REPORT AND RECOMMENDATIONS
by the
ENVIRONMENTAL PROTECTION AUTHORITY

SECRET HARBOUR PROJECT

Department of Conservation & Environment
Perth, Western Australia

BULLETIN 121
AUGUST 1982

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1. INTRODUCTION

The Secret Harbour project site is located on the coast north of Mandurah, between the settlement of Peelhurst and Becher Point. It is proposed that a large interdunal depression behind the primary coastal dune be dredged and connected to the ocean to form an inland harbour. Residential, commercial, tourist and recreation development is proposed on the balance of the site. The project if commenced, would be staged over eighteen years and have an ultimate population of approximately 15,000 people.

The proponents have carried out numerous studies over the last four years, culminating in an Environmental Review Management Programme. This document was open for public review for a period of three months and twenty three submissions were lodged by the public and various Government agencies.

The proposal could have substantial effect on the environment of the locality, and this was recognised by the proponent. Considerable research was carried out to establish possible impacts and safeguards were suggested to reduce impacts to a minimum. The proponents have identified the need for a substantial and continued management input and have proposed that a management organisation be set up and funded so that neither the state nor local Government should be required to expend funds for the operation of the harbour. The absolute need for, and continued operation of such management organisation is perhaps the most important aspect of this project.

Because of the urban nature of the project, it will be necessary for subsequent Town Planning approvals both at a regional and local level. Much detail of aspects relating to specific developments will be required at these later planning stages.

2. CONCLUSIONS

The ERMP prepared for the Secret Harbour project is a comprehensive document and includes considerable research into certain aspects of the proposal. In particular, the management programme included provision for a management organisation and this aspect received substantial attention. The Authority noted however that some conclusions reached in the ERMP were not justified and some issues were not addressed in a sufficient manner.

The Authority noted that many components of the project were addressed at the concept level, so considerable engineering design will be necessary to refine some aspects.

There are three major areas of concern with respect to the project. 1. The impact on coastal processes brought about by the breakwaters and sand by-pass system are considerable and if the operation of the by-pass system is not continued in perpetuity, massive erosion of beaches to the north of the harbour could occur. The Authority believes however, that the concept put forward to prevent coastal changes is acceptable and it should now be refined and designed in detail. Recommendations 1 to 3 cover this issue.

2. The impact on water resources of the locality could be substantial. The saltwater/freshwater interface will be moved inland as a result of the harbour construction and water levels in the area will be reduced as a result of the proposed groundwater abstraction scheme. Comprehensive monitoring of the changes to water levels and quality should provide an adequate indication of any adverse impacts, and sufficient flexibility should be built into the construction and management programme to modify the project in order that deleterious changes to water resources can be prevented. Recommendations 6-10 and 12-15 relate to this aspect of the project.

3. The project is dependant upon a costly and continuing management input to prevent undesirable effects on the environment. Funds for this management will be generated from within the project and will be underwritten by the proponent. If however, projected sales of land are not achieved this could seriously reduce funds for management. In the event of the project proving to be non-viable, or the proponent becoming insolvent, the Government would have to take on this high cost management. Suitable contingency

guarantees should therefore be adopted by Government to ensure that this project does not in the long term result in a drain on community funds. Recommendations 16-19 cover this matter.

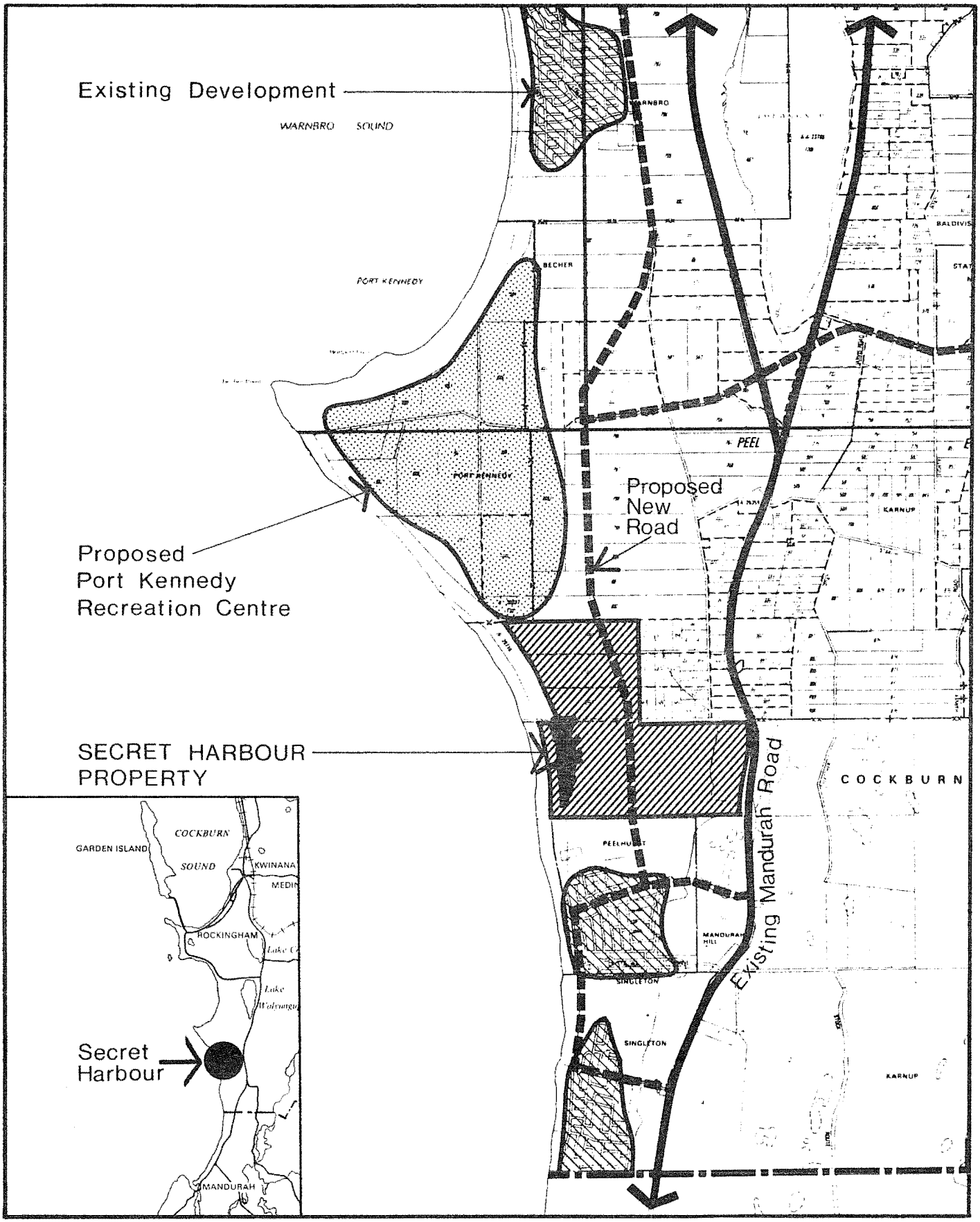
Overall, the Authority believes that the concept put forward should be approved, providing the additional information, studies and detailed management programmes requested are provided by the proponent. In addition, the recommendations of this report should be made a condition of any approvals given and the commitments made by the proponent in the ERMP should be reflected in the special Agreement Act which will be required for this proposal to proceed.

3. The ERMP

An ERMP must provide adequate detail of the proposal and alternatives, the potential impacts of the proposals and alternatives considered and details of safeguards and environmental management. In meeting these requirements the document must be written and compiled in a clear and concise format.

Unlike many ERMPs prepared for resource development projects the Secret Harbour ERMP addresses matters which constitute a substantial overlap between environmental issues and those normally addressed through statutory planning processes, or which are the subject of approvals from other Government agencies.

In this project, the proponent has described the major components of the project. The ERMP described in substantial detail a proposed management organization which would provide on an ongoing basis management for the project and surrounding areas. Other issues involving extensive long term analysis, refinement and detailed engineering design have been treated in broader fashion. The ERMP process is sufficiently flexible for this approach to be adopted.



THE SITE

PLAN 1

4. EXISTING ENVIRONMENT

4.1 Regional Setting

The proposal is located 50 kilometres south of Perth within the Perth Metropolitan Region. The majority of the site is zoned urban deferred with a reserve for Parks and Recreation along the coast, and a strip of rural zone along the eastern boundary.

In the 'Corridor Plan for Perth', a south west corridor is proposed and it includes the project land within the corridor. To the east of the project the land is zoned rural and to the south are isolated coastal holiday settlements. Immediately to the north, is a large reserve for public purposes which forms a regional 'break' in the urban corridor. A large portion of this reserve has been identified for development as a regional recreation area.

4.2 Climate

The climate of the area is identical to that of Perth and is characterised by hot summers and mild winters. Rainfall is approximately 900 mm per year and mainly falls during the winter months from June to September.

Wind patterns show typical summer and winter patterns for Perth coastal areas. The main significance of winds for this project are the strong summer sea breezes from the south and south-west, and winter storms which start from the north-west and swing to the south-west as they pass over the coast. Occasionional major cyclone events affect this section of the coast in summer and cause storm damage along the coast adjacent to the project.

4.3 Landform and Geology

The major portion of the project area is of recent geological origin of the Safety Bay sand series. There are coastal dunes adjacent to the coastline behind which is a large interdunal depression and a substantial mobile dune. Further east are low ridges which are remnants of earlier dune systems. At the eastern edge of the site are higher stabilized dunes overlaying coastal limestone.

Soil investigations at the proposed harbour site indicate that fine grey sands of marine origin exist interspersed with shell fragments. A limestone layer of approximately 1 metre thick was intercepted 16 metres below sea level.

The major significance of the soils of the project area are their low fertility and thus sensitivity in terms of wind erosion potential. In addition, only a limited range of plant species would be suitable for these soils unless major inputs of nutrients and water were available.

4.4 Hydrogeology

The site is underlaid by ground water in both confined and unconfined aquifers. A ground water mound exists towards the eastern side of the area with the main ground water flow to the west, although some flow eastwards to Anstey Swamp occurs.

Water quality of the aquifers has not been tested, but knowledge of bores in the locality indicates that potable water exists, with varying salinity levels especially in the deeper aquifers.

A saltwater/freshwater interface would exist at some distance back from the coast, this would vary depending upon the amount of freshwater head and flows from the east.

Water resources of this locality are presently being used as sole water supplies by residents of Peelhurst to the south, the beach camp run by the Department of Community Welfare and adjacent farms and small holdings.

4.5 Flora and Fauna

Both flora and fauna of the site were studied and were found to be typical of many coastal areas in the region. No rare or endangered species were located, although some doubt exists as to the adequacy of the survey.

Flora units related closely to landscape units and, with the exception of some areas to the eastern edge of the site, could be viewed as fragile. Much of the site has been degraded by previous activities, frequent fires and uncontrolled use of off-road vehicles which are a major threat to the present stability of the site.

Marine fauna was assessed, and it was indicated that apart from harvesting of the Western Rock Lobster from the offshore reefs little commercial fishing was carried out in the area. The beaches adjacent to the project are however popular with amateur fishermen.

4.6 Services

The project area is remote from both reticulated water supplies and deep sewerage. The MWA has plans to establish a waste water treatment plant at Port Kennedy which is 4 kilometres north of the proposed harbour, however projected timing for construction of this plant is not fixed at this stage.

Electricity supply and phone services are available along Mandurah Road.

Mandurah Road would provide an adequate facility for major traffic movements for the project area in the short term.

Other services such as fire, ambulance, hospital and police are remote, being located at Mandurah and Rockingham.

4.7 Landscape Evaluation

Landscape units relate directly to landform and could be divided into the following main categories.

- Strand and primary dunes
- Interdunal swale
- Mobile dune
- Mobile dune scrubland
- Degraded heath
- Seasonal wetland
- Hilly scrubland
- Open Tuart woodland

Each of these units were discussed in detail and their specific implications for development evaluated. Development of these units was then considered as a consequence of those implications and the need or desirability of retaining them as features of the completed landscape.

4.8 Ocean Conditions

Water quality of the ocean adjacent to the project is typical of marine waters in this locality, however slightly higher levels of turbidity have been noted due to sand suspension. In addition the discharge of waters from Peel Inlet could have some effect locally but this has not been quantified.

Tides in the locality are low, with predicted ranges between high and low seldom exceeding 700 mm. Barometric influences on water levels may be more significant than astronomic tides. For design purposes

it was assumed that the lowest water level will be 700 mm below Mean Sea Level and the highest 1.2 metres above Mean Sea Level.

Ocean currents are briefly discussed in the ERMP. Mention of the Leeuwin Current is made but the relationship of it to the coastline of the project is not explored.

Data on wind and waves was measured on site for a 12 month period. The wind data was compared with velocities and direction recorded for the same period at Fremantle and it was found that the Fremantle data compared favourably with that of the project area. Accordingly historical data on wind direction and velocity at Fremantle could be used in the study of Secret Harbour.

Swell conditions were investigated and it was deduced that the influence of the offshore reefs modified the pattern considerably and the resultant swell was not a significent force in determining littoral drift.

Wave energy was considered and predictions made for wave heights for a one in twenty year event, the height of 3.6 metres with a period of 9 seconds was then adopted for design purposes. Reference was made to two storm events, one in April 1981, the other being the cyclone of 1978. It was noted that although these storms caused considerable erosion on other sections of the Perth coastline they had little effect at Secret Harbour.

4.9 Sediment Transport

The mechanisms operating in the locality of the project to induce sediment transport were discussed. The influence of swell waves on littoral drift was considered to be a minimal factor. Wind waves were seen as the major determining factor of littoral drift, and their direction, strength, duration and mobility of sediment would determine the direction and amount of sediment transport. Following an analysis of these factors and available data, it was calculated that a nett movement of 50,000 cubic metres of sand moves in a northerly direction past the proposed harbour annually. This figure is a theoretical one and little information was provided on the exact manner by which it was calculated, accordingly it cannot be verified.

4.10 Coastal Changes

Considerable research was carried out in an attempt to identify the geological history of the site. Carbon dating techniques were used to establish the age of various features. It was established that the site is a Holocene accretion and that a beach ridge was built (on average) once every century with one substantial event occurring each 400 years or so. On average, the coastline has in recent times accreted about one metre per year, however it cannot be automatically assumed that shorter term events could not result in considerable changes to the coastline.

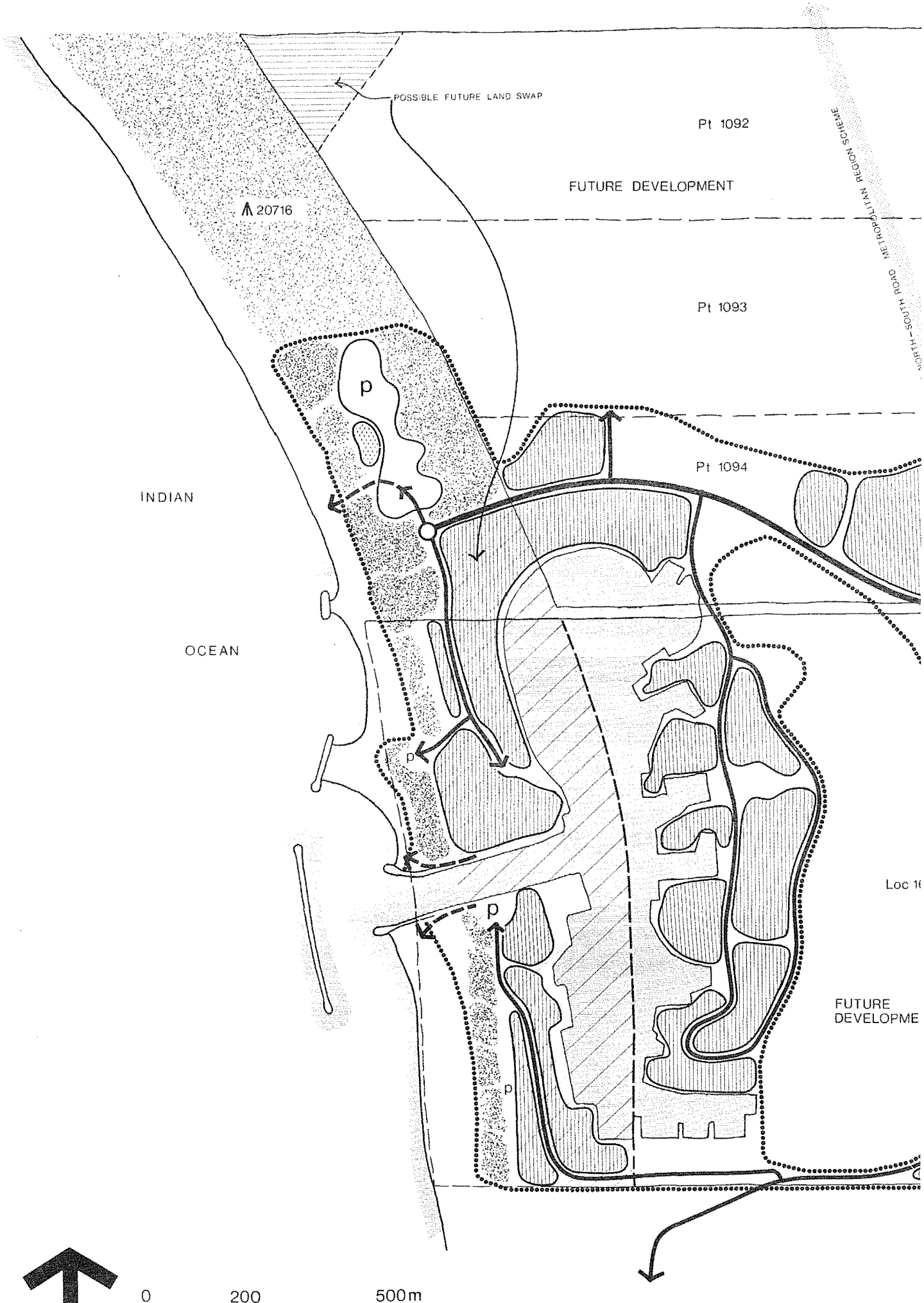
It was mentioned in the ERMP that substantial short term changes to the coastline occur to the south and to the immediate north of the project area.

