detailed consideration of this issue is beyond the scope of the EIS.

**Real Friends of Port Hacking**

A submission in support of the proposal was received from the above group.

This group gives the proposal their total support and see the tombolo as having a number of advantages, including the following:
* It is the only permanent solution to the shoaling.

* It will increase opportunity in the estuary for all types of recreational users.

* It will preserve the ecology of the waterway.

The submission also states that in their view, those groups opposed to the tombolo are motivated out of self interest. By way of comment the PWD refers the Commissioner's attention to the origin of the submissions which indicates that the majority of submissions received originate from Bundeena and Maianbar residents.

5.3.10 Friends of the Hacking River

A submission in objection to the tombolo was received from the above organisation. Their grounds for objection and the PWD's responses to them are described below.

The risk of the tombolo failing and doubts about its overall stability, and other technical matters

As stated in response to other submissions, the PWD is confident that given the extensive body of data it has collected, the comprehensive model testing, the expertise of the PWD in coastal engineering matters and the review of the scheme by other authorities, that the tombolo will perform to expectations.

Conflict between active and passive recreational users

As stated the subject proposal is expected to reduce any conflict between these groups of users, by substantially increasing the recreational opportunity for both these groups. It is acknowledged in the EIS (Section 22) however, that there will be a reduction in the "bay surf" and the creation of a small wind shadow immediately west of the tombolo. Generally however, the proposal is advantageous to passive recreational users.

Construction impacts, including truck traffic, noise pollution and air pollution

In response to these issues, it should first be stated that all impacts arising from these sources are short term only.

Furthermore, the EIS and the SPCC have determined that there will be no adverse impact relating to air pollution. In terms of noise pollution it was found that the noise impact was generally not significant, although there would be an impact to some residential properties at some stages during the construction period. However, this impact could be reduced by adopting certain ameliorative measures.

The traffic impact is fully addressed in Section 20 of the EIS, and was not found to be associated with a significant adverse impact.
Degradation of the aquatic environment

Section 16 of the EIS identified positive benefits to the aquatic environment due to the extra areas of habitat which would be created. A letter from the Australian Museum also agrees with the findings of the EIS that if the tombolo performs as planned, it is likely to increase the abundance and diversity of aquatic creatures.

Issues relating to increased boating activity

The PWD believes that this issue is beyond the scope of the EIS. Any identified need for regulation of boating activities to minimise any environmental impacts is best addressed through Sutherland Council's Management Plan for Port Hacking.

Reduced landscape amenity

The visual impact of the proposal is addressed in Section 19 of the EIS. It has been determined that the subject proposal will not have a significant visual impact.

Advocacy of maintenance dredging alternative

This option has been fully investigated by PWD and has been shown to be ineffective and in the long term, not cost competitive when assessed against the tombolo option. It is discussed in Section 5 of the EIS.

Response to Private Submissions

Due to the large volume of private submissions, it is impractical to discuss each submission individually. It is therefore proposed to discuss the matters raised in the private submissions on an issue basis. The issues raised can be broadly summarised as follows:

* Engineering feasibility
* Affects on resident groups
* Affects on recreational use
* Visual impacts
* Need for the proposal
* Evaluation of alternatives
* Adequacy of the EIS
* Various environmental effects
* Associated developments, including future marina development
* Overall justification of the scheme
* Statutory matters
* Community consultation.

Engineering Feasibility

Submissions to Council have raised a number of broad issues in relation to the engineering feasibility of the proposal. These include:

* Inadequacy of the modelling.
* The stability of the tombolo.
* No allowance having been made for sea level rise as a result of the Greenhouse effect.

* Indirect erosion of adjacent beaches.

Responses to each of these points are as follows:

**Inadequacy of the Modelling**

In undertaking analysis of the estuarine processes within Port Hacking, the PWD has used state of the art two-dimensional mathematical modelling to predict any changes which will occur (refer Section 14.2.1 of EIS). The two-dimensional model has been calibrated and verified against actual data collected in the estuary and the Department is therefore confident that the model will fully predict the effect of any changes. When used with the considerable estuarine expertise available both within the Department and within specialised consultancies engaged for this project, the two-dimensional modelling is a most effective tool. Nevertheless, it is recognised that the two-dimensional model alone is not able to fully analyse all the implications of the project. The Department's EIS foreshadowed the use of the physical model to, amongst other things, establish the orientation and alignment of the rock training wall at the northern end of the tombolo and the alignment of the beaches on the eastern and western sides of the tombolo. The use of a physical model was required additional to provide the level of detail needed to fine-tune the design. Indeed, as a result of the physical modelling, certain modifications to the tombolo concept have been made. These are detailed elsewhere in this submission.

