REPORT AND RECOMMENDATIONS
by the
ENVIRONMENTAL PROTECTION AUTHORITY

HALLS HEAD WATERWAYS PROJECT

Department of Conservation & Environment
Perth, Western Australia

BULLETIN 129
DECEMBER 1982

ERRATUM

The following paragraphs should be inserted immediately following Recommendation 8 on Page 21.

In addition, the design life of the protective structure of the connecting channel should be in the order of 100 years, in view of the critical role that these canals play in the exchange of waters between the estate and the Inlet Channel.

The Authority recommends that:

Recommendation 9

The proponent should provide information to the PWD to indicate that a design life of 100 years would be reasonable expectation for the protective structures along the connecting channels.

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HALLS HEAD WATERWAYS

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

Department of Conservation and Environment

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PREAMBLE

Environmental Review and Management Programmes for two canal projects, one from Parrys Esplanade Ltd for land on the west of the Inlet Channel (Halls Head Waterways project), the other from John Holland (Constructions) Pty Ltd for land east of the channel (Waterways Mandurah project), have been submitted for evaluation. Figure 1 shows the location of the two project sites, while Table 1 shows the characteristics of both projects.

The conservation values of the respective sites, flooding implications, consequences for groundwater resources and the possible impacts of the developments on the estuarine fishery are issues that have been considered in determining whether the projects are environmentally acceptable and could proceed. Also of fundamental importance is the quality of the source waters, the suitability of winds, tides and other phenomena to drive flushing mechanisms, and the geotechnical adequacy of in situ soils.

Table 2 summarises evaluation of these factors in relation to the canal proposals. In each case, the implications of development can be considered manageable, although detailed monitoring would be necessary to guide management efforts. In addition to these factors, because of differences in development concept and design detail, the projects raise many issues specific to the individual proposals which also require examination. Further, it has been necessary to examine the proposed developments in a regional context, particularly in terms of problems and expectations relating to the Peel-Harvey Estuary.

Management of the artificial waterways will be most important. However, as yet no manager for artificial waterways has been designated and neither has the means of funding management been determined. The Authority believes that a decision on management responsibility and funding should be made before any canal development is approved.

The Authority considers that management costs should be met by the beneficiaries of canal developments, the developers initially and the residents in the long term. However, canal developments will also cause demands for services in addition to those normally arising from new subdivisions. These demands will affect the Peel Inlet Management Authority, the Marine & Harbours Department, the Public Works Department and the Department of Fisheries and Wildlife, as well as the efforts already underway to overcome the environmental problems of the Peel-Harvey estuarine system. The Authority advises Government that, should approvals be granted for the canal developments, it would be necessary to acknowledge the validity of these demands.