4.11 Human Use

The project area is remote and there is no legal access to the beach fronting the site. Limited recreational use is made of the beaches in the locality for surfing and amateur fishing although 'surf beach' is a popular location. Access to beach areas is via a rough formed gravel road which crosses portion of the project area.

The offshore reefs are utilized by professional fishermen for the harvesting of rock lobster. Some recreational boat fishing takes place in the locality, but the distance from launching facilities limits this activity.

Portions of the site are used for off-road vehicles which are causing environmental damage to vegetation on the coastal dunes.


POSSIBLE FUTURE LAND SWAP
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FUTURE DEVELOPMENT
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Pt 1093
NORTH-SOUTH ROAD METROPOLITAN REGION SCHEME
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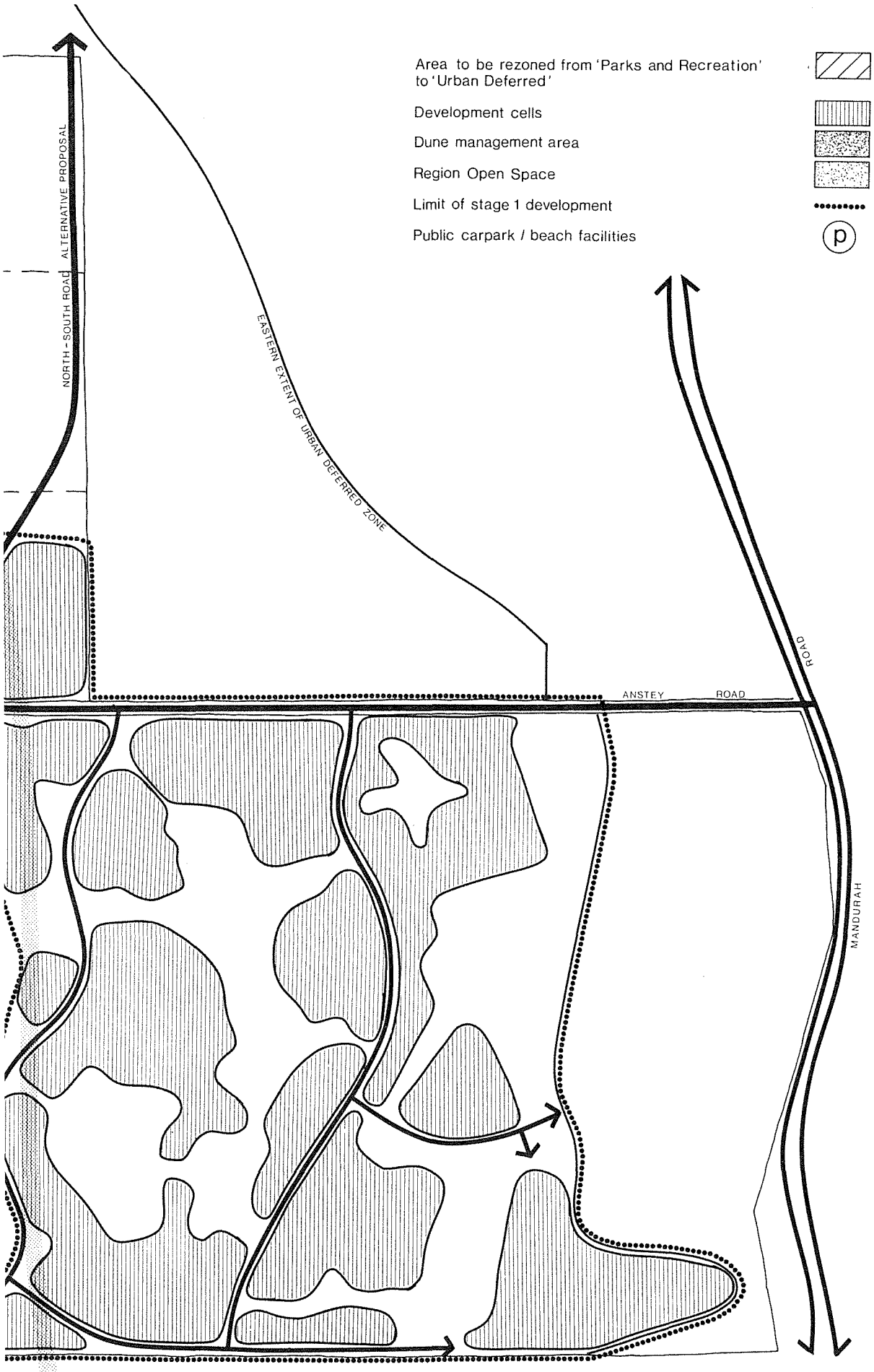


PRELIMINARY DEVELOPMENT PLAN

Harbour E.R.M.P.

PLAN 2

5. THE PROPOSAL

The proponent is seeking to create an urban lifestyle not currently available in the Perth region. In addition, recreation facilities would be established in an area where at present few facilities exist. These facilities are primarily associated with the harbour basin and water based recreation, however a wider range of recreational opportunities would also be provided.

The project would also cater for tourists and provide a staging point for travel within the region, or would function as a self contained holiday resort.

Emphasis has been placed on high quality development with thorough and comprehensive planning.

5.1 Harbour Basin

The focal point and main component of the proposal is the creation of a harbour basin with an area of 32 hectares capable of accommodating 1,200 boats. The harbour will be made by dredging an existing interdunal depression near the coast and building a connecting channel and a coastal breakwater system which will allow safe access to the ocean. The breakwater system will also permit the normal accretion and erosion processes to be controlled and thus create a stable beach. Because of this stability, development can be located close to the beach and integrate the harbour area with the beachfront.

In order to achieve a stable beach, it is proposed to operate a sand by-pass system where sand which accumulates on the southern side of the entrance channel will be pumped to beaches to the northern side, thus providing a continued supply of sand.

5.2 Coastal Dunes

Management of the coastal dunes adjacent to the project will be carried out by the proponent. The need for management as a result of the project proceeding was accepted in the ERMP and concept plans for the coastal dunes in front of the harbour and portion of the adjacent coastal reserve to the north of the harbour have been prepared.

Public facilities, carparking, picnic areas and walkways are proposed as well as dune restoration schemes.

5.3 Urban Development

The area around the harbour will be developed as a 'Town centre' with a range of public and private activities. Pedestrian access will be permitted around the 3.5 kilometres of harbour frontage. It is proposed that the following uses and development be located around the harbour.

- waterfront hotels and rental units
- yacht clubs and boat launching facilities
- hardstanding and boat servicing areas
- jetties and private moorings
- "fisherman's wharf" - landing, sales and restaurants
- boating museum
- town centre retail and commercial facilities
- specialist tourist activities, boutiques, open air restaurants etc.
- medium density residential dwellings
- public access ways and parking

A housing estate development is proposed for the eastern portion of the site. This development would be located around freshwater lakes and a golf course. An integrated open space system would provide pedestrian and cycle way links through the estate.

Other proposals include shopping centres, a retirement village, an industrial park and a sporting complex. The total population of the project would exceed 15,000 people and it could take up to eighteen years to complete.

It is also implied in the ERMP that the harbour basin could be expanded to the east and north to allow for the development of a canal estate. This aspect is only identified as a possible future proposal and was not evaluated in any way.

5.4 Landscape Principles

The proponent has adopted basic landscape principles to be applied over the whole project. The evaluation of the existing landscape, the constraints it imposes and the opportunities it provides were used in the formulation of principles.

The objectives of the principles are to:

- soften the effects of the prevailing south westerly winds to create shelter for plant growth and tolerable living conditions.

- conserve the primary dunes for their aesthetic appeal and functional role in beach stability
- retain natural vegetation wherever possible
- stabilise areas of bare sand (except on the beach) to minimise the potential for wind blown sand and erosion problems.
- create shade wherever possible in order to provide relief from the summer sun and spaces for outdoor relaxation.
- maintain a consistent visual design theme and standard for all building and engineering elements.

5.5 Services

The project area is remote from services and accordingly the proponent will need to provide essential services.

Water for domestic and irrigation purposes is proposed to be obtained from ground water supplies. Eventual connection to MWA mains will be necessary as it is envisaged that ground water resources in the locality could not supply the project in perpetuity. Intensive monitoring of ground water levels and quality is proposed to determine when connection to the mains will be required.

Deep sewerage will be provided to all development and a package treatment plant is proposed on the site. Connection to the proposed MWA Treatment plant at Port Kennedy would take place once that plant was constructed. The timing for the MWA plant has not been fixed and accordingly provision will need to be made to ensure sufficient capacity of any temporary plants.

Drainage is also proposed with a pumped ocean discharge. Provision has been made for some emergency overflow into the harbour basin and pumps for this system could be used to mechanically circulate the harbour waters if water quality was below an acceptable standard.

Other services such as telephone and electricity will be supplied as part of normal subdivision and development.

5.6 Management

A management authority is proposed, to ensure that essential and continuous management of the harbour and foreshore area will occur. The proponent believes that the project should not become a drain on State or Local Government funds and accordingly, funding for the management authority would be independent of those agencies. Initial funds for the management authority would come from a Trust Fund which is to be financed by a 2½% levy on all land sales. A special fee will also be charged annually on all property to meet management costs.

The management authority would also regulate activities within the harbour area and surrounds. Operation of the sand by-pass system is its most important task.

The local Council, land owners, the developers and Government agencies will be represented on the management authority.

In addition to management responsibilities, the authority will also undertake an extensive monitoring programme to continually assess the impact of the proposal on the environment and to modify the management programme in the light of those results. This aspect is most important, as it has been established that some matters will require change depending upon their impact on the environment.

5.7 Agreement Act

In order to provide a legislative base for the management authority and a means by which the necessary agreements between the proponent and Government can be made, an Agreement Act is proposed. The developer has made commitments in the ERMP to ensure that management is provided and that other matters are carried out. The Agreement Act will allow these commitments to be formalised and for suitable contingency guarantees to be made.

6. Environmental Assessment

Chapter 3 describes the Secret Harbour ERMP and shows that it encompasses issues which overlap those of an environmental nature and those normally addressed through the statutory planning process.

The Authority has limited itself to issues of environmental significance and accordingly, some data and discussion in the ERMP has not been commented on. It was considered that the evaluation of town planning issues in the document will be undertaken at appropriate stages by various planning agencies.

There will need to be subsequent decisions by the MRPA, Minister for Urban Development and Town Planning, Town Planning Board and the Rockingham Shire Council.

In evaluating the ERMP the Authority took into account twenty-three submissions lodged by private individuals and Government agencies.

6.1 Adequacy of the ERMP

Although the ERMP had some deficiencies, the Authority considered that it was adequate for government agencies and the public to review the project.

In terms of environmental assessment, the ERMP for Secret Harbour is a pioneer in that it is the first document to be prepared, and assessed on this type of project. This, together with the complexity of some of the issues and the paucity of data available has made the evaluation of some aspects of the proposal difficult.

To further refine the understanding of the project, substantial engineering studies will be required together with comprehensive field testing. Accordingly, such issues as coastal works, engineering structures and water supply have been treated at the concept level but with sufficient detail provided to assess whether the concept is sound.

Some sections of the document were poorly related to details in the Appendices and in some instances the significance of certain data was not explored or fully appreciated. Also certain statements were made without sufficient justification.

Some sections of the ERMP and specifically those covering management, were particularly well presented and comprehensive.

The ERMP was a comprehensive document in terms of the issues which were addressed and indicated that the Proponent was aware of the full range of impacts that could eventuate if the proposal is approved. Commitments to carry out further work where this was necessary were freely given.

6.2 Coastal Stability and Structures

The implications of coastal stability and the proposed harbour entrance structures are the area of greatest environmental concern. The developers and their consultants are aware of the importance of this aspect and the need for a thorough and comprehensive evaluation of it.

The proponents have undertaken considerable research and analysis in an attempt to obtain an appreciation of the history and stability of the section of coastline adjacent to the project area. These studies were far more comprehensive than most studies carried out for coastal residential projects.

Notwithstanding the research undertaken, there are many statements and conclusions made with respect to coastal stability which have not been justified. Accordingly, predictions as to future short or medium term events cannot be proven.

Because of major coastal changes which occur on adjacent beaches and as the site is on an exposed, sandy coastline, the potential exists for short or medium term erosion to occur. For these reasons, the Authority believes that any coastal development must be approached with utmost caution and adequate provision made to allow for and cope with major erosion.

The traditional approach to potential shoreline changes would be to determine a sufficient foreshore reserve capable of accomodating natural erosion and accretion. If a normal urban development occurred on the project area, a substantial setback would be required irrespective of whether the coast is accreting as suggested by the proponent. In addition, a large foreshore reserve would be warranted as this section of the coast is recognised as a major recreation resource.

The approach put forward in the ERMP is to stabilize this section of coast against further major accretion or erosion by the installation of the coastal structures associated with the harbour entrance. It is on this basis that the developers propose to bring major foreshore development close to the beach.

There is a need for the coastal structures to provide protection on two levels, one against major erosion to guarantee reasonable shoreline stability regardless of natural conditions. The other need is at a lower level of providing a usable beach during seasonal and short term changes. These two levels of protection are needed to stabilize the beach in front of coastal development and to prevent undesirable accretion or erosion on the adjacent coastline.

The structures, by their design, will prevent the natural movement of sand along the beach in response to seasonal conditions or storms. By depriving beaches to the north of the harbour entrance of normal sand supplies massive erosion could occur.

To combat this effect, a sand by-pass system has been proposed which will pump the trapped sand from south of the harbour entrance to beaches to the north, thus completing the natural process. This method has not been addressed by the proponent in detail. Sufficient detail of the by-pass system has been provided to permit its assessment as a concept.

Evaluation of the proposed structures and the sand by-pass system at the concept level indicates that the approaches are sound in engineering and environmental terms. The Authority accepts the concept as a means providing a harbour entrance and achieving a stable coastline without undesirable effects on adjacent beaches. The Authority notes however, that this can only be obtained at a considerable and continuing cost. The implication of these costs are discussed further in Section 6.11.

The Authority believes that it is essential for the proponent to show beyond reasonable doubt that the coastline in front and adjacent to the project can be maintained in a stable condition in perpetuity. The Authority also believes that the costs of achieving this stability in terms of construction, maintenance and monitoring should not be a charge upon the State and must be met by funds drawn from the project.

The Public Works Department has made detailed comment on development of land close to the beach, the need for certain commitments to be made and further studies to be undertaken on aspects of the project before rezoning is approved. These comments are on page no. 67 in Appendix II. The Authority endorses these comments and believes that the Metropolitan Region Planning Authority and the Rockingham Shire Council should incorporate them into the sequence of regional and local rezoning decisions.

It is noted that the proponents are unwilling to carry out detailed engineering studies until some approval in principle has been given to the whole project or to specific components of it. This aspect is important and the planning process should be used in a manner which will provide for it.

The Authority accepts the concept of the coastal structures and sand by-pass system proposed as a method of achieving protection of coastal developments, maintaining the supply of littoral sediments to beaches north of the harbour and providing a navigable entrance to the harbour basin.