**Stability of the Tombolo Sand Mass**

The tombolo sand mass has been designed to behave as a normal beach. This design exercise is relatively simple given the amount of information available in relation to water levels and wave heights for the immediate Sydney coast and Port Hacking area. During the design phase, allowance was made for three major storm events with recurrence intervals of approximately 50 years to occur without opportunity for the beach to recover. Even under such relatively extreme circumstances, it will not be possible to remove sufficient material from the beach and dune system so as to breach the tombolo.

The physical modelling has provided finer detail in relation to wave heights along the tombolo east beach. As a result the crest level of the dune at the northern end of the tombolo has been raised from six metres above ISLW to 6.5 metres above ISLW.

**Sea Level Rise Due to the Greenhouse Effect**

While there is broad scientific agreement about the future occurrence of sea level rise as a result of the Greenhouse effect, there is as yet no clear indication of the magnitude of such a rise. Estimates of the rise vary from as little as 20 centimetres to as much as 1.4 metres over the next 50 years. The PWD, in its role as the State's technical advisor on coastal engineering issues, believes that a value towards the lower end of the range is more likely. As regards an allowance for Greenhouse effects on coastal engineering projects generally, the PWD has taken the stance
that no specific allowance should be made at this time provided that future allowance can be readily made when the extent of the rise is better understood. Such a situation, of course, applies with the tombolo where even if the rise was towards the upper end of the range, it would simply involve a raising of the crest of the dunes in perhaps some 20 or 30 years' time.

**Indirect Erosion of Adjacent Beaches**

The physical modelling confirms that there is no significant change to the existing current conditions off the existing beaches. Physical modelling has also confirmed the views put forward as a result of two-dimensional modelling and earlier work in the EIS that there is not a significant potential for long shore movement of sand from the tombolo either towards the navigational channel or towards Horderns Beach. In essence, the tidal currents which would be too small to cause significant sand movement. Furthermore, they are greatly overshadowed by the wave induced currents, and these will be responsible for predominantly onshore - offshore movement of sediment.

**5.4.2 Effects on Residential Groups**

The submissions identified several potential effects on adjacent properties, including a reduction in land values, loss of water views, loss of waterfront access, impacts during construction and conflicts generated by additional traffic. Several of these submissions mentioned the possibility of taking legal action against Council to compensate for loss of amenity due to impacts arising from these sources.

In terms of impacts during the construction period, it is noted in the EIS (p.191) that some 40 residences would be immediately affected during this period, with the principal impacts arising from movement of construction vehicles, and noise generated by the construction of the tombolo. Given the ameliorative measures suggested in the EIS (Section 24 - p.209), and the fact that the period of affectation is limited to the construction period, and the relatively small number of affected properties, it is not felt that any such impacts are unacceptable.

Regarding loss of waterfront access, it should be noted that most of the existing properties along Crammond Avenue do not generally have direct waterfront access due to their elevation above the tombolo. Furthermore, there will still be comparative ease of access to the water for these properties along the eastern and western side of the tombolo once it is complete.

In terms of loss of water views, it is noted in the EIS (Section 23.5 - p.208) that the existing views over the waterway from a limited number of waterfront affected properties on Cabbage Tree Point will be altered from immediate water views to distant water views over a landscaped open space (the tombolo). An assessment of these views was undertaken in Section 19 of the EIS (p.170) which concluded that despite some reduction in appeal and visual quality, the views will still retain visual merit. Due to the high elevation of the properties, the direct effects on views are minimised.
In terms of property values, it is noted in the EIS (Section 23.5 - p.208) that values of some Crammond Avenue properties may decline due to a loss of views directly overlooking water. This impact of the proposal is acknowledged in the EIS, but it should be noted that only some 26 properties are likely to be so affected, and that the amount of affectation depends upon individual preferences for views "over land as opposed to views over water.

5.4.3 Effects on Recreational Use

Several of the submissions were concerned about the affect of the tombolo on the recreational use of the waterway. In particular, concerns over the loss of the area for "soft recreational pursuits", the likely proliferation of the numbers of larger boats in the area and the additional pressure on already limited facilities, were specifically mentioned in the submissions.

With regard to the use of the waterway for passive recreational purposes, it is demonstrated in the EIS (Sections 22.2 and 22.3) that the tombolo will have a net positive benefit in this regard, as it will extend areas of Horderns Beach along the eastern side of the tombolo; and along the western side of the tombolo a new additional length of beach will be created which will allow greater utilisation of Simpsons Bay for passive recreational purposes. It is also noted in the EIS that whilst the widening and deepening of navigation channels will generally make for greater ease of access within the waterway, Simpsons Bay will not be dredged, and will therefore continue to be accessible only to relatively shallow draught vessels. In terms of the pressure on existing facilities, Section 21.3 (p.188) of the EIS states that the PWD has agreed to assist NPWS with the upgrading of existing inadequate facilities once visitor use patterns have been defined. The EIS acknowledges the effects on certain recreational user groups but on balance the effects will favour the recreational use of both the waterway and the southern foreshores for most user groups.