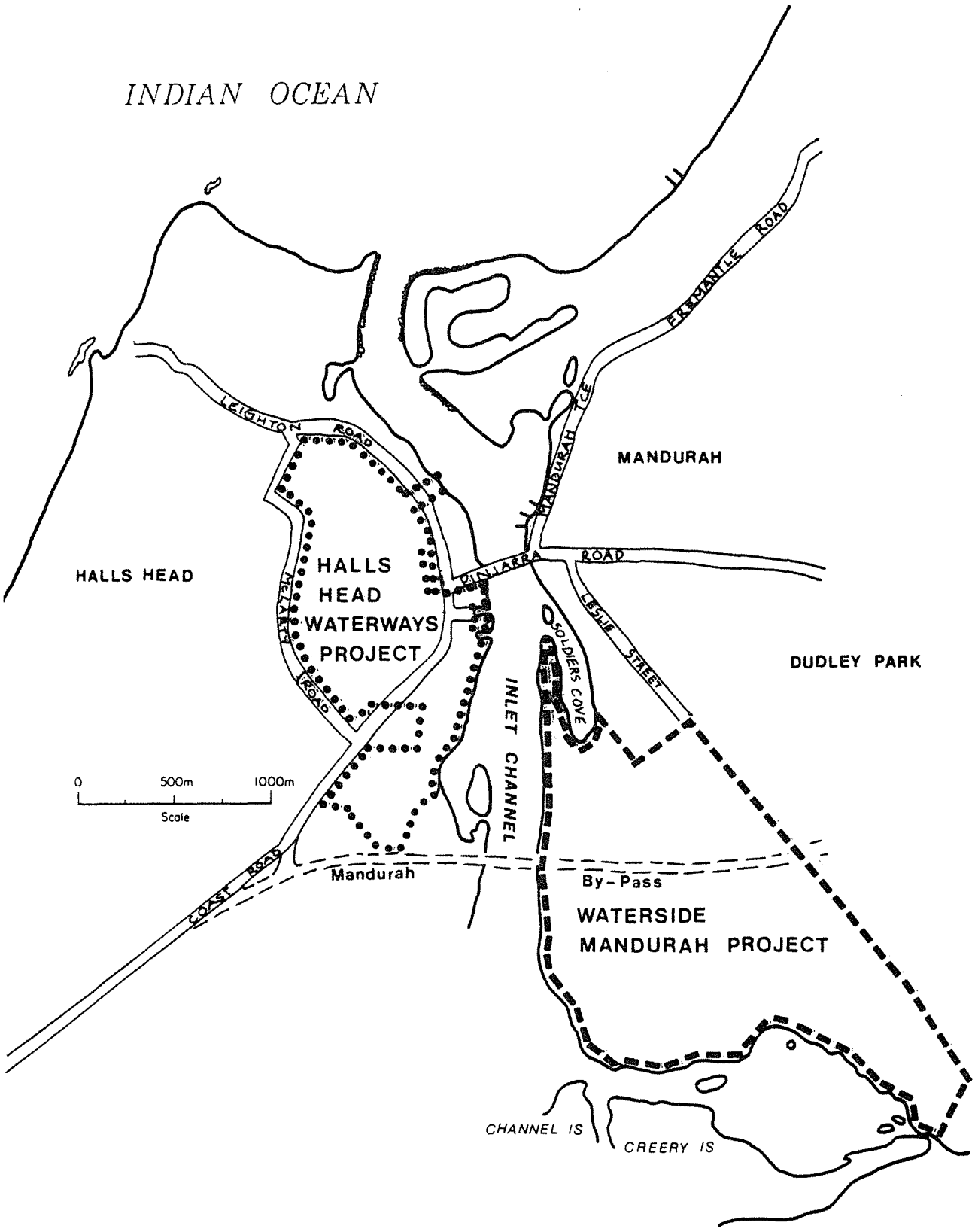

INDIAN OCEAN
FREMANTLE ROAD
LEIGHTON ROAD
MANDURAH TCE
MANDURAH
HALLS HEAD
HALLS HEAD WATERWAYS PROJECT
BINJARRA ROAD
LESLIE STREET
DUDLEY PARK
SOLDIERS COVE
INLET CHANNEL
0 500m 1000m
Scale
COAST ROAD
Mandurah
By-Pass
WATERSIDE MANDURAH PROJECT
CHANNEL IS
CREERY IS

Figure 1.

TABLE 1

ASPECTS OF THE WATERSIDE MANDURAH AND HALLS HEAD WATERWAYS CANAL PROJECTS AS IDENTIFIED IN THE ERMPS

FEATURE	PROJECT	
	WATERSIDE MANDURAH	HALLS HEAD WATERWAYS
Location	Pt Cockburn Sound Loc. 16 - (subdivided to three lots) east side of Inlet Channel	Pt Cockburn Sound Loc 16 - west side of Inlet Channel
Area (ha)	STAGE 1: 74; STAGE 2: 205; TOTAL: 279	129
Status of Land	Privately owned, subject to System 6, recomm., bisected by Mandurah by-pass	Privately owned, subject System 6 recomm., skirted by Mandurah by-pass
Proposed no. of lots	STAGE 1: 380; STAGE 2: 720; TOTAL: 1100 + commercial + med. density	Stages i-iv: 350; Stages v-x: 550 + tourist (150) Total 1050
Type of residence	Single residential + some medium density Potential for strata-titled islands	Fully developed units Strata-titled super-lots managed by corporate bodies
Construction/sale time	STAGE 1: 3-4 yr; STAGE 2: 6-8 yr; TOTAL: 9-12 yr	10 + yrs
Canals - area (ha) width (m) depth (m)	71.4 (25% of total area) 50 (stated): 28 (min. shown on concept plan 2.5	46 (36% of total area) 45 - 70 2.5
Total area of conservation + foreshore reserves (ha)	52 (18.6% of total area)	13.9 (10.8% of total area) (includes 1. 0 already provided)
Local open space	6%	10%
Area of reserves as per cent of dry land (ha)	25	16.7 (not including private open space related to units)
Lots with canal frontage (%)	65	98
Boats -		
Design vessel - length (m) draft (m)	10 2	10 1.5
Mooring	No permanent mooring, private ramps, jetty mooring 6m from wall & parallel to it Public boat ramp and parking area: marina proposed for Stage 2	End-on and side-on moorings; quayside mooring at shopping centre; no public launching or mooring
Est. no. of boats*	Approx. 900	Approx. 800

* Based on estimate of 80% ownership reported in Halls Head Waterways ERMP (Feilman Group, 1982).

TABLE 2
SUMMARY OF EVALUATION OF PRINCIPAL ISSUES

ISSUE	PROJECT	
	WATERSIDE MANDURAH	HALLS HEAD WATERWAYS
1. CONSERVATION	Extensive area of ecologically valuable saltmarsh/bird habitat adjacent to existing Channel and Creery Island reserves and subject of a System 6 recommendation.	Limited area of ecologically valuable saltmarsh/bird habitat subject of a System 6 recommendation.
Consequences of development	Some saltmarsh to be retained but a large area would be destroyed.	System 6 recommendation recognized by reservation.
Conflicts	Mosquitoes breed on saltmarsh and already cause a nuisance and, possibly, a health hazard.	
Conclusion	Limited conservation area as proposed, with vesting in WAWA, is acceptable.	Proposed conservation reserve acceptable with vesting in WAWA.
2. FLOOD RISK	Development site situated on flood plain and, therefore, is subject to periodic flooding.	Development site is beyond designated flood plain.
Consequences of development	Filling to above flood levels does not affect flood capacity providing adequate floodways are retained along the Inlet Channel. The canals would improve flood flows.	
Conclusions	Acceptable	Acceptable
3. GROUNDWATER RESOURCE	Superficial aquifer used by a number of existing residents notwithstanding availability of a reticulated water supply. Aquifer may already be subject to overuse.	
Consequences of development	Undesirable shift of saltwater/freshwater interface.	
Remedy	Curtain walling included in design. Advise against additional draw from superficial aquifer.	Curtain walling included in design. Advise against additional draw from superficial aquifer.
Conclusion	Manageable, subject to adequate monitoring programme	
4. COMMERCIAL FISHERY	Species important to commercial and amateur fishery migrate through the Inlet Channel.	
Consequences of development	Possible disturbance to migration when developments have only a single-opening and fish are trapped in "closed" canals.	
Conclusions	Monitor fish movements and develop through-channels if necessary.	
5. WATER QUALITY IN INLET CHANNEL	Generally suitable for beneficial uses defined by the Steering Committee on Canal Developments. Subject to periods of reduced quality during large-scale algal blooms in the estuarine system.	
Consequences of development for the source waters	Limited if project design minimizes input of pollutants of various kinds and maximizes water circulation. Plumes of organically coloured water may enter the Inlet Channel.	
Conclusions	Manageable, subject to some redesign, ongoing monitoring and maintenance.	Manageable, subject to ongoing monitoring and maintenance.
	Role of waterway manager of great importance	
6. FACTORS DETERMINING WATER MOVEMENTS IN CANALS	Diurnal and barometric tides and winds in the area are sufficient to drive flushing mechanisms and circulate water in the canals if engineering design is appropriate. Other phenomena such as density gradients would also contribute to water circulation.	
Suitability of design	Requires refinement of design, e.g. culverts may constrain circulation. Requires adequate monitoring and maintenance.	Acceptable subject to adequate monitoring and maintenance.
7. SOILS	Highly variable soils throughout - limited information provided.	Appear generally acceptable, but require further investigation.
Consequences for development	Variability of soils may cause engineering problems - disposal difficulties may arise if spoil is inadequate as fill material.	
Conclusions	Local variations in soil conditions can be further investigated in detailed engineering design.	Local variations in soil conditions can be further investigated in detailed engineering design.