The Authority recommends that:

Rec. 1 *Additional refinement and detailed design should be provided for the proposed coastal structures and sand by-pass system. These details should include verification of the amounts of sand moving past the harbour entrance and a study of the likely future alignments of the shore on either side of the entrance at various stages of sand by-pass. A realistic costing of the preferred sand by-pass operation, including on-going costs must also be provided.*

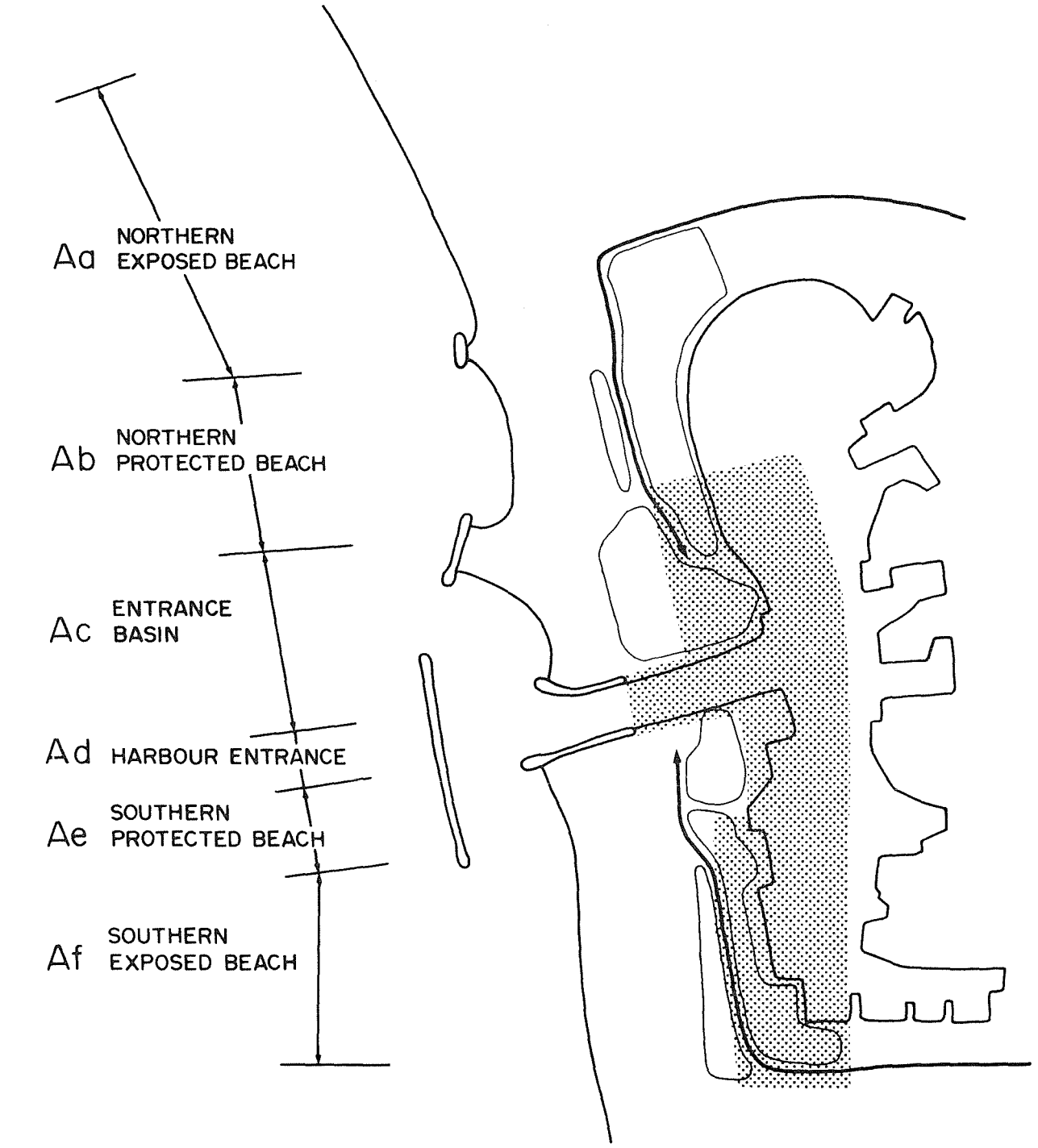
In terms of the rezonings sought the Authority recommends that:

Rec. 2 *A reduction in the present reserve for Parks and Recreation (under the Metropolitan Region Scheme) should not be permitted until a firm and irrevocable commitment by the proponents has been made to construct and maintain the break-waters and sand by-pass system as generally shown in the ERMP and as refined by subsequent detail design. When these requirements have been met, the rezoning could occur within the area defined by the dotted line on Plan 3.*

The Authority further recommends that:

Rec. 3 *Rezoning of sections of beach front (as shown in D8.1 of the ERMP) should not be approved until the following conditions have been met:*

- *Section Af. No additional rezoning within 100 metres of the present shore vegetation line until detail design of the entrance and sand by-pass system has shown that a lesser foreshore reserve will provide adequate pub-lic access and erosion protection.*



PLAN 3

Area which could be Rezoned from Parks and Recreation to Urban Deferred, as per Recommendation 3.

- *Section Ae. No additional rezoning within 150 metres of the present shore vegetation line until detail design of the entrance and sand by-pass system has shown that a lesser reserve will provide adequate public access and erosion protection.*

- *Section Ad. The width of the harbour entrance should not be limited by zoning or development until the detail design of the entrance (including allowances for possible harbour extensions) is complete and is shown to be adequate. Development could however, occur on one side of the entrance.*

- *Section Ac. No additional rezoning within 100 metres of the present shore vegetation line until further studies have shown that a lesser setback could be allowed. These studies should include;*

  (1) detail design of the entrance to adequately predict shore alignments for summer and winter conditions.

  (2) preparation of a development concept which can be shown to tolerate the high penetration of storm and swell waves to the beach centre.

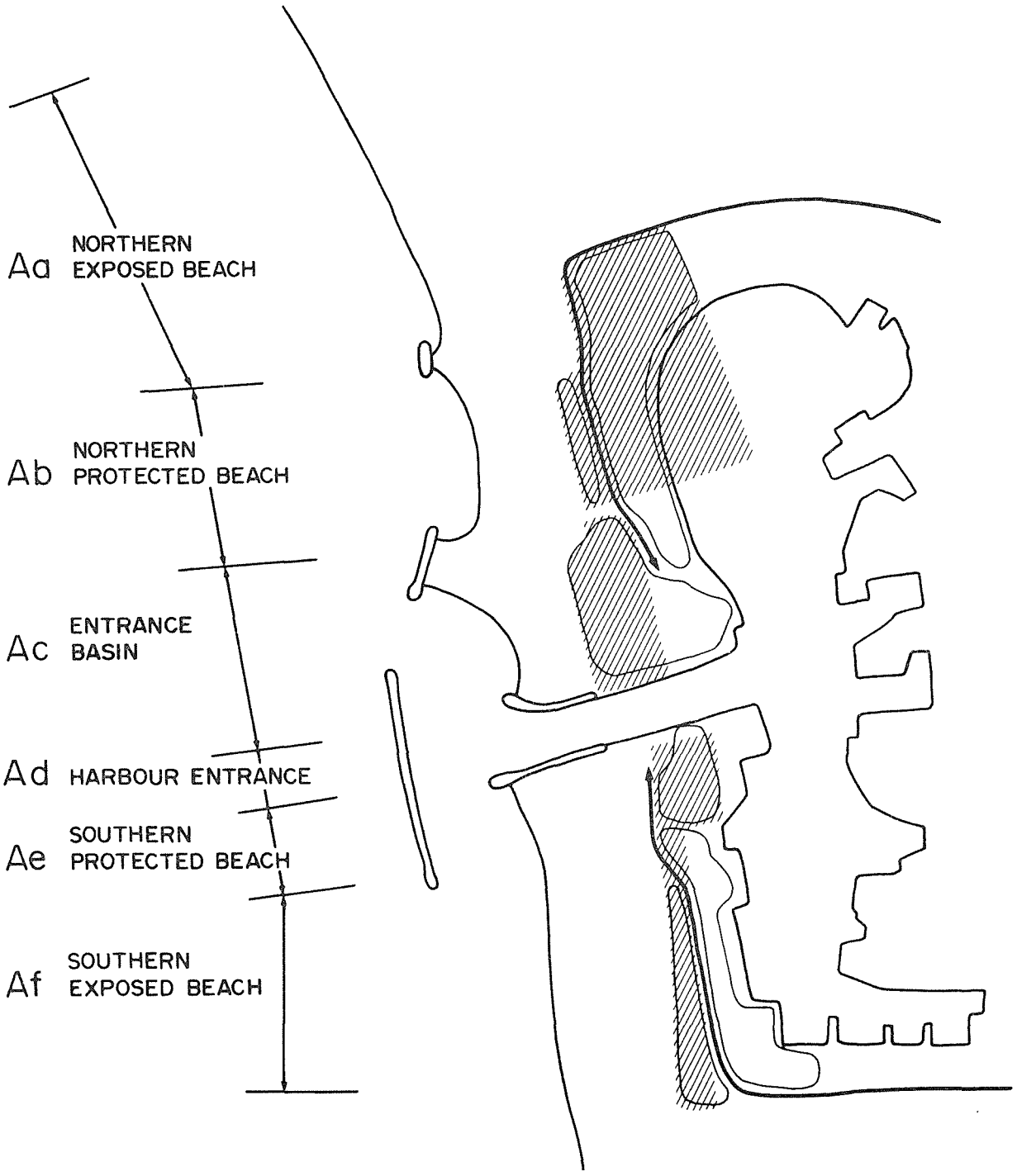
- *Section Ab. (1) No rezoning until a firm commitment has been made to construct and maintain the solid headland at its northern end in addition to the requirements of Recommendation 2.*

  (2) No rezoning within 150 metres of the present shore vegetation until a specific sand by-pass maintenance operation has been clearly shown to be economically and practically feasible.

- *Section Aa (1) No rezoning until a firm commitment has been made to construct and maintain the solid headland at its southern end in addition to the requirements of Recommendation 2.*

  (2) No rezoning within 200 metres of the present shore vegetation line until a specific sand by-pass operation has been proven to provide long term stability to this beach, and the 'Node' as identified in the ERMP has been proven to be stable in the long term.

Plan 4 represents graphically Recommendation 3.



PLAN 4

Areas which should not be Rezoned until the Requirements of Recommendation 4 have been met.

0 500 metres

Rec. 4 *All land between the highwater mark and the western extremity of development proposed in the ERMP should be returned to Crown ownership.*

Because development is proposed close to the beach, and as the condition of the beach is dependent upon management techniques which may require some time to achieve the desired results, there would be merit in delaying the construction of buildings in those localities until conditions are shown by experience to be acceptable. In addition the building and landscaping design will need to be specifically tailored to the conditions of each site.

Accordingly, the Authority recommends that:

Rec. 5 *Council and the proponent should delay the construction of buildings on land close to the beach front until sufficient time has elapsed to provide a clear appreciation of the effects achieved by coastal structures, the sand by-pass system and dune management techniques. Operation of the sand by-pass system and coastal structures should be to the satisfaction of the Minister for Works and stabilisation of coastal dunes to the satisfaction of the Commissioner for Soil Conservation.*

6.3 Water Supply and Hydrogeology

Because the project is remote from reticulated water supplies, the proponent expects to utilize ground water for both domestic and irrigation purposes in the early stages and to then connect to the M.W.A. system if the demand for water exceeds the safe limits of abstraction from the unconfined aquifer.

The Authority believes that this approach is reasonable providing the water resources of the area are capable of meeting the demands placed upon them without causing adverse effects.

The water supply issue was addressed by the proponent's consultant in Appendix AD3, and a subsequent addendum to it. It was initially proposed to utilize shallow groundwater until year eight of the project with abstraction rates commencing at .2 megalitres/day rising to 3.3 megalitres/day. Connection to the M.W.A. system would occur at the beginning of year eight. The demand rate applied during this period would result in the 'mining' of water from the unconfined aquifer and substantial changes to ground water levels outside the project area could occur.

Concern was expressed with respect to this aspect by the PWD., Geological Survey and the M.W.A. The water resources of the locality may be affected to a degree, whereby other users of the ground water could experience difficulty in obtaining continued supplies of water. In addition, water levels in Anstey Swamp to the east of the project could be reduced considerably. This wetland has been identified as having conservation value and should accordingly be protected from any adverse effect.

As a result of the concern expressed, the proponent produced an Addendum to Appendix AD3 which revised major aspects of water supply. The abstraction rate was modified following a refinement of shallow groundwater demands and was set at 1.7 megalitres/day, the total shallow aquifer was re-calculated to include the Rockingham formation and the time for connection to the M.W.A. system was brought forward by two years. As a result of these changes, the abstraction rates proposed are now calculated at 30% of total through flow and reductions in ground water levels would be reduced accordingly. In this manner, the potential impact of proposed ground water abstraction would be considerably reduced.

The hydrogeological studies carried out were based on current available data and no field testing of the aquifer was undertaken to determine water quality or quantity. The approach used by the proponents does however, indicate that it is recognised that ground water sources will not be sufficient for domestic supply for the project in perpetuity.

In assessing this issue, the Authority noted that there are two absolute requirements, one being that a connection to M.W.A. water mains must be shown to be available both in terms of the Board's ability to provide the connection and the proponent's ability to pay for it. The other issue is the ability of the unconfined aquifer to supply the water required without undesirable impact. To date these requirements have been discussed in a theoretical sense but not demonstrated practically.

In viewing the impact of excessive draw on the unconfined aquifer, the Authority believes that supplies to existing ground water users adjacent to the project area should not be reduced in either quality or quantity. Also the conservation value of Anstey Swamp is such that water levels in the swamp should not be reduced beyond natural perturbations so as to diminish the value of that area as a summer wildlife refuge or alter its existing ecology. In addition, vegetation on adjacent lands which is sensitive to ground water level changes should not be adversely affected.

The Authority believes that the concept of utilizing ground water resources for the early stages of the project and then connecting into the M.W.A. mains system is acceptable. It will however, be necessary for the proponent to prove that the water requirements can be met without adversely affecting the environment, or the rights of other ground water users and that a connection to M.W.A. mains can be achieved either in the sixth year of the project as proposed, or when monitoring indicates that an earlier connection is necessary.

The Authority also notes that urban land sales are required to finance management of the harbour and surrounds. In order to achieve this urban development, services including water supplies must be shown to be available before final approvals are issued through Town Planning agencies. It is reasonable however to accept the concept put forward for water supply if an alternate source is shown to be available.

The Authority therefore recommends that:

Rec. 6 *The concept of utilizing ground water for domestic and irrigation water for the early stage of the project be accepted, however before final approval for the project to proceed is given the proponent should be required to:*

- *Show that domestic water will be available from the M.W.A. after the first five years and that the project will have the funds to meet this cost.*

- *Carry out detailed hydrogeological studies including field investigations, test drilling and modelling, to demonstrate that the amount of ground water required will be available without detrimental effects on the shallow groundwater resource or the environment.*

Rec. 7 *As a condition of approval the proponent should undertake to change the management of water supplies to a strategy which will prevent unacceptable deleterious effects to the aquifers or the environment if in the opinion of the Minister for Water Resources, the ground water monitoring indicates that unacceptable effects are occurring or are likely to occur, as a result of the proponent's activities.*

Aspects relating to monitoring, including effects on water resources are covered in Section 6.11.

Rec. 8 *As a condition of approval the proponent should undertake to supply water to existing ground water users in the locality in the event that either water levels are lowered excessively or the quality of water is reduced to an unacceptable level as a result of the project.*

Rec. 9 *As planning proceeds the proponent should undertake additional studies of the Anstey Swamp area to determine the local hydrology in order that the relationship between water levels in the swamp and the shallow ground water table are understood. This information should then be used to ensure that water levels of the swamp are not affected by the project to a point where the conservation value of the swamp is reduced.*

Rec. 10 *Water resources in the general locality of the project should be regulated, as at present there is no control on the use of the unconfined aquifer. With the demands to be placed upon these resources and as there are many existing users dependant upon them as a sole source of water, control of such aspects as pumping rates, annual abstraction rates and bore depth should be implemented by the responsible agency.*

6.4 Harbour Basin

The major environmental impact of the creation of the harbour basin is that the existing saltwater/ fresh water interface will move inland by some 700 metres. The implications of this movement are primarily on the project area but they could extend to areas as far south as Peelhurst and north to the Community Welfare beach camp.

The aspect of continued water supply to residents of Peelhurst and the beach camp was covered in recommendation 8 and monitoring of any changes to ground water levels and quality associated with the harbour construction are addressed in the section on Monitoring.

The ERMP addressed the movement of the saltwater interface and indicated that it would not effect the quality of water in existing bores or the proposed production bores.

Some deep rooted vegetation close to the harbour may be effected, however vegetation on the dunes and adjacent areas should not be effected. Pioneer vegetation to be established in the locality should be selected to cope with the conditions of the particular locality

It is possible that the harbour basin may be constructed in stages, this would assist in limiting the impact of the harbour on the ground water and also provide the opportunity to monitor any changes which occur, thus providing knowledge which may then be used in subsequent stages.

The Authority notes that the movement of the saltwater interface must be accepted if the project proceeds, however it believes that every possible effort should be made to reduce it. Special engineering design of wall structures and ground water abstraction rates may be of value in reducing the influence of the salt water intrusion.

The disposal of dredge spoil from the harbour basin will also contribute to an increase in salinity levels of ground water to the east of the harbour. The ERMP has considered this aspect and has concluded that the increase will be within acceptable limits and will not affect production bores. The Authority endorses the proponents method of reducing the saline content of the dredge spoil. Staging of the harbour basin could lessen the effects as a longer time period would result in greater dilution of salt from the spoil material.

The ERMP considered the question of water quality within the harbour. The Authority accepts the arguments put forward indicating that water quality will be acceptable and can be maintained. Specific regard should be made to uses and activities around the harbour to limit the discharge of pollutants which would reduce the quality of harbour waters. The Authority noted that the project has made provision for forced circulation of harbour waters if water quality is found to be low at specific periods. Monitoring of water quality will be required and is covered in the ERMP and addressed further in Section 6.11.

Effects of the construction of the harbour and associated structures will generally be of a short term nature as fine limestone material will increase the turbidity of the harbour and adjacent ocean waters. This impact as been noted at other construction sites on the coast and it does not appear to be a significant problem.

The ERMP did not show the detail of the harbour engineering or structures over or into the water and their dimensions were not stated. Whilst the principles seem adequate, there is however, a need for the provision of details on aspects of the harbour and its structures. The Authority accepts that these issues are shown only in principle and that their refinement and approval can occur at a later stage in the approval process. It is noted that considerable engineering design will need to be carried out on this and other aspects of the project and that various statutory approvals will be required in due course.

The Authority noted that substantial extensions to the harbour were implied in the ERMP yet no allowance has been made for increased waterflows and boat movements, especially at the entrance. These aspects will require elaboration at the design stage of the harbour entrance.

As a consequence of the conceptual nature of the harbour the Authority recommends that:

Rec. 11 *As a condition of and prior to final approval, more detail should be provided by the proponent on the dimensions of the harbour and the engineering design of*

the various structures involved, as at this stage the adequacy of these aspects of the harbour basin can only be assessed at the concept level. This additional information should also address the relationship of possible future extensions to the harbour in terms of the adequacy of eventual harbour and entrance channel design.