5.4.4 Visual Impacts

A number of submissions expressed concern at the visual impact of the proposal stating that the visual assessment in the EIS is inadequate, that the tombolo cannot be landscaped as claimed, that the tombolo is out of character with the natural features of the estuary and that it is an incompatible land form.

It is the PWD's view that the visual impact assessment clearly demonstrates and illustrates the likely visual impact of the proposed works. The assessment acknowledges the visual changes that will occur but on balance concludes that views of the estuary from the main viewing points will still be of high visual quality. It is noted that the selection of viewpoints for the impact assessment was undertaken in consultation with officers of Council and members of the Community Liaison Committee.

The proposed landscaping programme for the tombolo was prepared by competent landscape architects in consultation with the Soil Conservation Service. The involvement of the Service in the project will continue.
With regard to the natural features of the estuary, the visual assessment found (p.173) that apart from the tombolo training wall, the tombolo will be sympathetic to the visual character of the lower estuary. The tombolo will echo and extend the existing visual land units of lower Port Hacking in the same proportions as they presently exist. Finally, it was found that the tombolo would appear as a natural extension of the landform.

5.4.5 The Need for the Proposal

A number of submissions raised fundamental questions relating to the need for a tombolo, or for any engineering works to address the shoaling problem. In particular, it was not understood why shoaling is perceived as a problem which requires a permanent solution. This issue is fully addressed in Section 5 of the EIS (p.58) in which the growing inadequacy of the maintenance dredging approach to solving the shoaling problem is discussed. This section also notes that due to extensive studies of the estuarine processes within Port Hacking, there now exists sufficient knowledge about the shoaling mechanisms to make a permanent solution possible.

Furthermore, while environmental groups and some Bundeena residents can afford the luxury of a parochial outlook which suggests that shoaling is not a problem, the PWD and the community generally cannot. It must be reiterated that this proposal has been put forward in response to demands from the local authority and the community for a more effective response to the shoaling problem in Port Hacking than the traditionally followed maintenance dredging measures. In particular, recent maintenance dredging exercises have revealed a significant increase in cost, due principally to the need for disposal of material in relatively remote areas from those being dredged. The tombolo represents the most effective means of alleviating the problem.

5.4.6 Evaluation of Alternatives

A recurring theme in the submissions was that other alternatives to the proposed tombolo had not been properly evaluated. In particular, many submissions specifically stated a desire to see the traditional maintenance dredging option continued.

The EIS devotes an entire section (Section 5.3 - p.61) to describing alternatives to the tombolo in terms of their cost, efficiency, likely environmental effect, and compliance with statutory planning policies. Furthermore, the PWD Report entitled Port Hacking Marine Delta: Management Options describes in detail the type of management options available to address the shoaling problem.

A complete evaluation of alternative options would require a document of the scale of this EIS for each of the 6 options. This was never considered to be appropriate, given the manifest inadequacies of other potential options, as identified in the Management Options Report. In particular, the maintenance dredging option has in recent years been found to be neither efficient nor cost effective, and is now even less so, given that a permanent solution to the shoaling problem is now possible.
Furthermore, the correct procedure in the preparation of an EIS is to fully analyse the proposal which is the subject of a development application. There are no provisions made under the Environmental Planning and Assessment Act for a similar analysis of all conceivable alternatives. The EIS complies fully with the Act in this regard.

5.4.7 Adequacy of the EIS

A number of submissions questioned the adequacy of the EIS on a number of grounds.

The PWD does not intend to discuss these various grounds as it is the Department’s view that the EIS adequately meets the requirements for an EIS prepared to accompany a development application for designated development. The EIS was prepared on behalf of the PWD by Planning Workshop and the Department believes that it meets all the requirements of the Director of Planning and the Environmental Planning and Assessment Regulations.

5.4.8 Other Environmental Effects

Many submissions were opposed to the tombolo on environmental grounds. Some of these submissions stated a general concern for the environment, whilst others mentioned specific impacts upon the environment which they considered would result from the construction of the tombolo. Those impacts specifically mentioned included the following: Traffic and parking impacts, including greater potential for collisions during and after the construction period; impact on marine ecology, including greater potential for sharks to enter the estuary; impact on water quality; the effect of the proposal on the Bundeena-Cronulla ferry; concerns about construction noise; and general loss of residential amenity.