CONCLUSIONS AND RECOMMENDATIONS

In assessing the proposal, the Authority firstly considered the basic suitability of the land for canal estate development and then the impact of the specific proposal.

As this project is one of two major canal estates proposed for land adjoining the Inlet Channel to the Peel-Harvey Estuary, it has been necessary for the Authority to consider both the cumulative and specific effects of the proposals.

After examining the environmental resources and characteristics of the site, such as conservation value, groundwater, estuarine fishery, floods, water quality in the Inlet Channel, water exchange mechanisms and soils; the Authority concluded that the site was generally suitable for this form of development. In reaching this conclusion, the Authority pointed out the need for a management agency to be appointed to manage, monitor and maintain the canals prior to any rezoning of the land to canal estate being approved. The Authority considers that Peel Inlet Management Authority should be the management agency.

The Authority notes that the Peel Inlet Management Plan has also identified the land adjacent to the Inlet Channel as being suitable for canal development subject to detailed environmental evaluation.

The Authority also considered that the design of specific proposals must be to a high standard to maximise the use of available resources of the sites, to minimise management and to minimise adverse impact.

The Authority is of the opinion that the site could be considered generally suitable for canal development, provided that the specific project design was appropriate to the site and the environmental impact of development was minimised through appropriate ongoing management and monitoring programmes.

The Authority concludes that the project can proceed, subject to the following recommendations being accepted and implemented:

1. *Prior to the land being zoned for canal development, the Peel Inlet Management Authority should be appointed as the manager for the artificial waterways.*

2. *Approval to the development concept proposed in the ERMP should be granted Development should be on a stage by stage basis with comprehensive environmental monitoring being undertaken to adequately assess the operation and impact of each stage. Approval to develop the next stage or stages should only be granted on the basis that the earlier stage is operating satisfactorily and that data is available to show that the next stage will be acceptable in environmental terms.*

3. *Prior to subdivision approval being granted, the Proponent should provide an undertaking that if in the opinion of the waterways manager (PIMA) there is inadequate flushing of the estate and unacceptable water quality and there is a demonstrated need to bring forward the construction time of the through canal, he will do so.*

4. *Prior to subdivision approval being granted, the Proponent should provide a firm undertaking that modifications to the proposal or staging will be carried out in the light of monitoring results from the preceding stage or stages and the predictions made on the operation of the next stage.*

5. *The Proponent should provide additional information to PIMA and PWD on the proposal to hydraulically link the project with the Mary Street Lagoon including the likely impact of such action. This aspect should be resolved prior to approval being granted for the north western stage of the project. Should approval for the connection not be forthcoming, then some other form of improved flushing for this stage should be found.*

6. *As planning proceeds, the Proponent should provide further details on engineering structures, canals, connecting channels and beaches to PWD, Shire of Mandurah and the waterway manager (PIMA). The design of these facilities should have due regard to the recommendations of the Steering Committee on Canal Developments.*

7. *Wall structures should be constructed so as to achieve at least a 30 year design life, as advocated by the Steering Committee on Canal Developments.*

8. *As part of the detailed engineering design associated with the connecting channels, their width and orientation to the Inlet Channel should be reviewed to ensure that the maximum and most efficient exchange of water occurs. This matter can be resolved between the Proponent, PWD and the waterway manager (PIMA) as planning proceeds.*

9. *The Proponent should provide information to the PWD to indicate that a design life of 100 years would be reasonable expectation for the protective structures along the connecting channels.*

10. *On completion of dredging of a connecting channel, a survey of the channel and the associated natural waterway should be carried out at the Proponent's expense and in accordance with PWD and PIMA requirements.*

11. *The Proponent should provide a firm proposal for the maintenance dredging of the northern connecting channel, to the satisfaction of the waterways manager (PIMA).*

12. *As planning proceeds, the Proponent should provide contingency plans for the prevention of pollution of the canals, in the event of a failure of the sewage disposal system. These plans should be to the satisfaction of the Peel Inlet Management Authority.*

13. *As planning proceeds the Proponent should provide further engineering and management details of the proposed stormwater disposal systems to satisfy the requirements of Shire of Mandurah, and the Peel Inlet Management Authority.*

14. *The Proponent should be required to document options for disposal of spoil unsuitable for residential landfill.*

15. *The conservation areas proposed should not be included within any canal zone and should be transferred to the Crown prior to or as a condition of subdivision for the creation of the first stage of the project.*

16. *The areas for 'Conservation of Flora and Fauna' should be vested in the W.A. Wildlife Authority. Management of these areas should accept the need for possible future channel widening options as may be required to increase water exchange between Peel-Harvey Estuary and the Ocean. Some limited public access to the conservation areas should be considered as part of their management.*