Rec. 12 *The proponent should make every effort through the design and staging of the harbour basin to limit the effect of the eastward movement of the salt water interface.*

Noting that there are environmental advantages in staging the harbour development the Authority recommends that:

Rec. 13 *The proponent should evaluate the possibility of staging the construction of the harbour basin in order to reduce generally the impact on ground water and to provide additional time for monitoring the manner by which the ground water in the locality changes as a result of harbour excavation.*

The Authority noted that depending upon abstraction rates, the quality of ground water inflow to the harbour could have implications on long term management of water quality within the harbour.

Accordingly the Authority recommends that:

Rec. 14 *The proponent should provide additional information on ground water inflow into the harbour, as part of the additional detail to be provided as required in Recommendation 6. The proponent should also provide additional information on the effects of effluent disposal from the sewage treatment plant on water quality of the harbour.*

Rec. 15 *As planning proceeds, the proponent should provide additional information on the effect of salinity increases associated with the disposal of dredge spoil on the ground water and the production bores. (The characteristics of the shallow ground water aquifer and details of the volumes and timing of spoil disposal will have to be established before the additional information can be provided).*

6.5 Management

The proponents have adopted a philosophy that management and maintenance of major aspects of the project should not become the responsibility of Government, its agencies or the Local Council and that the project should not result in an initial or continuing cost to the community. The EPA endorses this approach and notes that it is in accord with the findings of the Canals Steering Committee in its report to Government on Canal Developments.

Those responsibilities of Government agencies and the Local Council which are appropriate to a normal residential development are not proposed to be altered.

The ERMP sets out and discusses the proposed 'Management Authority' to carry out management, maintenance and monitoring tasks relative to the project. Funding mechanisms for the management authority are set out as well as general and specific responsibilities to be undertaken. The major responsibility of the management authority and one of greatest concern is the maintenance of the coastal structures and the operation of the sand-bypass system.

The ability of the Management Authority to operate and maintain major components of the project is directly dependant upon sufficient funds being made available to meet the high and continuing costs of the project, especially so in the first few years. The major input of funds to the Management Authority is from a Trust Fund which in turn receives its funds as a 2½% levy on land sales paid by the proponent. Therefore, if the sales do not occur, or are less than the rate envisaged, funds may not be available for management through the proposed structure. The ERMP has considered these aspects and contends that funding for management will be available on the basis of projected land sales as well as a guarantee by Secret Harbour Pty Ltd.

The Authority is particularly concerned that funds should be available for the proper management of this project, especially in view of the major environmental impact which would occur if management were not available. The Authority notes the methods proposed in the ERMP to ensure such management, but it notes the optimistic population projections which have been used and the tendency towards the selection of costly development options. The Authority believes that the whole question of management funding, population and sales projections, and project viability should be the subject of additional investigation, however this aspect should be the responsibility of the MRPA and Government.

The Authority notes that a special Agreement Act has been proposed to provide a statutory base for the management authority and for the necessary agreements between the company and the State Government. The Authority accepts the need for this approach, however care should be taken to ensure that the Agreement Act does not over-ride other pertinent legislation and specifically does not remove any existing powers of the Local Council.

The Authority notes from submissions that there will be a need for considerable negotiation with respect to the exact structure, responsibility and membership of the management authority, as well as clarification of details of the Trust Fund and controls over its use and investment of funds. It is noted that there are several matters of disagreement about the powers and structures of the management authority which were raised by the Rockingham Council and the Department of Harbours and Marine.

Although the proponents have adopted the philosophy that the State or Local Governments should not have to expend monies on the management of the project; it is noted that the project will impose additional burdens upon these agencies in terms of normal responsibilities.

The important issue of ownership of the harbour basin, was raised in the ERMP. The proponents suggest that it should be retained in their ownership, whilst some submissions noted that this would be in conflict with the recommendations of the Canal Steering Committee's Report. Notwithstanding the arguments put forward in the ERMP for private ownership, the Authority believes that the harbour basin should be in Crown ownership. To meet the requirements of the proponents, a long term lease of the basin area could be made in favour of the proponents. The walls and lands immediately adjacent to the harbour, should however be in the ownership of the proponent or management authority to ensure that costs associated with these structures are met by the management authority.

The Authority therefore recommends that:

Rec. 16 *In general terms, the management authority proposed in the ERMP be accepted as an appropriate method of meeting the management, maintenance and monitoring requirements of the project. Prior to final approval, details of the structure, responsibility and funding of the authority require negotiation with State and Local Governments.*

Rec. 17 *Further details be provided on the projected sales and overall viability of the project to show that the high and continuing costs associated with the management, maintenance and monitoring of the project can be met in perpetuity, without becoming a charge against the State or Local Governments. This matter should be resolved between the proponent, the MRPA and Government before any approval to the project is granted.*

Rec. 18 *The proposed agreement Act, to provide a statutory base for the management agency be accepted as an appropriate mechanism for setting up such an agency, but that the Act should not over-ride other pertinent legislation or remove any existing powers or responsibilities of the Rockingham Council.*

Rec. 19 *The commitments made by the proponent in the ERMP on details of management be accepted, subject to any subsequent modifications agreed between the proponent, Government agencies and the Local Council. These commitments should be incorporated in the Agreement Act.*

Rec. 20 *The Crown should own the harbour basin, but a long term lease of it should be made in favour of the proponent.*

6.6 Flora and Fauna

Although existing flora and fauna of the project area, some adjacent lands and the near shore area were described in the ERMP, studies were superficial and accordingly some of the conclusions reached could not be verified.

However, the Authority considered that the ERMP need not provide a detailed evaluation of land already zoned urban deferred under the provisions of the Metropolitan Region Scheme. The main emphasis of the ERMP should relate to the issues of prime environmental concern such as the coast, hydrogeology, management and other impacts outside the project area.

A main area of ecological value which could be affected by the project, is Anstey Swamp to the east of Mandurah Road. This wetland was not evaluated in the ERMP, although its value and significance appeared to have been appreciated. Both the Department of Conservation and Environment and Fisheries and Wildlife carried out inspections of Anstey Swamp and concluded that it was worthy of conserving due to its existing ecology and value as a summer wildlife refuge. It is noted that the Planning Strategy for the South-West Corridor published by the MRPA in 1980, also identified Anstey Swamp as a major wetland feature and included it in all options as a reserve for Parks and Recreation in order to protect its value as 'a wetland and flora and fauna reserve'.

The Authority believes that Anstey Swamp should be protected and that the utilisation of ground water for the project area should be regulated so as not to effect the water levels of the swamp area. The ERMP discussed this possible impact and made provisions for monitoring and further investigations into the hydrogeology of the locality.

The Authority believes also that excessive lowering of the shallow ground water table could have an adverse effect on some vegetation in the locality. The project area will, if development proceeds, undergo considerable change and much of the natural vegetation will need to be removed. The Authority recommends that every effort should be made to retain the natural vegetation on the site, and that vegetation outside the project area should not be permitted to be effected. Stands of Tuart trees along the eastern edge of the project area should be retained both for their ecological value and as a major component to the landscape.

In terms of fisheries, the Authority notes that the project will result in increasing pressure being placed on near and offshore reef systems, which are currently being used by professional fishermen for harvesting the western rock lobster. Whilst these pressures are inevitable the Authority believes that at some future date further management of these resources may be necessary. Accordingly, the Authority supports the proponents commitment in the ERMP to carry out further studies and monitoring of this aspect.

Water quality within the harbour basin could possibly have a detrimental effect on fish which are commonly caught. There is no evidence to suggest that this will occur, but the ERMP provides for regular monitoring to be undertaken to obtain a clear understanding of any impact.

In terms of the impact of the harbour and offshore breakwaters on the adjacent marine environment, the Authority believes that no substantial adverse effects will occur. Short term effects, mainly associated with increases in turbidity levels of nearshore waters will occur during the construction period and possibly also during the operation of the sand by-pass system. The timing of, and amount of sand moved in the by-pass operation will be the main determinants of the increased turbidity levels, and every effort should be made by the proponent and management authority to limit this effect.

The Authority recommends therefore that:

Rec. 21 *The present ecological and conservation value of Anstey Swamp be protected by reservation under the Metropolitan Region Scheme as Parks and Recreation.*

Rec. 22 *Management of ground water resources in the locality of Anstey Swamp should recognise the conservation value of this wetland, and abstraction rates from the shallow ground water aquifer associated with this project should be adjusted to ensure that the normal water levels of Anstey Swamp are not reduced so that the ecology or summer refuge value of the area is diminished.*

Rec. 23 *The management of the harbour basin in terms of water quality should have specific regard to minimising pollutants which may have an adverse effect on fish within or immediately adjacent to the harbour.*

6.7 Sewerage and Drainage

A piped stormwater drainage system for the harbour area and the residential areas east of the harbour is proposed, with a total catchment area of 130 ha. Discharge of the system is to be to the ocean, north of the harbour entrance and off-shore. Provision is also made for a small volume, emergency overflow of drainage waters into the harbour. The ERMP concludes that the proposed discharges will have no harmful effect on the ocean or harbour water quality.

The Authority noted that the eastwards movement of the saltwater/fresh water interface was dependent upon several factors, one of which was the amount or extent of a fresh water head to the east of the harbour. Disposing of stormwater in the manner proposed would in effect be reducing the recharge of this fresh water head and may accordingly contribute to the eastward movement of the saline interface. Neither the ERMP nor the hydrogeologist's report covered this aspect. In view of its significance, and the need to limit the movement of the saline interface, the Authority believes that the effect of stormwater disposal on this movement should be further investigated as part of the additional hydrogeological studies to be undertaken.

Notwithstanding the above, the Authority believes that the discharge of stormwater in the manner proposed would not have a significant environmental impact on ocean waters.

The ERMP did not address the sewage treatment facility in detail and accordingly a considerable amount of further information will need to be provided.

The MWA treatment plant proposed at Port Kennedy may not be operational within the time frame suggested by the proponent. This means that the proponent may have to provide sewerage facilities for a longer period of time and for greater population than originally envisaged. In this eventuality, the MWA suggests that a site capable of providing sewage treatment facilities for up to 3,000 dwellings should be planned for. A suitable site for a plant and disposal area to accommodate this population, may not be available within the project area.

In addition to providing the sewerage facility, the impact of operating it for the time envisaged needs to be clearly understood. The main environmental impact of a treatment plant of this size would be its effect on ground water quality. This aspect has three further implications, in that it could effect the quality

of domestic water supplies drawn from production bores in the shallow ground water aquifer, it could effect shallow groundwater resources generally, and it could effect the water quality of the harbour by providing an increased nutrient source. All of these implications require further investigation, and until that information is available and assessed by the appropriate agencies, the concept of treatment and disposal of sewage within the project area should not be approved.

The Authority notes that under present Government Policy if deep sewerage is not able to be provided then the project cannot proceed.

The Authority therefore recommends that :

Rec. 24 *As planning proceeds the proponent should provide additional information on the implications of proposed stormwater disposal system on movement eastwards of the fresh water/salt water interface. If the implications are significant then the stormwater disposal system should be modified in order to limit the movement of the saline interface.*

Rec. 25 *The proponent review and provide further information on the projected capacity and operating life of the sewage treatment facility until a connection to MWA system is shown to be available. In addition, the proponent should provide further information to prove that a sewerage facility for the required capacity (until connection to the MWA system is available) can be located on the project area without undesirable effects to the ground water resources of the area, or the water quality of the harbour. Approval of the concept of sewerage facilities on the project area, as suggested in the ERMP, should not be granted until this information is provided.*

6.8 Landscape

In the long term the project will result in major changes to the land form and landscape of the project area. The Authority's main concern with respect to this aspect is limited to the coastal dune formations, and the stands of mature Tuarts at the eastern boundary of the site.

The Authority notes the proposals for these areas and believes that the general concepts put forward are sound and should be accepted. Management will be the key issue for the long term conservation of these landscape units and it appears that adequate provision for this has been made. The landscape importance of the tuarts is of special significance to the attractiveness of that section of Mandurah Road between Anstey Swamp and the project area, and the Authority believes that this existing character should be maintained.

The Authority is aware that a portion of Reserve C20716 which is adjacent to the beach north of the harbour, is shown as being required for harbour development, and the developer proposes that an equivalent area of land be provided in exchange. This matter will require the approval of the Department of Lands and Surveys which require such exchanges to be on an equal value basis. In environmental terms no objection to this proposal is seen.

The exchange is considered to be of importance, as the land shown for exchange purposes is the subject of a System 6 recommendation to the Authority. Although the Authority is not bound by the recommendations, it notes that the subject area is not proposed for development in the ERMP but is shown as 'future proposals'. Accordingly, the Authority believes that this matter should be the subject of later consideration as firm proposals for this area may take into account the objectives of the recommendation. In any event, the Authority believes that any exchange of lands should receive further study to determine the most appropriate size and location of the exchange parcel following the determination of valuations.

The Authority recommends therefore that:

Rec. 26 *The concept of a land exchange for portion of reserve C20716 be accepted, however, the size and location of the parcel of land to be exchanged should be determined following further investigations.*

6.9 Urban Development

The Authority noted that the proposal contained large areas of urban development. It believed that the existing statutory planning process covering regional and local issues is able to adequately regulate this aspect of the proposal. There are some issues which are of concern from the environmental viewpoint.

Several submissions objected to residential development occurring on the ocean side of coastal access roads, as this could limit public access to adjacent beaches. The Authority considers that more details of coastal management proposals for these areas should be provided and that unless public access to and recreation opportunities for the adjacent beaches are shown to be adequate, approval to the residential development as proposed should not be issued. In addition, it should be shown that management techniques and the foreshore width are capable of accommodating coastal processes in these localities, especially during the period in which the sand by-pass system is operating.

The ERMP showed considerable areas of proposed fresh water lakes associated with residential development. No details were given as to methods of construction, where the water for them would be obtained, how acceptable water quality would be achieved or how adequate management would occur. The Authority is aware that these lakes were shown as a concept, but before any acceptance of them is issued, further information must be provided.

The Authority therefore recommends that:

Rec. 27 *Further details of coastal management plans should be provided to clearly demonstrate that the proposed residential development on the western side of coastal access roads (Sections Af and Ab of Plan D8.1 of the ERMP) will not deny public access to, or enjoyment of the adjacent beaches. In addition, it should be shown that management techniques are capable of keeping the dunes and beach in a stable form. This will necessitate the establishment and operation of the beach management programme before consideration should be given to rezoning for residential development. Should rezoning and development occur, further details of specific techniques and public access, will need to be provided.*

Rec. 28 *As planning proceeds the proponent should provide further details of the proposed freshwater lakes, to show that they will be environmentally acceptable in terms of water quality, effects on water resources, construction and appropriate long term management. Until this information is provided, approval should not be issued for this aspect of the project.*

6.10 Earthworks and Stabilization

The volumes of sand proposed to be moved in this project are massive. It is anticipated that approximately 4.5 million cubic metres of sand will require relocation, 600,000 cubic metres of which will be dredge spoil and contain large amounts of salt.

The ERMP discussed the implications of moving such large volumes of material and the Authority accepts the general approach put forward, in order that the effects of these works will be minimised. There was however, no detailed information provided, as this matter was addressed at the concept level.

The Authority believes that because of the amounts and type of material involved, this aspect of the proposal should be reviewed by the Commissioner for Soil Conservation to ensure that the techniques to be used are appropriate.

In addition, the stabilization methods proposed rely on large volumes of irrigation water. However the availability of such volumes or approval for their use has not been demonstrated. If the required amount of water is not available, an alternate approach to stabilization or timing of earthmoving may be necessary.

The Authority therefore recommends that:

Rec. 29 *The concept advanced for earthmoving and stabilization be accepted, however further details on techniques to be used should be provided as planning proceeds. Endorsement of the proposal should be dependant upon acceptance by the Commissioner for Soil Conservation.*

6.11 Monitoring

The ERMP makes provision for and commitments to a monitoring programme. Some aspects of monitoring are covered in detail, whilst others are treated in a broader fashion.

The Authority accepts the proposals and commitments for monitoring but believes that considerable additional detail will need to be provided by the proponents on the specific components and that some additional issues should be included in the programme.

The Authority believes that monitoring must be seen as only a part of reviewing the impact of a project. The analysis of results, regular reporting and commitments to modify the project in the light of monitoring are essential to the total review process. In the ERMP some commitments have been made for various aspects of the project, but the Authority believes that firm commitments on all major aspects should be made and reflected in the Agreement Act.

The Authority emphasises that monitoring the impacts of the coastal structures and sand by-pass, and the effect of the project on ground water is essential to determine the extent of coastal development and the time frame for connecting the project to MWAs water mains. The implications of inadequate monitoring or failure to make appropriate alternatives to the management programme could be considerable in terms of effects on the environment.

Because of the necessity for comprehensive monitoring of the effects of the project, the major issues are listed below and the agencies responsible for reviewing the monitoring results are nominated.

6.11.1 Hydrogeology

Changes to ground water resources in the locality is a major issue. Water levels, quality, aquifer characteristics and movement of the saline interface will need to be monitored to identify any adverse impacts or to predict any

potential changes. The water levels of Anstey Swamp and water availability in terms of quality and quantity to existing users of ground water are of particular concern.

The influence of salt from spoil disposal and possible effects of effluent disposal on domestic production bores also required careful review.

The results of monitoring water resources should be provided to the Minister for Water Resources.

6.11.2 Coastal Changes

Because of the major alteration to coastal process which will result from the project and the potential for erosion of beaches to the north of the harbour, a detailed understanding of the operation of the breakwaters and sand by-pass system is required. Some decisions on development of coastal lands will be dependant upon the success of these structures and the management of the sand by-pass system will require detailed and continuous knowledge of sand accumulations. Results of monitoring should be reported to the Public Works Department.