These issues have been comprehensively addressed in the environmental impact statement and none were found to be associated with a significant adverse impact. Furthermore, the EIS lists several precautionary measures which can be taken to further alleviate any untoward impacts. Such measures are listed in Section 24 of the EIS, and included the restriction of truck movements to daylight hours, and the erection of warning signs at appropriate locations; limiting operating hours of construction equipment. The EIS did not identify any significant adverse impacts relating to water quality or marine ecology, rather the EIS generally identified benefits relating to these issues.

5.4.9 Associated Development

A recurring theme in the submissions is the likelihood of associated development with the tombolo.

The proposed development is a specific work for a specific site designed to provide a permanent solution to the shoaling problem of the estuary. All development associated with the work is described in the EIS. Any future development by other authorities or private interests would be subject to the same statutory responsibilities for seeking development.
consent as the PWD has been obliged to undertake. Any future development of a designated kind or type would require the preparation and exhibition of an EIS. It is the PWD's view that any discussion of associated development not part of the application is irrelevant to this Inquiry.

5.4.10 Justification for the Tombolo

Several submissions noted that the preferred management option involving the tombolo concept had not been comprehensively justified. In particular, the overall need for the proposal, when assessed against such issues as the set of values underlying the proposal, and its potential for changing the character of the settlements of Bundeena and Maianbar when other alternatives are available; and the justification of the proposal in terms of its cost.

As stated in the EIS (Section 5), the subject proposal represents the most feasible management option for addressing the shoaling problem. It represents a long term solution to the shoaling problem and hence its cost is less than that of other permanent solutions. As the demand for the recreational facilities (both active and passive) of the waterway at a regional level will increase regardless of the management option, the proposal will result in the waterway being more able to accommodate this increasing demand. However, the proposal will not result in any substantial change to the character of the settlements of Bundeena and Maianbar, which will retain their semi-isolated ambience. For this reason, the PWD believes that the proposal does not involve a value conflict with the essential nature of Port Hacking.

5.4.11 Statutory Matters

A number of submissions questioned the permissibility of the tombolo in terms of its compliance with various planning instruments. This aspect of the proposal is addressed in Sections 4 (p.50) and 13 (p.121) of the EIS. It is noted in Section 4 that the proposal embraces the use of the site for both reclamation and extractive industry. Reclamation is a permissible use with consent under the Sutherland Planning Scheme Ordinance within the Waterway 7(a) zoning; however extractive industry is not permissible under the planning scheme, but is permissible under the provisions of State Environmental Planning Policy No.9 (Extractive Industry), which applies to the Port Hacking Waterways 7(a) zone. The proposal is therefore fully consistent with relevant planning instruments regarding its permissibility.

Section 13 of the EIS (p.121) reviews the compliance of the proposal with the SREP 9, and with the Draft Sydney REP (Botany Bay). The proposal was assessed against these plans, and found to comply with them.

It is noted that the proposal does not comply with Sutherland Council's Code for Waterfront Development, in that it will change the natural landform of the foreshore. However, this code clearly was not meant to apply to such developments as the one proposed, and so does not provide guidelines for dredging and reclamation, both of which are permissible uses within the waterway. Furthermore, this Code does not comply with
SREP No.9. The lack of compliance of the proposal with this Code is not considered significant nor does it raise any issue relating to the permissibility of the proposal.

The proposal generally complies with the existing Royal National Park Plan of Management, and with the Draft Port Hacking Management Plan Discussion Paper.

5.4.12 Community Consultation

Some submissions noted that the public had not been adequately consulted during the decision making process. The process of community consultation is detailed in Section 23 of the EIS, which notes an ongoing process of community consultation, in attempting to address the shoaling problem, commencing as early as 1985. The PWD believe that this Inquiry is a further stage in the community consultation process associated with this project.

It is also worth noting that the PWD agreed to an extension to the exhibition period for the development application and in anticipation of community interest in the project, prepared and manned a major public exhibition of the proposal.
6. CONCLUSIONS

The Public Works Department has devoted considerable resources over some eight years to the study of the estuarine dynamics of Port Hacking in an attempt to resolve the shoaling problems of the estuary for the long term future. A solution has been developed in consultation with the local and regional community which has been demonstrated will meet the objective of providing shoal-free channels without the need for ongoing maintenance dredging.

The amendments to the proposal reflect the Department's continuing process of investigation, design and evaluation of the proposal leading to a design which responds to the dynamics of the estuary while minimising adverse effects. While these amendments change the detail of the lower estuary works, the basic concept remains the same as do the majority of the environmental impacts discussed in the EIS. The detailed design has allowed some of the design elements that were marginal at the time of preparing the EIS to be considered and addressed by design modification.

The Department rejects the opposition expressed in submissions to the exhibition of the application. The majority of the objections are both ill-founded and parochial.

The Department supports the application and the findings of the EIS.