17. *The Proponent should provide additional information to show that the 'soft edges' proposed as foreshores of the conservation areas will be stable and not require excessive management. This information should be provided to the waterway manager (PIMA).*

18. *A programme of monitoring should include regular observation of fish movements. Redesign of the canal waterway to complete a through canal should be considered as a means of minimizing disturbance to fish movements.*

19. *The proposed foreshore area along the Inlet Channel south of the traffic bridge should be increased to compensate for the loss of foreshore area brought about by the construction of the northern and southern connecting channels.*

20. *Additional foreshore areas should be provided between the existing bridge and the northern shore of the southern connecting channel to allow for adequate public access, recreation and floodway. Vesting of these areas should include the purpose of River Management.*

21. *The foreshore areas, as ultimately agreed upon, should not be zoned for canal development when zoning occurs and their transfer to the Crown should take place prior to, or as a condition of final approval to the first stage of the project. Prior to subdivisional approval being issued, the Proponent should prepare a management programme for the foreshore areas acceptable to the waterway manager (PIMA), these plans should be implemented as a condition of approval.*

22. *Before construction commences, the Proponent should discuss with the Shire of Mandurah the question of noise levels and hours of operation, and he should follow the 'Procedure for Assessing the Noise Effect of Proposed New Developments on Existing or Proposed Noise Sensitive Developments' as prepared for the Noise and Vibration Control Council[7].*

23. *The Proponent should liaise with the Commissioner for Soil Conservation on appropriate methods to minimise dust levels and stabilize soils during and after earthmoving operations.*

24. *The Proponent include in the management programme, suitable provisions to protect the conservation areas, floodways and foreshore areas from any adverse effects during the development of the estate. Agreement to this aspect of the plan should be obtained from the waterway manager (PIMA), PWD and WAWA.*

25. *Detailed planning for Stage 1 of the project should include provision for a boat waste water pump-out facility connected directly to the reticulated sewerage system.*

26. *Prior to subdivision or construction approvals being granted to the project, the boundary of the Management Area of the Peel Inlet Management Authority should be extended to include the whole of the project site.*

27. *The appointment of the waterways manager would need to consider the manner by which funds for management will be raised and the adequacy of resources available to the manager to carry out its responsibilities.*

28. *The Proponent should develop a management plan which satisfies the Peel Inlet Management Authority.*

29. *The management area for the project should include sections of the adjacent Inlet Channel that in the opinion of PWD and PIMA may be affected by the existence of the project. The management area will need to be defined as the management plan is defined.*

30. *The Proponent should reach an agreement with the waterway manager (PIMA) as to a time, or performance level at which the responsibility for all or parts of the project are handed over to the waterway manager. This agreement should be reached prior to subdivisional approval being issued.*

31. *The Proponent should develop a monitoring plan which satisfies the Peel Inlet Management Authority.*

32. *The Proponent should provide guarantees in a form acceptable to Government for remedial works which may be required as a result of failure of the project to achieve the standards required by the waterways manager.*

TERMS AND ABBREVIATIONS

Authority	:	Unless otherwise qualified, is the Environmental Protection Authority.
Canal or Canal Waterway Connecting Channel	:	As defined by the Steering Committee on Canal Development[6].
ERMP	:	Environmental Review and Management Programme.
Inlet Channel	:	The channel linking the ocean with Peel-Harvey Estuary.
Management Area	:	The area over and adjacent to a canal estate within which a designated body is responsible for maintenance, management and monitoring.
Mandurah By-Pass	:	The proposed second stage of the Mandurah by-pass road which, with the proposed new bridge, will complete a link between Mandurah Road and Old Coast Road.
PIMA	:	Peel Inlet Management Authority.
Proponent	:	Parry's Esplanade Pty Ltd, proposer of the project and responsible for the production of the ERMP for Halls Head Waterways project.
PWD	:	Public Works Department.
Waterside Mandurah	:	The proposed canal development on the eastern shore of the Inlet Channel, south of Soldiers Cove. The Proponent for this project is John Holland (Constructions) Pty Ltd.
WAWA	:	Western Australian Wildlife Authority.

1. INTRODUCTION

1.1 General Background

Halls Head Waterways and Waterside Mandurah are two residential canal developments proposed for land adjoining the Mandurah Inlet Channel. In combination the two projects would place in excess of 2 000 residential lots in the area, some of which would be on land recognised in the Peel Inlet Management Programme (1982)[2] as potentially suitable for residential canal development.

The Peel-Harvey system has been and will continue to be, strongly influenced by the activities of European man. These influences have altered the quantity and quality of water flowing to the estuary from the catchments, and the estuary's connection and interchange with the ocean. Residential canal estates would impose another impact on the system.

In its evaluation of the Halls Head Waterways project, the Environmental Protection Authority has considered the following:

- Development of canal estates may have the potential to degrade existing environmental resources, e.g. areas of conservation value, groundwater resources, landscape and fisheries.

- Poorly designed or located development could exacerbate events such as floods.

- Canal estates promote expectations of high environmental quality within the development with good-water quality and general amenity, durable construction and low maintenance demands. Shortcomings in quality will create demands for remedies, usually on some segment of government.