6.11.3 Water Quality (Harbour & Ocean)

Although it is unlikely that the project will cause any deterioration in the quality of waters adjacent to the project, the ERMP has made provision for monitoring to be carried out. Increased turbidity levels could be expected during sand by-pass operations but these should be of short duration only.

Water quality of the harbour is expected to be acceptable and the ERMP addressed in detail the evaluation of relative issues and management to maintain adequate quality. The facility will exist via the drainage overflow system to mechanically circulate the harbour waters. Monitoring will need to cover primary indicators, with more comprehensive monitoring if shown to be warranted. Reporting on this aspect should be to the Department of Conservation and Environment.

6.11.4 Stabilization and Dune Management

Extensive areas of the project will require revegetation, and the coastal dunes will require long term management. The success of management techniques should be continually assessed and if

necessary modified. Monitoring and agreement on techniques to be used should involve the Soil Conservation Service of the Department of Agriculture.

6.11.5 Vegetation

Although management of water resources should prevent any adverse effect on vegetation occurring as a result of ground water abstraction, monitoring of changes to vegetation, especially in the Anstey Swamp area should be carried out. Lowering of water levels in the swamp of up to .28 of a metre was predicted, however vegetation response to this change (if it in fact eventuates) is not known. Results of this monitoring should be conveyed to the Minister for Water Resources.

6.11.6 Freshwater Lakes

These lakes were addressed at a concept level in the ERMP and details of construction, management and potential effects are not available. It is anticipated that maintenance of acceptable water quality could be a problem and if the lakes are an expression of the ground water they could have some effect on ground water resources. It is necessary therefore, that monitoring of water quality in the lakes and the adjacent ground water should be carried out. Results of monitoring should be conveyed to the Minister for Water Resources.

6.11.7 Aboriginal Sites

It is unlikely that significant archaeological sites are located in the project area. However, the proponents should be aware of the provisions of the Aboriginal Heritage Act, which requires any Aboriginal Sites that are located during construction to be reported to the WA Museum.

6.11.8 Management Costs, Sales and Project Viability

Management costs will be high, and environmental and financial implications of inadequate management are considerable. The ERMP has suggested that studies of these costs and project feasibility will be frequently up-dated, so that project staging and operation can be reviewed. The EPA supports this continued review and believes that it should form part of the monitoring programme. Reporting of this component should be to the Minister responsible for the Agreement Act.

The Authority therefore recommends that:

Rec. 30 *The proponent's commitments in the ERMP to a monitoring programme be accepted and a detail monitoring programme should be prepared for those issues identified in the ERMP and this report. The monitoring programme should be to the satisfaction of those agencies responsible for specific issues. It should also make provision for analysis of the results, reporting and clear statements on modification of the management and monitoring programmes, if results indicate that adverse impacts are anticipated or are actually occurring.*

6.12 Future Proposals

The ERMP implies that the harbour area of the project may, at a later date be extended to the east and north to create a canal estate. No details or consideration of this future development was provided, but it was stated that a comprehensive assessment of it would be carried out should a firm proposal be made.

The Authority accepts that the future proposals can be the subject of future study, however because of the substantial environmental implications associated with them, the Authority believes that adequate data from monitoring the impacts of the current proposal should be available before consideration is given to any harbour extensions.

The Authority recommends therefore that:

Rec. 31 *As planning proceeds, future proposals implied in the present ERMP but not dealt with, should be the subject of further comprehensive environmental assessment prior to any consideration of those proposals. Furthermore, such assessment will be dependant on adequate data from monitoring the impact of the current proposal.*

6.13 Contingency Guarantees

Many of the submissions on the ERMP expressed concern regarding the financial implications which could be passed onto the Government if the project is not viable and management of the sand by-pass system could not be met. The environmental implications of not continuing the sand by-pass operation are considerable as massive erosion of beaches to the north of the harbour would occur.

The Authority noted that several similar sand by-pass operations exist around the world, however reports on them have indicated that substantial difficulties can occur. It is essential therefore that suitable contingency guarantees are arranged to ensure that the community will not have to bare the financial burden should the project not prove viable. In this regard, the Authority specifically noted that the population projections used by the proponent were optimistic.

The ERMP addressed the contingency issue and the proponent has made commitments to ensure that management is provided. The proponent suggested that the Agreement Act be used as a method of binding the proponent to that commitment.

It was suggested in one submission that regardless of agreements and guarantees, the ultimate responsibility for management would be upon Government and that the expenditure required for adequate management may not be justifiable soley for recreation purposes. Accordingly, a use for the harbour which would justify public funds to be spent needs consideration. Such a use may be commercial shipbuilding, and providing this change in land use could be tolerated then this could be seen as a contingency use.

The Authority therefore recommends that:

Rec. 32 *The MRPA and Government should have special regard to the viability of the project and accept the necessity for continued management. The Agreement Act to permit the project to be advanced, should make suitable provision to ensure that if the project is not viable, or the proponent becomes insolvent, the Government is adequately protected against the financial burden which will result.*

6.14 Project Advancement

The proposal involves many complex and inter-related issues, often one being dependent upon another. It has taken a considerable amount of time, research and funds to reach this state and a substantial amount of detailed design will be required before construction approval can be issued.

The Authority believes that if the project is to proceed, interaction between the proponent and Government agencies will need to be co-ordinated. This will be essential if an acceptable time frame for development is to eventuate and if the various and complex issues are to be resolved.

The Authority recommends therefore that:

Rec. 33 *If the project proceeds a project co-ordinator be appointed by Government to provide a focal point for proponent/Government interaction. In addition, a technical group composed of representatives of appropriate Government agencies, the local Council and the proponent should be set up to provide assistance to the co-ordinator and facilitate resolution of the numerous outstanding issues.*

7. LIST OF RECOMMENDATIONS

Recommendation 1

Additional refinement and detailed design should be provided for the proposed coastal structures and sand by-pass system. These details should include verification of the amounts of sand moving past the harbour entrance and a study of the likely future alignments of the shore on either side of the entrance at various stages of sand by-pass. A realistic costing of the preferred sand by-pass operation, including ongoing costs must be provided.

Recommendation 2

A reduction in the present reserve for Parks and Recreation (under the Metropolitan Region Scheme) should not be permitted until a firm and irrevocable commitment by the proponents has been made to construct and maintain the breakwaters and sand by-pass system as generally shown in the ERMP and as refined by subsequent detail design. When these requirements have been met, the rezoning could occur within the area defined by the dotted line on Plan 3.

Recommendation 3

Rezoning of sections of beach front (as shown in D8.1 of the ERMP) should not be approved until the following conditions have been met:

- *Section Af. No additional rezoning within 100 metres of the present shore vegetation line until detail design of the entrance and sand by-pass system has shown that a lesser foreshore reserve will provide adequate public access and erosion protection.*

- *Section Ae. No additional rezoning within 150 metres of the present shore vegetation line until detail design of the entrance and sand by-pass system has shown that lesser reserve will provide adequate public access and erosion protection.*

- *Section Ad. The width of the harbour entrance should not be limited by zoning or development until the detail design of the entrance (including allowances for possible harbour extensions) is complete and is shown to be adequate. Development could however, occur on one side of the entrance.*

- *Section Ac. No additional rezoning within 100 metres of the present shore vegetation line until further studies have shown that a lesser setback could be allowed. These studies should include;*

  (1) detail design of the entrance to adequately predict shore alignments for summer and winter conditions.

  (2) preparation of a development concept which can be shown to tolerate the high penetration of storm and swell waves to the beach centre.

- *Section Ab. (1) No rezoning until a firm commitment has been made to construct and maintain the solid headland at its northern end in addition to the requirements of Recommendation 2.*
  (2) No rezoning within 150 metres of the present shore vegetation until a specific sand by-pass maintenance operation has been clearly shown to be economically and practically feasible.

- *Section Aa (1) No rezoning until a firm commitment has been made to construct and maintain the solid headland at its southern end in addition to the requirements of Recommendation 2.*
  (2) No rezoning within 200 metres of the present shore vegetation line until a specific sand by-pass operation has been proven to provide long term stability to this beach, and the 'Node' as identified in the ERMP has been proven to be stable in the long term.

  Plan 4 represents graphically Recommendation 3.

Recommendation 4

All land between the highwater mark and the western extremity of development proposed in the ERMP should be returned to Crown ownership.

Recommendation 5

Council and the proponent should delay the construction of buildings on land close to the beach front until sufficient time has elapsed to provide a clear appreciation of the effects achieved by coastal structures, the sand by-pass system and dune management techniques. Operation of the sand by-pass system and coastal structures should be to the satisfaction of the Minister for Works and Stabilisation of coastal dunes to the satisfaction of the Commissioner for Soil Conservation.

Recommendation 6

The concept of utilizing ground water for domestic and irrigation water for the early stage of the project be accepted, however before final approval for the project to proceed is given the proponent should be required to:

- *Show that domestic water will be available from the M.W.A. after the first five years and that the project will have the funds to meet this cost.*

- *Carry out detailed hydrogeological studies including field investigations, test drilling and modelling, to demonstrate that the amount of ground water required will be available without detrimental effects on the shallow ground water resource or the environment.*

Recommendation 7

As a condition of approval the proponent should undertake to change the management of water supplies to a strategy which will prevent unacceptable deleterious effects to the aquifers or the environment if in the opinion of the Minister for Water Resources, the ground water monitoring indicates that unacceptable effects are occurring or are likely to occur, as a result of the proponent's activities.

Recommendation 8

As a condition of approval the proponent should undertake to supply water to existing ground water users in the locality in the event that either water levels are lowered excessively or the quality of water is reduced to an unacceptable level as a result of the project.

Recommendation 9

As planning proceeds the proponent should undertake additional studies of the Anstey Swamp area to determine the local hydrology in order that the relationship between water levels in the swamp and the shallow ground water table are understood. This information should then be used to ensure that water levels of the swamp are not affected by the project to a point where the conservation value of the swamp is reduced.

Recommendation 10

Water resources in the general locality of the project should be regulated, as at present there is no control on the use of the unconfined aquifer. With the demands to be placed upon these resources and as there are many existing users dependant upon them as a sole source of water, control of such aspects as pumping rates, annual abstraction rates and bore depth should be implemented by the responsible agency.

Recommendation 11

As a condition of and prior to final approval, more detail should be provided by the proponent on the dimensions of the harbour and the engineering design of the various structures involved, as at this stage the adequacy of these aspects of the harbour basin can only be assessed at the concept level. This additional information should also address the relationship of possible future extensions to the harbour in terms of the adequacy of eventual harbour and entrance channel design.

Recommendation 12

The proponent should make every effort through the design and staging of the harbour basin to limit the effect of the eastward movement of the salt water interface.

Recommendation 13

The proponent should evaluate the possibility of staging the construction of the harbour basin in order to reduce generally the impact on ground water and to provide additional time for monitoring the manner by which the ground water in the locality changes as a result of harbour excavation.

Recommendation 14

The proponent should provide additional information on ground water inflow into the harbour, as part of the additional detail to be provided as required in Recommendation 6. The proponent should also provide additional information on the effects of effluent disposal from the sewage treatment plant on water quality of the harbour.

Recommendation 15

As planning proceeds, the proponent should provide additional information on the effect of salinity increases associated with the disposal of dredge spoil on the ground water and the production bores. (The characteristics of the shallow ground water aquifer and details of the volumes and timing of spoil disposal will have to be established before the additional information can be provided).

Recommendation 16

In general terms, the management authority proposed in the ERMP be accepted as an appropriate method of meeting the management, maintenance and monitoring requirements of the project. Prior to final approval, details of the structure, responsibility and funding of the authority require negotiation with State and Local Governments.

Recommendation 17

Further details be provided on the projected sales and overall viability of the project to show that the high and continuing costs associated with the management, maintenance and monitoring of the project can be met in perpetuity, without becoming a charge against the State or Local Governments. This matter should be resolved between the proponent, the MRPA and Government before any approval to the project is granted.

Recommendation 18

The proposed agreement Act, to provide a statutory base for the management agency be accepted as an appropriate mechanism for setting up such an agency, but that the Act should not over-ride other pertinent legislation or remove any existing powers or responsibilities of the Rockingham Council.

Recommendation 19

The commitments made by the proponent in the ERMP on details of management be accepted, subject to any subsequent modifications agreed between the proponent, Government agencies and the Local Council. These commitments should be incorporated in the Agreement Act.

Recommendation 20

The Crown should own the harbour basin, but a long term lease of it should be made in favour of the proponent.

Recommendation 21

The present ecological and conservation value of Anstey Swamp be protected by reservation under the Metropolitan Region Scheme as Parks and Recreation.

Recommendation 22

Management of ground water resources in the locality of Anstey Swamp should recognise the conservation value of this wetland, and abstraction rates from the shallow ground water aquifer associated with this project should be adjusted to ensure that the normal water levels of Anstey Swamp are not reduced so that the ecology or summer refuge value of the area is diminished.

Recommendation 23

The management of the harbour basin in terms of water quality should have specific regard to minimising pollutants which may have an adverse effect on fish within or immediately adjacent to the harbour.

Recommendation 24

As planning proceeds the proponent should provide additional information on the implications of proposed stormwater disposal system on movement eastwards of the fresh water/salt water interface. If the implications are significant then the stormwater disposal system should be modified in order to limit the movement of the saline interface.

Recommendation 25

The proponent review and provide further information on the projected capacity and operating life of the sewage treatment facility until a connection to MWA system is shown to be available. In addition, the proponent should provide further information to prove that a sewerage facility for the required capacity (until connection to the MWA system is available) can be located on the project area without undesirable effects to the ground water resources of the area, or the water quality of the harbour. Approval of the concept of sewerage facilities on the project area, as suggested in the ERMP, should not be granted until this information is provided.

Recommendation 26

The concept of a land exchange for portion of reserve C20716 be accepted, however, the size and location of the parcel of land to be exchanged should be determined following further investigations.

Recommendation 27

Further details of coastal management plans should be provided to clearly demonstrate that the proposed residential development on the western side of coastal access roads (Sections Af and Ab of Plan D8.1 of the ERMP) will not deny public access to, or enjoyment of the adjacent beaches. In addition, it should be shown that management techniques are capable of keeping the dunes and beach in a stable form. This will necessitate the establishment and operation of the beach management programme before consideration should be given to rezoning for residential development. Should rezoning and development occur, further details of specific techniques and public access, will need to be provided.

Recommendation 28

As planning proceeds the proponent should provide further details of the proposed freshwater lakes, to show that they will be environmentally acceptable in terms of water quality, effects on water resources, construction and appropriate long term management. Until this information is provided, approval should not be issued for this aspect of the project.

Recommendation 29

The concept advanced for earthmoving and stabilization be accepted, however further details on techniques to be used should be provided as planning proceeds. Endorsement of the proposal should be dependant upon acceptance by the Commissioner for Soil Conservation.

Recommendation 30

The proponent's commitments in the ERMP to a monitoring programme be accepted and a detail monitoring programme should be prepared for those issues identified in the ERMP and this report. The monitoring programme should be to the satisfaction of those agencies responsible for specific issues. It should also make provision for analysis of the results, reporting and clear statements on modification of the management and monitoring programmes, if results indicate that adverse impacts are anticipated or are actually occurring.

Recommendation 31

As planning proceeds, future proposals implied in the present ERMP but not dealt with, should be the subject of further comprehensive environmental assessment prior to any consideration of those proposals. Furthermore, such assessment will be dependant on adequate data from monitoring the impact of the current proposal.

Recommendation 32

The MRPA and Government should have special regard to the viability of the project and accept the necessity for continued management. The Agreement Act to permit the project to be advanced, should make suitable provision to ensure that if the project is not viable, or the proponent becomes insolvent, the Government is adequately protected against the financial burden which will result.

Recommendation 33

If the project proceeds a project co-ordinator be appointed by Government to provide a focal point for proponent/Government interaction. In addition, a technical group composed of representatives of appropriate Government agencies, the local Council and the proponent should be set up to provide assistance to the co-ordinator and facilitate resolution of the numerous outstanding issues.

APPENDIX 1

REVIEW OF PUBLIC SUBMISSIONS

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Six public submissions were received by the Authority and were taken into account in the evaluation of the project. Table 1 lists those individuals who lodged submissions.

These submissions raised several issues of concern both in terms of environmental factors and potential costs to the community associated with the continuing management of the harbour entrance. These issues are discussed below and are summarised in Table 2.

1. Aboriginal sites

Two submissions mentioned the need to survey the project area for aboriginal sites or artifacts.

2. Disposal of sewage effluent

Two submissions related to sewerage services, one raised opposition to any form of oceanic discharge and the other criticised lack of information on the position and ownership of the land on which the treatment plant is to be located.

3. High Management Costs and Implications for the Government

Considerable concern was expressed in terms of the high management costs associated with the sand bypass system and the possibility that in the event of the Management Authority not being able to meet these costs that the State Government might have to become involved. The submission stated that expenditure of taxpayers' money on a project such as this should not be permitted. It was suggested that there is a need for very thorough investigation and acceptance by the Government of this financial aspect and its implications.

The possibility of insufficient lots being sold in the first few years of the project to pay for management and the sand bypass was also highlighted.

4. Conservation of Coastal Dunes and Vegetation

The need to protect the coastal dunes both as a formation associated with coastal processes and in terms of their vegetation was expressed. In addition, the use of Crown Reserve 20716 was opposed as public coastal lands should not be given over to development. Whilst expressing these views, the same submission appreciated and commended the proponents in seeking to create a high quality development and a recreational facility of this nature.

5. Other Issues

One submission which was compiled by eight individuals was most comprehensive, and in addition to some of the issues already mentioned, made comment on the following matters.