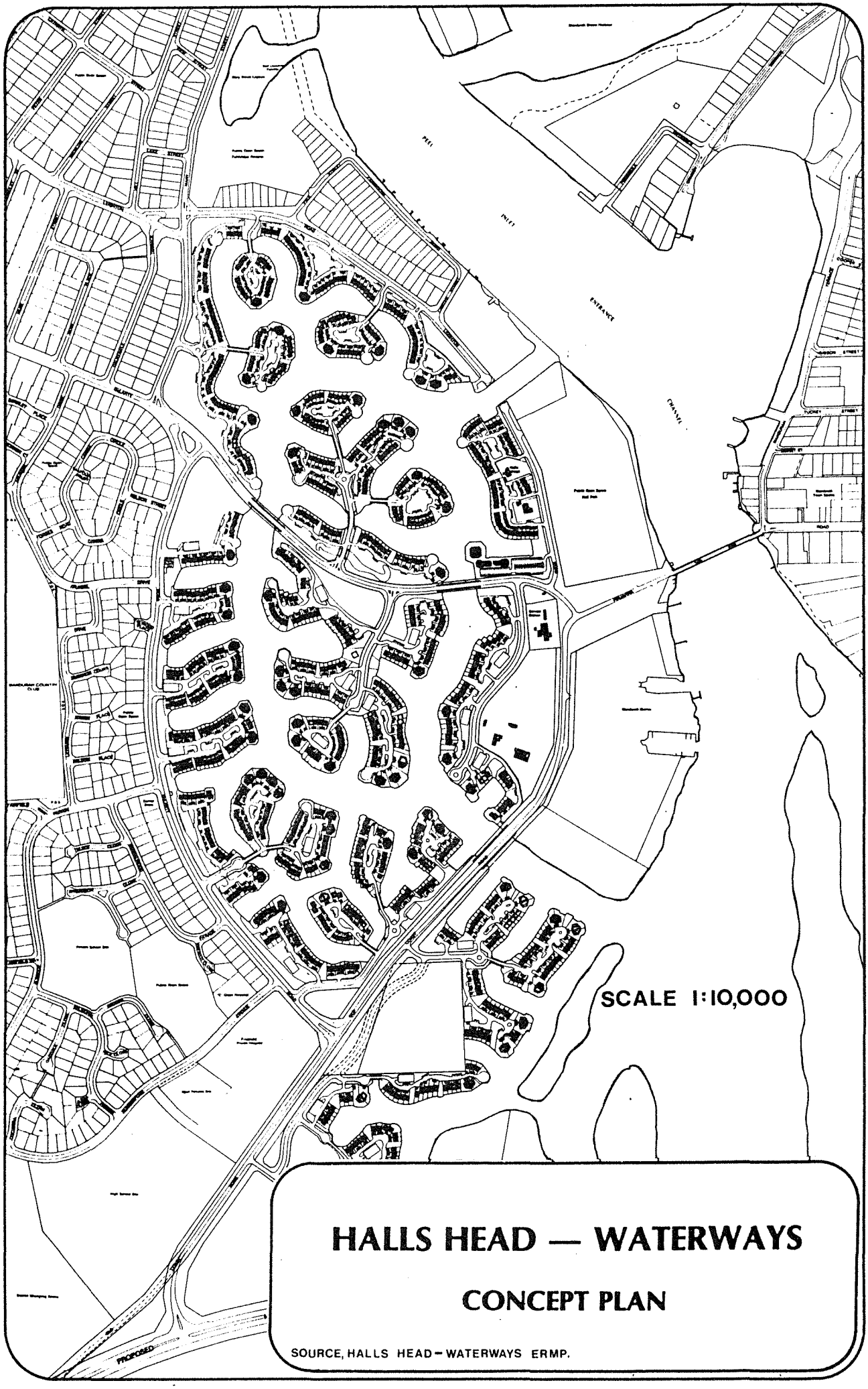
- Occupants of canal estates will, no doubt, have expectations of access to high quality environments nearby. In this regard, the problems of the Peel and Harvey Estuaries are well known.

In the short term, risks of poor environmental conditions within the development must be borne by the developer as any obvious unsatisfactory environmental consequences will deter purchasers. It is therefore obviously in the developer's interest that quality is as high as possible.

On the other hand, long-term environmental effects within and adjacent to the development, leading to continuing high management costs, may take some time to manifest themselves and not become apparent until the developer's involvement has ceased. The Authority, therefore, has had to consider the extent by which the proposed canal estate would increase demands for long-term management and reduce environmental quality.

1.2 Methods

The assessment process employed in evaluating the ERMP's for the Waterside Mandurah and Halls Head Waterways proposals has two steps. As a first step, the suitability of the project sites for canal development was examined by evaluating seven principal environmental factors, these being:



HALLS HEAD — WATERWAYS

CONCEPT PLAN

SOURCE, HALLS HEAD – WATERWAYS ERMP.

- conservation values;
- flood risk;
- impact on groundwater resources;
- the commercial fishery;
- water quality in the Inlet Channel;
- water exchange mechanisms; and
- the suitability of soils as substrates for development.

In assessing the suitability of the project for canal development, it was also necessary to consider the proposals in the context of the Peel-Harvey estuarine system as a whole, particularly as the system is subject to massive pollution by agricultural fertilisers and as the success of remedial measures cannot be assured at this stage.

Because the two project sites are close together, and rely upon the same source water, treatment of the principal environmental factors is essentially similar for both projects.

The second step in the assessment process was to evaluate the suitability of the actual development proposals put forward. Attention was paid to planning and engineering mechanisms to be utilised to achieve an acceptable development within the limitations imposed by the prevailing environmental conditions. Because of fundamental design differences, assessment of the detailed acceptability of each project differs.

Notwithstanding the different forms of the two projects, assessment has revealed similar requirements for both in terms of management and ongoing monitoring. Additionally, the allocation of responsibilities for monitoring and any need for remedial works revealed as necessary during the development phase are also similar. Accordingly, the Authority has adopted a similar approach to management, monitoring and contingency guarantees.

1.3 The Project

The proposal is to create a canal estate development on 129 hectares of land on the western side of the Inlet Channel at Mandurah.