5.1 Existing Environment (Section C). Several aspects of this section were criticized, mainly on the basis of insufficient data.

5.2 Proposed Changes (Section D). Criticism was made of the density of proposed housing. In addition, the population and boating demand figures were considered to be optimistic. It was also contended that a 1 in 100 year storm event should have been examined to assess the impact of that storm intensity and more work should be carried out on wave refraction diagrams. The development and management of dune areas was questioned and it was suggested that detail design work should be provided. Also insufficient detail was provided regarding municiple services and some predictions for demand for such services were made on optimistic projections.

5.3 Environmental Effects of the Development (Section E). Again, the lack of detail and data was criticized with particular concern expressed with respect to breakwaters and water quality with the harbour area. In relation to management, concern was expressed with respect to funding the operating budget and it was considered that the foredunes should be owned by the public and not the Management Authority.

Whilst making these criticisms, this submission stated that the proposal has merit as a concept.

TABLE 1

SUBMISSION NO	INDIVIDUALS NAME
1.	R H Pearce
2.	S J Carter
3.	P L Ridgway
4.	H Frochter
5.	F L Preschaw
6. (Joint)	P J Briffa K R Dawson R N Emery R J Klein C M Pepper J Pudney I Tapley M Ward

TABLE 2

ISSUES INVOLVED	SUBMISSION NUMBER 1	2	3	4	5	6
Aboriginal Sites	X		X			
Sewage Treatment and Disposal		X				X
Management Costs and Implications					X	X
Conservation of Coastal Lands				X		X
Alienation of Portion of Reserve 20716				X		
Quality of the ERMP						X
Water Quality						X
Harbour Works						X
Support for Proposal In Concept				X		X

APPENDIX II

SUMMARY OF FORMAL GOVERNMENT SUBMISSIONS

CONTENTS

1. WA DEPARTMENT OF TOURISM

Subject to environmental considerations, the Department fully supports the development concept. From a tourism point of view the proposal is considered to be most desirable and will provide an integrated tourist complex of international standing.

The provision of additional marina facilities south of Perth will also cater for the established requirements of boat owners in both the short and long term. The project also conforms with this Department's plans for development of facilities in that region.

2. DEPARTMENT OF AGRICULTURE

The project is proposed on a coastline which has been accreting in recent geological time. Morphology of the hind dune area suggests that a major erosion event did occur several hundred years ago and that the accretion rate has not been constant. Because the area is not underlain by rock it has a potential for gross sea erosion.

The whole concept of Secret Harbour is based on the ability of the proposed structures to control sea erosion. This concept is untested for the local wave regime and it may therefore be inappropriate to have multi storey buildings between the harbour and the ocean.

The building setback is shown as approximately 75 metres from the vegetation line. This is inadequate and should be increased to at least 150 metres.

Section D8.6 refers to 'armouring' a section of the beach to minimise sand drift. This approach is conceptually unsound and will not be effective in the medium term as it will be overwhelmed by wind blown sand from the beach.

No mention is made of the possibility of 'red tides' caused by the growth of toxic dinoflagellates. The implications of these occurring are such that they must be considered.

There is no account made as to the existing environment of the 'Hilly Scrubland' and 'Open Tuart Woodland', although these units are included in the evaluation of landscape units. In addition the floristic list appears to be extremely meagre with only 48 species listed. No details were given, as to when or over what period the survey was undertaken.

3. PUBLIC WORKS DEPARTMENT

By virtue of the involvement of PWD in the urban land development process the submission was divided into three sections.

3.1 Water Supply and Water Resources

The submission notes that the total water requirement for domestic and irrigation purposes will peak after about five years from the commencement of the project at about 3.52×10^6 m^3/annum. PWD believe this figure to be very high.

At Appendix AD3 and its addendum, the groundwater consultant attempts to indicate the availability of groundwater to meet these requirements. The work is however a desk study, based on limited information currently available. It should be noted that the opinion that groundwater will be available in quantities to meet the expected development, has not been confirmed with respect to either quantity or quality, by field work or exploratory drilling. In addition the assumption is made that damage to the shallow aquifer by seawater intrusion will be permitted.

The report acknowledges the possible consequences of drawing in excess of available groundwater throughflow and indicates that ground water for domestic supply will therefore not be available in perpetuity. It follows that supply from outside the area, from say the Metropolitan Water Board will be essential after the first few years (5).

The construction of the proposed harbour will move the salt water interface approximately 700 metres inland from its present position. As the harbour is basic to the whole concept of the development, this movement of the saline interface must be accepted if the proposal is to be approved.

In addition to this 700 metre incursion, development of shallow groundwater resources in the first five years will cause further inland movement of the saline interface due to a reduction in fresh groundwater heads which maintain the position of the interface. The effect of the proposed pumping will be quite widespread and seawater intrusion is quite possible as far afield as the existing development at Peelhurst to the south and the Department of Community Welfare camp to the north.

As the development has the potential to alter the quality of groundwater in the area, the developers should be required to provide other users with alternative supplies if they are damaged.

Exploitation of the shallow groundwater will cause groundwater levels to drop in the Anstey Swamp area and this could be expected to reduce surface water levels. Although the developers have suggested that the swamp may have an impervious bottom, water levels relative to surrounding groundwater, suggest that it may be a local groundwater discharge zone during the summer months at least. Whether there is a need to maintain the swamp as a wetland needs to be assessed.

It is proposed to draw up to 2.9×10^6 m^3/annum from the Leederville Formation for irrigation purposes, with a long term requirement being 1.2×10^6 m^3/annum. This is a substantial draw rate and because of a lack of hydrogeological information, the effects of pumping cannot be accurately determined. The water availability and effects of the proposed pumping would need to be evaluated prior to acceptance of the project.

During the excavation of the harbour basin, the spoil will be disposed of inland from the harbour, almost half the way to the proposed production bores. The residual salt in the spoil will be leached into the groundwater by rainfall. The consultants believe that the resulting increase will be tolerable but his is questionable and needs further checking, especially any potential effect on the production bores.

The PWD recommended therefore, that before the project is approved, the developers should be required to:

a) Show that domestic water will be available from the Metropolitan Water Board after the first five years.

b) Carry out a detailed hydrogeological study including field investigations, test drilling and computer modelling, to demonstrate that the required groundwater will be available, that its quality will be satisfactory and the effect of the development on the area.

It was further recommended that approval to the project should be conditional upon the developer formally agreeing to:

(a) carry out an appropriate groundwater monitoring programme, approved by the Minister for Water Resources, to check the performance of the aquifers and provide annual reviews by a competent hydrogeologist;

(b) change the management of their water supplies to a strategy which will prevent unacceptable deleterious effects to the aquifers, if in the opinion of the Minister for Water Resources, the groundwater monitoring indicates that unacceptable deleterious effects are occurring, or likely to occur, as a result of the developer's activities;

(c) arrange alternative supplies to others in the region, if monitoring indicates that the water supplies of others have been damaged by the activities of the developers.

3.2 Sewerage

Deep sewerage is to be provided and the developers assume that after 1988 they will be able to discharge into the Metropolitan Water Board treatment plant to be located at Port Kennedy. This needs to be confirmed with the Board.

The treatment and disposal of effluent as proposed may be satisfactory but will need to be checked in detail when firm proposals are put forward.

The PWD recommended that the developers confirm that the Metropolitan Water Board treatment plant at Port Kennedy will be capable of allowing the connection with this development by 1988 and that the developer's scheme conforms to the Board's standards.

3.3 Coastal Engineering and Harbour Development

Comment on the specific content of the ERMP by PWD was difficult, as there was no referencing of the key technical statements and very little specification of the development.

While several sections of the ERMP discuss ocean forces and coastal sediment movement, key items involving quantification of littoral drift are baldly stated without supporting computations. On some of the date presented, such as refraction diagrams, the variation of wave period and direction and the use of an abnormally high tide level detract from their value and raise suspicion as to the adequacy of other work. There are also inconsistancies between 'observed' sand movements through the Murray Reefs and the stated areas of vegetated seabed inside the reef. Refraction diagrams prepared by PWD show a less confused sea state in the area and aerial photographs do not all show multiple wave fronts.

Whilst the geomorphic studies are of interest they have not been subjected to peer review within academic circles, so they cannot be validated by this Department. The identification of the wide beach ridge sequence as a Holocene accretion, does however conform to this Department's understanding of the site. It cannot however be concluded that "it is unreasonable to assume that erosion of the coastline could be expected during the lifetime of the Harbour". It is relevant to note that the accretion pattern has produced (on average) one beach ridge each century and one more substantial change each 500 years. Contemporary observations suggest that short term erosion and accretion occur in the creation of these features. The identified, recent continued accretion could well be such a short term phase. The report is in error in suggesting that shorelines of 1912 and 1924 are based on aerial photographs, or on the work of this Department. They are certainly not known to be compatible with Departmental data from 1942 onwards, and they could therefore give an erroneous indication of the movement of the Node.

While much is made of the presence of a Node, its stability and permanence as a shore feature during the lifetime of the harbour has not been established, unless one intends to ascribe a very short life to the harbour. However, purchasers of land will be paying very highly indeed for the harbour, and they would certainly require it to continue to give value to their land throughout their lifetime, and for their heirs. The planned life of the harbour must therefore be measured accordingly.

The proponents have correctly identified the need for very substantial breakwater works to shelter the harbour and its entrance channel. However, the entrance structures and the harbour itself have been made particularly costly by the selection of a harbour depth which is needed by very few recreational vessels in this State. The cost penalty for this decision extends to excavation volume, breakwater volumes and rock size, and retaining wall cost.

The entrance and breakwater, are not well defined. The main breakwaters location varies between plans from 160 to 210 metres offshore. The design waves also vary between plans. The breakwater height is variously quoted to be between 4 and 7 metres above sea level. This part of the project is thus shown in principle, rather than as it will be.

The dimensions of the harbour itself are also given only in principle. Items such as water volumes, channel widths and mooring areas must be more precisely stated before it is possible to review their adequacy for boat operation, boat moorings or bank stability. The principles seem adequate and appropriate, although with a tendency towards the more costly end of the development scale. They cannot be confirmed as conforming to the requirements of any of the relevant authorities. One additional problem is that very substantial extensions of the harbour are implied, yet no allowance is shown to have been made for increased water flows and boat movements, particularly at the ocean entrance.

The operation of sand bypassing will permit the management of the regional beach problems which would otherwise result from the construction of the breakwater and its consequential impact on littoral drift. However, it is an operation which, from reports on similar projects around the world, has substantial difficulties. One very reputable review in the United States has suggested that such operations should not be undertaken except where there is an outstanding public need. It is in this context that particular attention must be paid to this part of the ERMP.

It has already been said that the quantities of sand moving past the site are only generally stated, and the computations cannot be verified. Nevertheless the average quantities quoted for bypassing are of the same order as the quantities believed by this Department to move past Mandurah. The extremes are less certain, and a cautious operator should allow for a wider range of quantities, from zero to several times the average. While the mechanical systems proposed could be made to handle this range, the financial management programme does not have this tolerance, particularly in the early years.

Neither the ERMP nor the supplementary report show to any reasonable detail the range of shoreline conformations which could occur at the various stages of the sand bypassing operations. It is most unlikely that the beach can be routinely constrained in a + 20 metres range as suggested on plan D 8.1. The "after dredging" alignment of the southern shore will be different after a summer operation than after bypassing in winter, as will the northern shore at the dump zone, and the later studies imply that a single bypass exercise each year will move the beach a much greater distance than 40 metres. There is a substantial cost penalty involved in carrying out this task several times each year.

The various problems which are of concern in the nominated bypass operations can be overcome at added cost, both in capital and operation. It has been suggested that a small dredge could operate effectively in the sand trap area, but a small dredge normally requires booster pumping to discharge as far away as the north beach, and optimum cost effectiveness may result from a larger dredge. There is no data in the ERMP on which to determine whether or not a realistic cost for sand bypassing has been established.

There are many other elements of this development which conform to the previously suggested "expensive end" of the available options for development. These include the double handling of dredged spoil to clear saline water, the proposal for pedestrian crossing of the entrance (which must mean a tunnel if maxi-yacht masts are to have unimpeded entry), the main breakwater and its maintenance requirement, and the rather loosely specified methods of preventing algal blooms. Some of the costly items are associated with the initial development, but many will be transferred to the Management organisation to handle in perpetuity.

With so many items loosely or incompletely defined, it is not possible to raise precise and specific objections to the proposal. It was noted that the project is very dependent on property sales and charges yielding sufficient revenue for management in perpetuity. It may be that the developers are taking an optimistic view of the demand for this form of property, and that a pessimist would note the performance of other "pioneer" harbour and waterfront developments at Yunderup and Two Rocks, and the proposed alternate availability of waterfront property at Mandurah, where the owners will not have to carry the full charge of keeping an ocean entrance channel open. The waters near Secret Harbour are not well favoured for fishing or diving, perhaps because of the turbidity noted in this ERMP.

It is necessary to give some thought to the consequences of the operators becoming insolvent after the breakwaters are built. Without continued sand by-passing several decades of littoral drift would be trapped and stored south of the site, producing a devastating impact on the shores further north, and therefore public funding would probably be utilised to continue by-passing. The most probable cause of insolvency would be an inadequate demand for the recreational harbour at the cost involved, and public funding of by-passing would thus have little benefit unless a non-recreational use was available. The only alternate use for which a demand is known at present is for shipbuilding, for which the costs involved could well be justified. Provided that a change of landuse to shipbuilding could be tolerated, then there is a contingency use available for this pessimistic outcome of the project.

The ERMP proposes a very substantial rezoning of foreshore land, in advance of any detailed study of the likely alignments of the shore and it is believed that this rezoning is premature. The rezoning should not be considered on the basis of present knowledge, except under the following conditions. The zones referred are as shown on plan D 8.1 of the ERMP.

- Zone Af :
  (1) No rezoning until a firm commitment has been made to construct the breakwaters and harbour entrance as generally shown in the ERMP.

  (2) No rezoning within 100 metres of the present shore vegetation line until detailed design of the entrance and sand bypassing system has shown that a lesser foreshore reserve will provide adequate public access and erosion protection.

- Zone Ae :
  (1) No rezoning until as Af (1) above.

  (2) No rezoning within 150 metres of the present shore vegetation line until detailed design of the entrance and sand bypassing system has shown that a lesser foreshore reserve will provide adequate public access and erosion protection.

- Zone Ad :
  (1) The width of the harbour entrance should not be limited by zoning or development area approvals until the detailed design of the entrance (including appropriate allowances for extensions to the harbour) is complete and shows a specific width to be adequate. At this time it would be most unwise to fix more than one boundary of the entrance channel.

- Zone Ac :
  (1) No rezoning until as Af (1) above.

  (2) No rezoning within 100 metres of the present shore vegetation line until the detailed design of the entrance has predicted shore alignments for both summer and winter conditions, and a development concept which can tolerate the high penetration of storm and swell waves to the beach centre (figs. 8-10, supplementary report, D 5.1 in E.R.M.P.) has been developed and shown to allow a lesser development set back.

- Zone Ab :
  (1) No rezoning until a firm commitment has been made to construct the solid headland at its northern end in addition to a specific design of entrance works and sand by passing system.

  (2) No rezoning within 150 metres of the present shore vegetation line until a specific sand by-passing maintenance operation has been clearly shown to be economically and practically feasible.

- Zone Aa :
  (1) No rezoning until as Ab (1) above

  (2) No rezoning within 200 metres of the present shore vegetation line until a specific sand by-passing operation has been proven to provide long term stability to this beach, and the Node as identified in this E.R.M.P. has been proven to be stable in the long term.

4. TOWN PLANNING BOARD

The Board is not involved in the project at this point in time but should the project proceed, the Board will then be required to advise the Minister for Urban Development and Town Planning on Local Authority re-zoning proposals and also to impose subdivisional conditions.

The ERMP has afforded a public review of the project however if the project proceeds then the public have further opportunity to comment on both Metropolitan Region Planning Authority and Local Authority re-zonings.

It is noted that in accordance with the Canals Committee Report, further details will be required of the canal development and associated subdivision.

5. TOWN PLANNING DEPARTMENT

Subsequent to the receipt of the ERMP the Department has received a number of related reports including a structure plan detailing town planning matters not dealt with in the ERMP. The following comments relate only to the ERMP.

The project, if completed, would provide an attractive residential environment which would be a considerable Regional asset. In particular it would provide a valued ocean orientated boating facility for the growing number of boating enthusiasts and thereby provide some relief to other more congested areas.

The locality is viewed in current planning strategies as being suitable for urban purposes. The use of the Parks and Recreation Reserve for Urban purposes is on balance, acceptable, provided sufficient benefit accrues to the public on account of the recreational attributes of the project.

The proposed stormwater discharge mechanism by-passing the harbour and discharging from the southern offshore breakwater is supported.

Some planning issues have not been adequately covered in the ERMP. It is understood that the structure Plan addresses some of the planning issues which should have been covered in the ERMP. While it is not intended to comment in detail on the Structure Plan at this time, it is pointed out that the plan does not adequately cover matters such as school sites and shopping centres.

Some proposals assessed by the ERMP require further assurance from technical officers in other departments. In particular advice from the Public Works Department on the likely impact of water extraction and excavations on the potable water supplies and on the proposals for the sand by-pass are required. Further work, particularly to assess the possibility of periodic N-S sand drifts blocking the northern channel, would also be desirable.

Advice from the Department of Conservation and Environment in respect of the environmental value of Lots 1092 and 1093, as mentioned in the System 6 Report is also requested.