The estate would be in the form of a series of interconnected islands within a large water body rather than the traditional form associated with the existing canal estate at Yunderup. The estate would be joined to the Inlet Channel by two large connecting channels.

The project will be staged over a period of approximately ten years and in total will provide about 1 000 residential units. The concept adopted is for total development where finished residential (medium density) units will be sold rather than the sale of vacant normal size residential lots.

The canals have been designed for vessels up to ten metres in length and the depth of water to be provided will be a minimum of 2.1 metres. The canals will vary in width from a minimum of 45 metres for minor canals to a maximum of 75 metres for the main, through canals.

Special emphasis has been placed on architectural co-ordination of the proposed residential units, each with a canal frontage and private mooring area.

The Proponent has adopted a philosophy of high quality development and the design has been aimed at achieving a minimal disturbance to the existing environment as possible.

The proposal was submitted for assessment following the acceptance by Government of the Recommendations of the Steering Committee on Canal Developments. It has incorporated most of the basic requirements of those recommendations.

1.4 The Project in the Context of the Peel-Harvey Estuarine System

As the Hon Minister for Conservation and the Environment has said, "the State Government has expended very substantial sums on research and possible solutions and remains firmly committed to reversing the deteriorating conditions of the Peel-Harvey Estuary"[3]. There is no doubt that a radical cure to the eutrophic condition can be achieved, but how soon and at what cost have still to be determined[3].

The Authority is well aware that short-term solutions are not available and it has, in the past, advised against developments that imply an expectation of high environmental quality in the vicinity of the Peel-Harvey estuary while water quality and algal problems continue to degrade its amenity. The Department of Conservation and Environment has also consistently urged caution on proposed developments in the region which would rely on high environmental quality.

The proposed Waterside Mandurah and Halls Head Waterways canal estates would be partly buffered from the poor environmental quality of the estuary by the strong oceanic influences upon the waters of the Mandurah Inlet Channel, influences which are largely dissipated by the physical characteristics of the estuaries. Nevertheless, approval of these developments may imply confidence in the early solution of eutrophication problems. This confidence imposes great responsibility upon the Proponent and the waterways manager. The Proponents must produce designs which have the least environmental impact and make the best use of the natural features and characteristics of the area. The waterway manager must have expertise and resources to ensure the developments continue to function without detriment to the area as a whole.

2. EXISTING ENVIRONMENT

2.1 The Subject Land

The project is proposed for land on the western side of the Mandurah Inlet Channel. The major portion of the site is on the western side of the Old Coast Road and does not front onto the Inlet Channel. The smaller portion is between the Old Coast Road and the Inlet Channel; it's northern boundary being the existing traffic bridge and the southern boundary is the proposed Mandurah By-Pass Bridge.

The majority of the site is generally flat and lies below the 2 metre contour, with the section adjacent to the Inlet Channel being less than 0.5 metres above high water mark. A large depression exists at the northern end of the site, is inundated in winter and supports a stand of paperbarks. Extensive filling of the site would be required to raise the site above flood levels to permit it to be used for residential development.

The majority of the site has been used for agricultural activities and widespread clearing has removed all but a few mature Tuart trees and a stand of paperbarks. The area adjacent to the Inlet Channel has been degraded by past agricultural activities and vehicle tracks. Despite these activities, there is an area of healthy samphire marsh adjacent to the Inlet Channel.

2.2 Conservation

The site contains two areas which will warrant assessment as to their conservation value. One is a long depression towards the north end of the site which supports a seasonal wetland and associated vegetation. The other area is the samphire marsh adjacent to the Inlet Channel. Portion of the samphire area has been identified in the System 6 Report as having conservation value and that it should be protected.

The remainder of the site is cleared pasture with a few mature Tuart trees on the higher margins. There are some historic buildings on the site associated with early farming activities.

2.3 Floods

As the site is low-lying it would at periods of extreme floods have both a flood storage and floodway function. The land adjacent to the Inlet Channel is very low-lying and is subject to inundation each winter. The balance of the site is generally higher but has some low-lying portions which are subject to winter inundation.

2.4 The Groundwater Resource

The groundwater found in the locality of the project is in two separate formations. The unconfined aquifer under the Halls Head Peninsula is generally very limited and contains a thin lens of fresh water over brackish and saline waters at depth. This aquifer is utilized by local residents for garden reticulation bores.

The confined aquifer is in the Leederville Formation and contains brackish sub-potable water in limited quantities.

The groundwater resources of the area are not significant and are already subject to overpumping.

2.5 Estuarine Fishery

The Peel-Harvey Estuary provides an important nursery area for commercial species of fish such as sea mullet, cobbler and King George whiting.[4] The system supports the largest commercial and amateur estuarine fishery in Western Australia and any damage to the fishery would be serious.[5]

The Inlet Channel provides the only migratory route to the ocean, for fish and crabs entering or leaving the estuary.

In terms of habitat, the Inlet Channel is of some importance to fish, particularly south of the Mandurah bridge. The area north of the bridge is highly modified and offers little in terms of areas suitable for shelter or breeding other than the rock walls at the mouth of the channel which mainly provide a habitat for marine fishes. The shallow flats on the eastern side of the channel provide a limited feeding area. South of Mandurah bridge the area is more favourable as a habitat, providing sheltered areas such as Soldiers Cove and more extensive shallows which provide sheltered waters for overwintering marine fishes and crabs (Potter et al., in prep.).

2.6 Water Quality in the Inlet Channel

The problems facing the Peel-Harvey Estuary are outlined in DCE Bulletin 118[3]. Relevant quotations follow:

"Until 1980 the algal nuisance affected mainly Peel Inlet; the weed accumulations were unpleasant and were costly to remove. However, the massive blooms of the blue-green alga Nodularia in the summers of 1980-81 and 81-82 are a new dimension in the conditions of the estuary."