A legal agreement between the State Government and the developer should be drawn up following the Environmental Protection Authority's recommendation on the ERMP, should it be favourable. This agreement should guarantee that the cost of the capital works associated with the project shall not fall on the general public. While the ERMP states that funds will be assured for various works, the nature of this assurance requires clarification. Possibly a Bank guarantee for the amount required for the carrying out of works in the event of the project not being completed could be a requirement.

An acceptable Management Authority for the harbour and associated facilities is a pre-requisite to commencement of the project. The Authority proposed may establish an undesiragle precedent for projects of this nature, being too orientated towards development representation. The Department of Local Government's advice on this matter and possibly the Government's determination should be sought at the earliest opportunity.

More attention to landscape design should be given if buildings are to be sited in the zone between the harbour and the beach. Roads or other hard edges should separate building envelopes from the dunes enabling drift to be more easily seen and corrected. A more detailed management plan for the foreshore should be made available to the Metropolitan Region Planning Authority prior to its consideration of the coastal management aspects of the project.

Antifoulings on boats contain tributyl tin, copper, arsenic and mercury and other toxic substances in high concentrations. These have not been considered in the ERMP.

Swimming may be dangerous near the by-pass dredge and its draw-down area. Provision needs to be made for restricting the public in these areas.

Navigation may be hazardous if unrestricted commercial development occurs north of the harbour entrance due to lights distracting navigators entering the harbour channel.

The project envisages attracting people because of the unique recreational environment. Consequently existing regional population projections may prove too pessimistic. However, the report is too optimistic in many areas relating to population and workforce. Much data is based on the South-West Corridor Report by T S Martin and Associates which was based on 1971 Census figures. The Authority's Strategy for the South-West Corridor, based on the 1976 Census has resulted in lower projections for population and workforce; the population figure formerly expected to be achieved by 2000 is now not expected until 2010. The Feasibility Study prepared in conjunction with the ERMP estimates that population in the Perth Region will grow by over 4% per annum 1986-1996. This estimate must now be regarded as over-optimistic.

It must be doubted whether white collar work will be created in large numbers in the Rockingham/Kwinana area, consequently many residents would be involved in long commuting distances to the inner areas of Perth. The Town Planning Department land use forecast report estimates that by 2001 about 45% of the SW sector resident workforce will have to work elsewhere.

It is estimated (p 65) that there will be a need for an additional 20 000 dwelling units pa by 1996. Town Planning Department estimates are that 12 000 pa will not be needed until 2001.

1976-1980 population growth rates for the Mandurah region are overstated, and the comparison between Mandurah in the 1980s and Wanneroo in the 1970s is exaggerated - and in any event Wanneroo may have achieved 40% of the Region's housing growth 1970-74, but it did not achieve 70% as indicated in the Feasibility Study.

There are a number of shortcomings of the ERMP when compared with the requirements set out in the Canal Estates Policy. It is hoped that the EPA will take account of this policy when making its recommendation, or that they be reported on subsequently, particularly with regard to :

(a) the desirable subdivision pattern, building envelopes and residential codes adjacent to the waterways;

(b) the ownership of the foreshore and waterway and its transfer to the appropriate body. (The Company's proposal to maintain ownership may establish an undesirable precedent and appears to be unnecessary in order to maintain control over land use).

(c) details relating to the construction of jetties, moorings and other harbour structures;

(d) the availability of facilities for boats to dispose of waste;

(e) the location and frequency of access points and reserves adjacent to the harbour;

(f) the arrangements for the owner to take responsibility for the management of the interface between the harbour and the development.

6. DEPARTMENT OF MINES - GEOLOGICAL SURVEY

Geological Survey has provided comment on three occasions and it is appropriate that all of these comments are mentioned here in order to gain a proper appreciation of the hydrogeological implications of the project. The two initial responses relate specifically to the ERMP. As a result of concerns raised, an addendum report was prepared by the consultant and submitted during the review period. This additional report set out a revised abstraction rate and brought forward the time for connection to the Metropolitan Water Board's mains to five years in order to reduce the impact of groundwater abstraction. Comment on the addendum was then provided.

6.1 Comment on the initial proposal (as set out in Appendix AD3 of the ERMP)

The report presents an acceptable outline of the hydrogeology of the area and makes good use of the available information. However, these data are only sufficient to provide the basic pattern of groundwater flow and can not be regarded strictly as a flow net analysis in the rigorous sense. Nevertheless the estimate of the recharge rate, set at about 10% of the mean annual rainfall, is probably realistic.

The predicted drawdown pattern resulting from groundwater abstraction has necessarily had to be derived from a number of assumptions, all of which are reasonable. This pattern clearly indicates the following effects:

a) A withdrawal of groundwater from storage both inside and outside the property boundaries.

b) A lowering of water table levels outside the property boundary by up to 0.6 m including 0.25-0.4 m at Peelhurst.

c) A landward movement of the seawater interface will occur (Fig. 12) from which it may be inferred that the fresh-water lens, as cut by shallow bores on the coastal side of Peelhurst, may become too thin to be pumped.

d) Pumping from more than one site will result in less intensive drawdown within the developed property and increased drawdowns on its boundaries. These effects are not discussed by the consultants.

e) Water table drawdown within Anstey Swamp is predicted to be 0.32-0.6 m, however, this may be reduced slightly by reduced evaporative losses and hence greater groundwater recharges consequent upon the water table lowering.

No evidence is presented in the report to support the statement on Page 103 to the effect that "the water required" for domestic use will, for a period of eight years or so, be drawn from the unconfined aquifers without detriment to the level of groundwater or surface water or vegetation" Water table levels will undoubtedly change in response to the pumping rates that are envisaged and their magnitude should be assessed by more comprehensive modelling studies than have so far been attempted. Furthermore a field investigation is required not only to establish the hydraulic characteristics of the aquifers to be pumped but the relationship between the water level in Anstey Swamp and the surrounding body of groundwater. If direct hydraulic connection exists between the two bodies of water the artificial maintenance of the water level in the swamp by pumping groundwater referred to on P150 may either be impractical or be very expensive because of rapid recirculation. It is nevertheless possible that the influence of pumping and of the harbour development itself on groundwater levels over the eight year period of use may be acceptable when weighed against the benefits which may accrue. It is considered that a more definitive picture could be presented and should be sought before permitting the development to proceed.

The proposal to withdraw water from the Leederville aquifer is unsupported by any estimate of throughflow and may not be acceptable to the Metropolitan Water Board. Accordingly,the proposal should be referred to the Board for its comments with respect to abstraction rates from both the unconfined aquifers and the Leederville Formation.

It is evident from the comments of the consulting engineers Halpern, Glick & Lewis that the proposed mean water supply demand of the development is substantially less than that assumed for the hydrogeological report at 1.7-1.9 KL/d per dwelling, rather than 4.0 KL. Although the corresponding water table drawdowns would be proportionately lower, abstractions of shallow groundwater would still exceed natural throughflow within the property and groundwater would be drawn from adjoining areas.

If water is extracted from the harbour excavation at the rate of 40 000 KL/day a progressive eastwards movement of the seawater interface may be expected. However, lower rates of extraction are believed possible with the maximum recirculation of slurry water through appropriate drainage. This would have the effect of:

a) minimizing, if not eliminating the introduction of a brackish leachate to areas P and Q.

b) minimizing disturbance of the fresh-water lens in the narrow strip of land between the harbour and the ocean.

It is nevertheless true that when the harbour is opened to the sea a new seawater interface will develop below its eastern margin, effectively moving it 700 m inland from its present position. Whether it remains in this position or moves even further east will be dependent on the proportion of the groundwater underflow that is allowed to move westwards past the pumping bores.

The hydrogeological consultant has calculated the influence on groundwater salinity of the leached salt from the spoil stacks as about 494 mg/L TDS. It should be made clear that this is the estimated increase in the salinity of the infiltrating rainwater and that evapotranspiration could produce a further substantial increase in the salt concentration at the water table. Dilution with the prevailing body of groundwater would probably bring salinity down to an acceptable level at production bores. Further dilution with infiltrating rainfall subsequent to harbour construction could be expected to remove residual salt.

The quality of the water in the harbour after opening to the sea will be substantially that of seawater. As any groundwater could be expected to bring with it some nutrients, a potential could exist for algal blooms to develop and in consequence it may be necessary to accentuate tide flushing by the use of some pumped circulation. The ERMP includes a calculation in Appendix E1 of the nutrient input to the harbour waters based on an assumed 15% leach to groundwater of applied fertilizers and then assesses a required harbour flushing rate of 7% to keep the nutrient concentrations below the algal 'bloom' levels. This appears feasible but attention is drawn to the possibility of the volume-rates of groundwater input to the harbour being different to those assumed and that these could best be calculated after further modelling studies.

Emphasis is laid in the report on the fact that the development will be deep sewered and that a treatment plant will be constructed. Waste water will be used to irrigate "a piece of land out of reach of the harbour" with "no chance of effluent affecting bores or the harbour water" (P130). Although the disposal of waste water in this way is generally acceptable it should be noted that some nutrient residuals may reach the water table and hence may move towards both the harbour and pumping bores under pumping conditions if natural or induced hydraulic gradients induce such movement. This possibility should be examined after further groundwater modelling studies.

The use of groundwater resources in adjoining areas must be regarded as being to the detriment of the future development of these areas. If further groundwater modelling studies confirm that the abstraction of shallow groundwater will cause measurable drawdowns outside the

developed property it is highly desirable that the interests of existing groundwater users be safeguarded. An undertaking should be made on the part of the developers to supply water to them in the event that either water levels are lowered excessively or that seawater intrusion causes a deterioration of water quality.

The consultant concludes that a more detailed assessment of the development is required and this is strongly supported in all aspects. There is a particular need to mathematically model the influence of groundwater abstraction on water table levels and the effect of this, and harbour placement, on the movement of the seawater interface. However, the rates of groundwater abstraction applied in these studies must be set at a more realistic average, rather than peak levels in order to keep water level changes outside the development to the minimum.

There is also an evident need to more clearly define the water requirements for harbour dredging and spoil transport. The procedures required to minimise seawater encroachment prior to harbour opening should be defined.

- It is considered that the data presently provided is inadequate for approval to be given for the project to go ahead. A particular need is seen for the influence of pumping on water levels and the seawater interface to be much better defined. Actual pumping bore locations and abstraction rates need to be incorporated in mathematical modelling of the system and realistic hydraulic parameters need to be derived from actual pumping tests. Account should also be taken of the preceding comments.

- A monitoring program is required and this will be more easily planned after further hydrogeological investigation is completed. However the following facilities would appear to be needed on the basis of current information:

  a) Water table levels should be recorded at Anstey Swamp, at intermediate sites between pumping bores, the north boundary of Peelhurst and at the centre of the north boundary of the property.

  b) Seawater interface piezometers (in trios) should be installed in the centre of the east shore of the harbour, at the NW corner of the Peelhurst development and about 100 m from the NW corner of the property.

c) A trio of piezometers may be required to observe leachate movement below the Q spoil stack. This could also be used in future for seawater inter face observation if the harbour development were to be extended.

6.2 Comment on Addendum to Appendix AD3 of the ERMP

Further to previous comments on Secret Harbour; an addendum to the hydrogeological report prepared by Rockwater was assessed. The principal modification to the initial proposal is a reduction to four years of the period over which the shallow groundwater would be used for domestic supply. Furthermore the daily abstraction rate would fall to no more than 1.7 ML/day. These changes would be made possible by the developer funding an extension to the M.W.B. water supply system earlier than was envisaged in the first proposal. This modification has the effect of substantially reducing the potential impact of pumping on water table levels in the area.

Thus the consultant now predicts the three year drawdowns in response to abstraction at 1.7 ML/day to be 0.11 to 0.28 m over the area occupied by Anstey Swamp and 0.06 to 0.13 m at Peelhurst. These predictions (in a new Figure 13) would not be realised in practice because aquifer anisotropy would promote a greater abstraction from screened intervals than from shallower depths, with consequentially reduced drawdown at the water table. Also the predicted drawdowns in areas where a seawater interface occurs, as at Peelhurst, would be partially balanced by movement of that interface which in time would reduce drawdown.

As a potential drawdown of even 0.28 m at Anstey Swamp may be significant, it is important that the relationship between swamp waters and the main body of groundwater be investigated. This is now recommended by the consultant (Para. 7.5.2) and should become a condition of government acceptance, as should a comprehensive program of groundwater monitoring.

The reduction in abstraction from shallow groundwater is sufficient to remove the need for comprehensive aquifer modelling studies referred to in comments. However a full program of groundwater monitoring should be considered essential and the current proposals of the consultant in respect to this is acceptable but matters of detail may require some discussion.

A reduction in the quantity of shallow groundwater abstracted will have the effect of allowing a greater volume rate of groundwater discharge westwards into the harbour than the original proposal. This should provide a greater dilution capacity for any leached nutrients arising from fertilizer applications or residuals from any waste water that reaches the water table from the sewerage treatment plant. Although the possibility of algal blooms in the harbour due to nutrient input may therefore be reduced, it will still have to be taken into account in waterway management and will necessitate appropriate hydrochemical and biological monitoring in the long term.

Although the abstraction of substantial quantities of marginal-quality water from the confined aquifers is very unlikely to cause drawdown effects in the shallow aquifer, there is a probability that leachate from the irrigated area of the development will contain sufficient salt to give salinity increases at the water table. This will affect both irrigated areas and areas in the direction of groundwater movement (i.e. the west) but is unlikely to affect the quality of water to be pumped for public supply now that the proposed abstraction rates have been reduced.

Any salinity increases induced by irrigation water will be confined to the area of the development but should be monitored. There may be a need to continue to pump some shallow groundwater for irrigation purposes beyond the four-year water supply period in order to both reduce draw on the confined aquifer and mitigate any tendency for shallow groundwater salinities to rise to undesirable levels.

7. Department of Fisheries and Wildlife

7.1 Fisheries

From the aspect of fisheries, the Department had no objection to the development of Secret Harbour but the proposal has raised two areas of concern.

- That the increased amateur fishing pressure resulting from the development could lead to increased competition with professional fishing in the region, including the Murray reefs offshore from Secret Harbour where the western rock lobster is caught by boats from Mandurah and Safety Bay.

- That water quality in the harbour and the adjacent ocean might be detrimental, directly or indirectly, to commonly fished species in the region or cause their flesh to become unsatisfactory for human consumption.

The ERMP shows an awareness of these two areas of concern, and the future studies, including regular monitoring, proposed by the ERMP will determine their validity and significance. The Department agreed that such studies should occur but would like further details of their expected implementation.

On page 148 of the ERMP the statement is made that "The Management Authority will, in conjunction with the Department of Fisheries, investigate the effect of the new boat and fishing population on crayfish and other ocean fauna". It should be emphasized that while the Department is happy to give advice it does not have the resources to take part in such an investigation.

On page 146 of the ERMP it is suggested that flora and fauna of the Harbour be checked against contamination by heavy metals and other substances. As a preliminary guideline to future water quality monitoring activities relevant to fisheries, in addition to the ERMP's suggestion of checking nutrient and disolved oxygen levels in the Harbour waters, there may be a need to determine total hydrocarbon levels and the levels of any toxic substances leached from anti-fouling preparations on boats.

If heavy metal analysis of fish is considered necessary, the species sampled should include the cobbler, since of the commercial benthic feeding species, it would have the greatest retention time in the harbour.

Finally, there are some statements in the ERMP and appendices which need correction or interpretation, especially if they are ever used for future reference.

ERMP

- p. 26, para. 5. A more complete list of species caught by professional fishermen in the region is given in appendix AC3 to which the ERMP does not appear to have referred.

- p. 56, para. 2. Professional fishing does occur in the area.

- p. 123, final para. There will be major seasonal changes in the species present, but, as stated, they will not be due to salinity changes.

- p. 127, para. 2. Surely the presence of a Harbour will mean some increase in boat numbers in the area.

Appendix E1.

Pages 2 to 5. Algal Bloom and Nutrient Levels. Neither Nodularia nor Cladophora would be expected to occur in sea water. Further, there has been a complete misunderstanding of published results on nutrients and algal blooms. It is strongly recommended that the consultants discuss the role of nutrients in algal bloom formation with the author quoted in the text.

7.2 Flora and Fauna

Generally, sections of the ERMP concerning the flora and fauna of the project area are extremely superficial and of limited value in evaluating possible input. Thus statements in the document relating to the effects of the proposal are suspect.

Lists of plants and species found in the area appear to be far from complete. No details are given as to how the lists were developed or the methods or effort involved.

The major implication of the project on wildlife or areas of conservation value would appear to be with respect to Anstey Swamp. The potential down-draw which could result from the abstraction of water from the unconfined aquifer, is such, that there is little doubt that a deleterious impact on the wildlife value of the wetland would ensue.

From field investigations, it appears that this wetland is related to and under the direct influence of the ground water table. Whilst short term changes to the wetland as a result of lowered water levels are not expected to be significant, longer term changes could result in the encroachment of marginal adapted vegetation into the wetland. In addition, the summer wildlife refuge value of the wetland would be lost.

8. DEPARTMENT OF YOUTH SPORT & RECREATION

The Department has examined the ERMP and it supports the development proposal so long as environmental and Town Planning requirements are met. One aspect of the proposal however, was not favoured, this being residential development abutting public beaches north and south of the harbour entrance.

It is believed that the harbour will provide an attractive residential setting not available in Perth and it will offer a diversity of recreation opportunities that are not usually provided by residential subdivision. The benefits of the development will flow to residents, tourists and visitors to the area.