"It is not possible to predict the future of the estuary with any certainty, there are too many unknowns; the variability of rainfall, the use of agricultural fertilizers and the ability of coastal plain soils to store and release phosphorus. However ... its condition is not likely to improve until the amount of phosphorus available to plant life in the estuary is reduced."

"The Nodularia blooms will probably become more extensive and more prolonged and they will in turn fertilize greater quantities of green algae."

"If the blooms get worse there will be a further decline in fish populations and in professional and amateur catches, ... it is likely that blooms do create unfavourable conditions for crabs."

The water quality of the Inlet Channel has been reasonably well documented from various studies. The Inlet Channel carries marine water from the Ocean to the Peel-Harvey Estuary on a flood tide, and estuarine water to the Ocean on an ebb tide. The canal estate would draw its source water from the Inlet Channel.

3. DOCUMENTATION

3.1 Background

The ERMP for this project was prepared following the Government's acceptance of the recommendations of the Canals Steering Committee. Those recommendations set out a basic procedure to be followed in order to obtain approval for the zoning of land for canal estate development. In terms of environmental assessment, the Authority viewed a Notice of Intent for the project and determined that in view of the nature, location and possible impact of the project an ERMP should be prepared.

The ERMP was prepared by the Proponent and released for public comment for a period of ten weeks.

3.2 Adequacy of the ERMP

The Authority considers that the ERMP was generally an adequate document for assessment purposes and that it correctly identified the major environmental implications of the proposal. It did, however, have some deficiencies and some aspects such as management received only limited coverage. There was much repetition of certain statements and some conclusions were not sufficiently justified.

The Authority considers that the document contained a considerable amount of information in excess of what is required for an ERMP. It noted, however, that the proposal is for a type and style of development new to Western Australia.

Some aspects of the proposal were treated as a series of options and no firm decisions were made. This approach however, was not used where issues of major environmental significance were involved. The selection of preferred options for these minor issues can be adequately made at later approval stages.

It is clear that regardless of the shortcomings of the ERMP, the Proponent is aware of the environmental implications of the project and has made commitments to reduce those implications to a minimum. There is, however, a need for considerable further details of certain aspects of the project to be provided at subsequent planning stages.

3.3 Public and Government Submissions

Of the eighteen submissions received from the public, twelve were essentially the same and expressed concern over the effect of the proposal on fisheries, water exchange between the ocean and the Peel Inlet and the possibility of nutrients entering the estuary.

The submissions from the Peel Preston Preservation Group were comprehensive and covered a wide range of issues indicating that it had viewed the project and its implications as a whole. Other submissions raised individual or a few issues.

The Authority noted that the degree of public concern for this form of development, as expressed in recent months, was not reflected in the number of submissions received. In addition the

public submissions did not indicate a major public concern over the proposal; however, it is not possible to draw any other conclusions from the level of public comment received.

Thirteen submissions were received from Government agencies and, although many were critical of certain aspects of the ERMP or requested additional details, none were opposed to the project. Many submissions were comprehensive and showed that considerable time and effort had been spent in evaluating the project and the information put forward in the ERMP.

4. ENVIRONMENTAL ASSESSMENT

The ERMP for this project is a comprehensive document and addresses many matters which overlap environmental issues and those which are normally covered by the statutory planning process. This situation has arisen from the recommendations of the Canals Steering Committee[6] and perhaps also from the fact that this ERMP is one of the first documents to address a canal estate proposal.

In assessing the document, the Authority has limited itself to issues of environmental significance and has not provided comment on planning matters unless they have a direct effect on the environment. It is assumed that the various phases of statutory planning will consider those other matters in due course.

The Authority noted that some issues were discussed in considerable detail whilst others which were intended for later detailed design were discussed at the concept level. The assessment process, together with the subsequent planning approvals required, is sufficiently flexible to allow for this approach to be followed, especially where the project is to be staged over ten years.

As already mentioned, an assessment process involving two steps has been employed in the evaluation of the project. Initially the basic suitability of the project site for canal development was examined on the basis of relevant environmental issues. Secondly the suitability of the actual proposal was assessed in terms of its environmental impact at a local and regional level.

4.1 Identification of Issues

In examining the suitability of the project site for canal development, issues relating principally to environmental factors have been assessed. These factors have been more fully discussed elsewhere (Section 2. The Existing Environment) and can be summarised as:

- the conservation value of saltmarsh and other wetland areas of the site;
- the role of the site in mitigating upstream flooding;
- the potential for impact on groundwater resources;
- the potential for impact on the estuarine fishery;
- the adequacy of source water quality;
- the adequacy of prevailing hydrological and meteorological influence to promote exchange and water circulation; and
- the structural adequacy of in situ soils

The object in examining these matters has been to determine whether or not the anticipated environmental consequences of canal development on the project area could be considered acceptable and manageable.

Having made these judgements, it is then necessary to establish at a more detailed level whether or not the actual development projects that have been put forward are acceptable. In assessing the possible environmental impact of the project, it has been necessary to consider a wide variety of matters which, although impinging upon what are in fact environmental issues, would also be dealt with by other agencies dealing with planning and engineering matters.

The basic environmental factors that determine site suitability are similar for both the Waterside Mandurah and Halls Head Waterways projects and accordingly, there are certain common elements in the Authority's assessment. However, basic differences in the two development concepts mean that most matters relating to the suitability of the two proposals involve emphasis on different considerations, although there is some commonality.