The proposal is concerned with providing opportunities for recreation that is aquatic based and primarily caters for the requirements of residents and tourists. In particular, tourist accommodation at the harbour entrance may provide the public with holiday opportunities not currently available in Western Australia.

The provision of opportunities for the general public, and of public access to coastal resources is of concern to this Department. In this regard, the proposal to site what is apparently medium density and single residential housing on the coastal strip north and south of the harbour entrance may prejudice public access to the beach. Accordingly, single residential housing is not favoured in the areas between the coastal access roads and the beach. It would be preferable to retain the area as Public Open Space for the purposes of parks and recreation.

It is noted that the project proposes recreation nodes along the beach to the north of the Harbour. This concept of development in coastal locations is supported.

It is proposed to exchange a portion of Crown Reserve 20716 required for harbour works and development, with a similar area of land from Pt 1092. This land swap may be inequitable. The recreational value of the land parcels should be the major concern before a land swap is completed.

With respect to the management authority proposed, the Department believed that there is a need to ensure it will fill its responsibilities to the general public, as well as the residents of the area.

9. WESTERN AUSTRALIAN MUSEUM

Although the likelihood of locating significant archaeological sites in the project area is minimal, it is considered that an area such as the one proposed should be examined by a qualified archaeologist.

Should any site be located the proponent would then be obliged to report its existence and make formal application for its utilisation.

10. SHIRE OF ROCKINGHAM

The Council has agreed in principle, to the establishment of the Secret Harbour project and accepts the proposed Management Authority to manage the development. However, because there is no similar development in Western Australia, it is requested that the Management Authority be established and reviewed in 10 years time, and every 5 years thereafter.

The following are Council comments relating to the Secret Harbour Environmental Review and Management Report and Appendices.

10.1 SPECIAL ACT OF PARLIAMENT

The basis of the Secret Harbour project is that it be carried out as a result of a Special Act of Parliament. If such an Act or Agreement is not promulgated, then it will be impossible to carry out development under the existing legislation as it would involve several

Acts, each overlapping, and in some cases, not covering the criteria intended. The Council agreed that a Special Act of Parliament or Ratified Agreement is necessary to implement the proposed development indicated in the Report, and to allow the Management Authority to operate.

In addition the Report indicates that the powers of the Management Authority shall not conflict with the provisions of:-

- Bush Fires Act
- Health Act
- Acts providing conservation of wildlife and indigenous fauna
- Environmental Protection Act.

This section does not include the Local Government Act, Town Planning and Development Act, and the Metropolitan Region Scheme Act.

Council requested that assurances be given that the proposed legislation does not over-ride any of the current powers or functions of the Council within the Secret Harbour area.

10.2 MANAGEMENT AUTHORITY

10.2.1 Membership

It is proposed that the Management Authority consist of 5 members:

1. One member nominated by the residential landowners and occupiers.
2. One person nominated by commercial property owners and occupiers.
3. One representative nominated by the Rockingham Shire Council.
4. One representative nominated by the relevant Minister.
5. One representative of the Secret Harbour Trust;

together with Harbour Master acting as Secretary and ex-officio member of the Authority without voting rights (the members will be appointed by the Governor).

Council objected to this aspect of the Report and requested that two Local Authority representatives be on the Management Authority - 1. A Councillor, and 2. An officer nominated by the Council.

Also that the method of election of the Management Authority and the term of office should be arrived at by discussion or consultation with the Rockingham Shire Council.

In addition, if for any reason, or because of the Management Authority, a decision on any matter cannot be arrived at, then such matter can be referred to the Rockingham Shire Council for determination.

10.2.2 Development Proposals

The Rockingham Shire Council is required to submit to the Management Authority for a report and recommendation on applications for the following:-

- Town Planning
- Interim development order
- The subdivision or amalgamation of land
- Development of any land
- Change of use of any land
- Any relevant application

Council agreed in principle with the proposal, however because of the requirements of various Acts and By-laws, it may not be possible to accede to this request at all times.

10.2.3 By-Laws

The Management Authority will have power to prepare and publish By-laws and Regulations with the consent of the Minister, and reviewed by the Rockingham Shire Council. The Rockingham Shire Council may also make special By-laws relating to the area under the jurisdiction of the Management Authority at the request of the Management Authority.

Council believed that any By-law or Regulation proposed by the Authority should require the consent of the Council and the Hon. Minister.

10.2.4 Dune Management

It is proposed that the ongoing maintenance and management of the coastal protection strip is undertaken by the Management Authority, and that the cost should be met by the Rockingham Shire Council.

There is clearly a need to clarify this aspect of the Report as the Management Authority could encumber Council with the additional costs without referring the matter to Council. In addition, the Soils Conservation Section of the Agriculture

Department should be requested to consult with the Council as well as the Management Authority in regard to the management of the dune area.

10.3 SECRET HARBOUR TRUST FUND

These funds are proposed to be invested in income-earning properties and the income will accumulate in the sinking fund to finance major maintenance of harbour facilities etc. The major problem with this aspect of the Report is that if the funds are invested in Secret Harbour, commercial land or enterprises, and if the project collapses, the sinking fund money will be worthless.

Council requested that the Environmental Protection Authority should ensure that the sinking funds will be invested in income-earning properties outside the Secret Harbour area.

10.4 TECHNICAL COMMITTEE

It is proposed that there will be Special Technical Advisory Committees appointed when deemed necessary. Such Committees shall comprise of Officers of the relevant Departments, Shire Council, Consultants or individuals that the Authority may decide, and they shall be appointed upon terms agreed with the relevant Authorities.

Council objected to this aspect of the Report and requested that a Technical Committee be formed on a permanent basis, comprising of Officers nominated by the Council, Town Planning Department, Department of Conservation and Environment, Public Works Department, and additional Technical Officers considered relevant. The Technical Committee should be formed as soon as possible to commence with the monitoring as the development proceeds.

10.5 HARBOUR EXCAVATION EFFECTS

Slurry will be pumped to the spoil area within the harbour where water will be dispersed by run off, infiltration and evaporation. When the spoil has drained, the fill will be trucked to the disposal areas. We have an assurance, from the Report, that the leaching from the disposal areas will not have an adverse effect on the groundwater.

Council requested the Environmental Protection Authority to give an assurance that leaching from the spoil in the disposal areas will not have an adverse effect on the groundwater, and the Environmental Protection Authority request the matter be referred to the Public Works Department for monitoring.

10.6 SEAWATER INTERFACE

The Report relates to the effect the salt water intrusion may have on the ground water quality (including existing bores) when drainage is combined with water withdrawal. Concern has been expressed as to the possible effect the salt water intrusion may have on the existing Peelhurst Townsite and Anstey Swamp.

Council requested the Environmental Protection Authority to ensure that the groundwater usage will not have an adverse effect on the aquifers by the salt water intrusion. This aspect of the Council's concern relates to the effect groundwater pumping may have on the Peelhurst Townsite, Anstey Swamp and surrounding areas.

10.7 FUNDING OF THE PROJECT

The Report sets out the cash flow analysis and method of funding the project.

There has been a considerable amount of comment with regard to the ability of the project to be funded sufficiently to ensure the harbour operates satisfactorily. It is considered that this point should be adequately catered for within a contingency clause to ensure that, if there is a total failure of the project, the land should be rendered satisfactory for further land uses.

Council requested that a contingency clause be included in the Agreement to ensure that, if the project fails, the land will be rendered suitable for future land uses.

10.8 HARBOUR FACILITIES

The report sets out possible methods of creating harbour facilities (wharf facilities, floating jetties etc).

Council believed that the Environmental Protection Authority should request the Public Works Department to thoroughly investigate the proposed construction of the wharves and harbour facilities to ensure that they could be managed and maintained satisfactorily.

10.9 BUILDING THEME

The Report recommends the introduction of an Architectural Review Group to check plans lodged with the Local Authority to ensure that they conform with the established architectural controls.

Council believed that appropriate Council Officers should form part of the Architectual Review Group.

10.10 GRASSED PARKING AREAS

The Report suggests that the grassed areas, used for recreation, will be used for carparks at peak times near the beach. As this is also peak erosion time, it would be better to provide additional sealed car-parks even if it is further to walk to the beach. Maintenance of any unsealed carparks would be high. Council objected to carparking on the unsealed areas.

10.11 SEWERAGE DISPOSAL

The nutrients from the effluent disposal system must not enter the Secret Harbour complex, adversely affect the groundwater supply, or be detrimental to any future development to the north of Secret Harbour. Appropriate means to ensure that these effects do not occur should be investigated and implemented.

10.12 HILLY SCRUB LAND

Areas of natural acacia and low heath vegetation will be incorporated in the proposed open space network in the combination of informal limestone paths and cycleways. The Report does not indicate who will maintain the informal limestone paths and cycleways.

Council believed that the developers should provide sealed cycleways and paths throughout the area and that they be maintained by the Management Authority.

10.13 QUARRYING

It has been proposed that limestone be excavated from within the area to use on the project. It has not yet been established that the stone will be suitable for the purposes proposed. There is therefore a need for clarification as to whether the limestone on the site is suitable for the uses proposed.

10.14 OWNERSHIP OF LAND

The Secret Harbour project proposes re-distribution of the regional open space in the northern section. The purpose of this re-allocation of land is to rationalise the regional open space reserve with the proposed development in the area. Council supported the proposed exchange of regional open space in the northern section of the project, as shown on the plans.

10.15 DOMESTIC SUPPLIES OF WATER

It was considered that, at the present time, there may not be sufficient water in the aquifer to serve the community or the excessive draw on the aquifer may have an adverse effect on the surrounding area.

Council believed that through the Public Works Department and the Mines Department, the availability of water in the underground aquifer to supply water for both domestic and reticulated purposes should be investigated. Also the required draw-off, should not adversely effect the existing farming community or the urban area south of the development by increasing the salinity of the water or lowering the water table.

10.16 MONITORING OF GROUNDWATER

The Report suggests that monitoring of groundwater levels in the unconfined aquifers throughout the project area should be carried out. Council believed that monitoring of the underground water levels of the unconfined aquifers should commence immediately.

10.17 DRAINAGE OF EASTERN PORTION & GOLF COURSE

It is understood that drainage of the eastern portion of the estate is to be through a lakes system intergrated with a golf course, no details of which have been provided in the ERMP. Whilst Council agrees with the concept in principle, details of the design, method of construction, management and maintenance of the surrounds and water quality need to be discussed and approved by the Council and relevant State Authorities before any work proceeds.

10.18 MUNICIPAL SERVICES

The Council reserved the right to give further consideration to the design and proposed construction of the proposed drainage systems, roads and footpaths when detailed plans are available. And at this stage, Council pointed out that it does not

necessarily agree to the use of porous pavements, and the limited drainage design as suggested in the Report. Council also required that earthworks and other construction work involving movement of large quantities of soil is to be carried out so as not to have any adverse effect on the existing residents within the areas. Council should also specify the times when the work may be carried out.

CONCLUSION

The Council supported the development of the Secret Harbour project, subject to the specific issues, mentioned above being answered to the satisfaction of the Environmental Protection Authority. Should there be any over-ride in legislation, particularly in regard to maintenance and management of the estate, the matter should be determined by the Council and the developers by mutual arrangement.

11. DEPARTMENT OF LANDS & SURVEYS

The Departments main involvement in this project lie in the provision of land from the foreshore reserve, i.e. between high water mark and low water mark for construction of the entrance channel to the harbour, and the provision of part of Reserve 20716 in exchange for freehold land on equal area basis.

Both of these issues will require further negotiation with the company before a final decision can be given but in the case of the foreshore reserve, it may be necessary for the company to lease and possibly purchase from the Department, the 75 metre strip for construction of the entrance channel. Any exchange of land approved would have to be on the basis of equal value and not equal area.

Any proposal for dune management on Reserve 20716 would require formal approval of the Department. Agreement will have to be reached as to the extent and nature of the work proposed before such work could commence.

Portions of two public roads, Anstey Road and Surf Drive, which encroach into the area to be developed, will require closure and disposal.

Internal subdivisional requirements with respect to reserves will be dealt with by the Town Planning Board in accordance with established policy and procedures. The question of ultimate ownership of the harbour bed is a matter for legal interpretation and Government policy.

It appears that ownership of the harbour would remain with the registered proprietor unless the State were to insist on surrender, in accordance with the "Recommendations for the Development of Canal Estates". If the harbour is retained in freehold, the section of foreshore to be inundated by the entrance channel may need to be sold in fee simple to ensure continuity of Title to low water mark. This aspect will be discussed further with the developers.

12. DEPARTMENT FOR COMMUNITY WELFARE

The Department has a Beach Camp on Reserve 33877 which adjoins the north western boundary of the project area. This beach camp plays a vital role as an activity and development centre for adolescents.

The camp has been developed in sympathy with the environment and the Department has stabilised and managed much of the fragile land on the adjacent coastal reserve. The ERMP fails to adequately recognise the existence or community role of the camp and future planning should include a proper understanding of the implications of the project on the camp.

It is noted that a Management Authority should be established to, among other things, have jurisdiction of the coastal reserve. It is considered that provision should be made for the Department to be represented on the Management Authority.

The System 6 Study Report makes recommendations (M106) affecting this area. The Report suggests that the western portion of the lots 1092, 1093 and 1094 (which are part of the project area) should be incorporated into a Regional Park with the balance of the Port Kennedy area. This recommendation is based on the conservation value of the area and the recreational potential. The ERMP does not accept this proposal, although part of this land has been suggested as a land swap for portion of Reserve C20716. More land should be set aside in this area by the developers to be retained in its natural form.

The Department expressed concern over the effect the proposal could have on ground water supplies, which are the only source of water for the camp. It was suggested that the developers should provide the camp with a water supply if the quality or quantity of groundwater is reduced as a result of the proposal.

In addition concern was expressed that a lowering of the watertable or an increase in its salinity level could be detrimental to vegetation in the locality.

The project will result in bisecting the beach in this locality and this loss of continuity should be noted and overcome if possible.

The effect of the project on beaches to the north of the harbour does not appear to have been adequately studied and it is suggested that approval of the project should not be given until this aspect has been given more consideration.

The concept plan shows a connecting road from the project, north to Port Kennedy, on the western side of the camp. It is considered that any connecting road should be to the east of the camp.

The social environment of the project and its impact have received little attention and the developers should consider the needs of the young, especially those who may not be able to afford to utilize the expensive facilities proposed.

Through experience gained in the development and operation of the camp, the Department has an appreciation of the environment of this locality and would like to be consulted as this project proceeds.

13. WATERWAYS COMMISSION

The Commission has not assessed this project as it is presently reviewing projects within its Management areas. At some future date, comment will be made with respect to management issues in the ERMP.

14. METROPOLITAN WATER SUPPLY SEWERAGE & DRAINAGE BOARD

The project area is at the south western extremity of the MWB Area and only portion is actually with it. The area is remote from existing services.

In terms of urban water supply and wastewater disposal requirements of the project, the staging proposals are not inconsistent with the Board's planning. The timing is however, many years ahead of the economical extension of MWB services.

As the local water supply and deep sewerage scheme will eventually be connected to the Board's schemes it will be necessary for all permanent facilities to be installed to the Board's standards. The Board has no objection to the Management Authority being responsible for the 'local' services for Stage 1.

At the appropriate time the Board is prepared to consider the supply of scheme water at the developer's cost. This cost is however, considerable and the project will depend upon local underground water supplies for Stage 1. Whether or not local groundwater resources can be utilized without long term detriment cannot be determined without further data, however there is a need to understand the possible short and long term effect of groundwater abstraction from both the unconfined and Leederville formations.

There is currently no control over the use of groundwater from the unconfined aquifers in this area, and due to the dependence of the Peelhurst community on private bores it may be that some regulation is necessary. This control could be achieved under the Rights in Water and Irrigation Act.

The project is to be deep sewered and the effluent treated in package plants. It is suggested that a connection to the proposed Port Kennedy Plant occur in 1988. It is unlikely that this plant will be commissioned by 1988. This means that developers own treatment system will have to be designed and located to meet development needs of up to 3,000 people, but a suitable site for this size plant may not be available within the project area. Further investigation of this aspect and options available, will need to be carried out.

The ERMP does not suggest that the Board take over the drainage requirements of the project; it is assumed therefore that administration of this service including the stormwater pump station will be by others.

15. DEPARTMENT OF HARBOURS AND MARINE

All navigable waters, which would include the proposed harbour, fall within the jurisdiction of the WA Marine Act. Accordingly all existing marine legislation will apply and many of the proposals suggested in the report with respect to harbour management are superfluous. Control and enforcement of these regulations should rest with the appropriate body which has the skills to deal with such matters. As the State navigation and marine authority the Department of Harbour and Marine must assume this responsibility.

As this development is specifically creating a requirement for additional expenditure, provision should be made by the developers to off set the cost of employing a Marine Inspector for an appropriate period. This cost should include associated expenses such as a vessel, vehicle and on-site accommodation.

The cost of approved navigation aids and the maintenance of the aids should be borne by the developers. The ownership of the aids should be vested with the State Government.

All structures within the waterway and below high water mark will need to be licensed under the Jetties Act.

The ERMP proposes that the harbour bed should remain in private ownership. It is noted that the report of the Steering Committee on Canal Developments deals with this aspect of ownership and states that the Crown should be the owner of the land below canals.

16. MAIN ROADS DEPARTMENT

No objection is raised to the proposal as there are no Declared Main Roads or Highways involved.

17. DEPARTMENT OF PUBLIC HEALTH

No mention is made of any microbiological analysis on the proposed water supply nor any future monitoring proposals for the supply.

Details of the discharge facility for sewage from boats should be provided in due course. In addition plans for the treatment and disposal facility for domestic sewage will need to be approved by the Department.