4.2 Suitability of the Land for Canal Development

4.2.1 Conservation Values

The Proponent reviewed the conservation value of the project area and concluded that generally the site had been heavily degraded by past agricultural activities. The remnants of an old meander form a seasonal wetland at the northern part of the site, but evaluation of this wetland showed that it had limited conservation value.

The samphire area east of the Old Coast Road was the main area of study. It was found to be seriously degraded over a major portion. The section of samphire at the southern end of the area was, however, considered to be of conservation value, and the ERMP proposed that it be reserved for conservation of flora and fauna. This same area has also been identified in the System 6 Study as worthy of protection and the proposal in the ERMP is similar in size and location to that recommended in the System 6 'Green Book'[4].

Although other portions of samphire vegetation in this area have some conservation value, it is considered that their retention would not appear to be a practical proposition. This opinion is supported by the Department of Fisheries and Wildlife.

The Authority considers that the conservation value of the project site is not substantial and providing the area identified as having importance is protected, the conservation value of the land would not constitute a reason for not permitting the land to be used for canal development.

4.2.2 Groundwater Resources

As stated in the section on existing environment, the groundwater resources of the project area are not significant. The unconfined aquifer is already subject to over-pumping with problems of increasing salinity being experienced in shallow bores during summer months.

The groundwater resource in the locality of the project is extremely limited and any development on the project site should not be permitted to further reduce it.

The shallow groundwater beneath the project area is brackish, being a transition zone associated with the freshwater/saltwater interface. The development of canals on the site will result in a shift landwards of the interface and the unconfined aquifer under the canal estate will be more saline as a result.

The Geological Survey section of the Mines Department has agreed with the above findings and consider that the hydrogeological implications are not a major impediment to the use of the subject land for canal development. Protective measures to minimise the impact of the proposal on groundwater resources should be implemented as well as monitoring any changes to the resource.

The Authority considers that providing appropriate design techniques are used, the hydrogeological implications of using the project site for canal development would not be significant.

4.2.3 The Estuarine Fishery

The importance of the commercial and amateur fisheries centred on the Peel-Harvey Estuary is such that developments on land adjacent to the estuarine system should not be allowed to have any significant adverse effects upon it. In assessing the acceptability of canal development along the Inlet Channel in relation to the estuarine fishery, the Authority has identified the following as being of importance:

- possible reduction of water quality in the Inlet Channel;
- impact of construction or maintenance dredging;
- interruption of fish movement patterns; and
- increases in boating activity or fishing pressures.

From its examination of these issues, the Authority has concluded that the major concern is the possibility of interruption or alteration of fish migration between the ocean and the estuary. In its submission, the Department of Fisheries and Wildlife observed that single opening canals along the Inlet Channel could pose a threat in this regard, citing the possibility that juvenile mullet might congregate in the artificial waterways rather than completing their winter migration to the estuary. Possible interruption of fish migration was also a matter of concern to the Mandurah Professional Fishermen's Association.

Other factors which could affect fish migration patterns would be dredging activities or major reductions in water quality which could occur when the canal projects or stages of them are joined to the Inlet Channel.

The Authority believes that dredging or connection operations can be timed so that increased turbidity levels or reduced water quality will not cause significant alterations to fish migration.

In relation to other issues, the Authority notes that both the Department of Fisheries and Wildlife and the Mandurah Professional Fishermen's Association are concerned at the possible impact of development on the estuarine fishery. The effects of an increase

in boating activity on the estuarine fishery also required attention. It is difficult to assess how great an impact these factors may have on the estuarine fishery particularly as it is the cumulative impact of all developments rather than the consequences of an individual project that requires consideration. However, it is considered that, with appropriate design, management and monitoring, canal developments along the Inlet Channel could be arranged so as to minimise possible impacts.

The Authority also notes that if canal estates are developed along the Inlet Channel, once a benthic community establishes in the canals, the resultant additional habitat could be seen as a beneficial consequence of development. This increased habitat could be of particular significance as embayments along the Inlet Channel are used as an overwintering area by several species of fish.

From its consideration of the possible impact canal development along the Inlet Channel may have on the estuarine fishery, the Authority concludes that with appropriate design, management and monitoring, such development could be regarded as acceptable.

4.2.4 Flood Impact

The project site does not have a significant flood role in terms of flood storage or floodway. The PWD has advised that canals will compensate for any loss in flood plain, however floodways through the estate and along the foreshores of the Inlet Channel must be retained.

Accordingly, from the viewpoint of floods, the subject land is suitable for canal estate development. Buildings within the proposed development would have to be built above the 1.5 metre flood level.

4.2.5 Water Quality In The Inlet Channel

The Inlet Channel connects the Peel-Harvey Estuarine System to the ocean and its quality is influenced by the quality of those two water bodies.

Data available indicates that for most of the year, the water quality of the Inlet Channel is acceptable as source water for a canal estate. There are periods, however, when reduced water quality has been observed in the Inlet Channel and this could have a detrimental effect on water quality within the canals. These periods vary in duration but generally occur through the months of November, December and January.

Although this reduced water quality will have some effect on an ebb tide, waters of the Channel on a flood tide will be essentially marine.

The ultimate water quality within the canals will relate to source water quality, flushing times and nutrient input. These factors can only be assessed for a specific project.

Because of these periods of reduced source water quality, in the design of any project, flushing times should be reduced as much as possible and nutrient input to the canal should also be minimised.

The Authority concludes that in terms of the beneficial uses of canal waters, the water quality in the Inlet Channel is adequate as source water, providing high flushing rates and low-nutrient loading of the canal waters can be achieved in the design of the particular project.

PIMA has stated that it considers the waters of the Inlet Channel would generally satisfy the water quality requirements listed in the Report of the Steering Committee on Canal Developments[6].

4.2.6 Water Mechanisms

In the evaluation of the suitability of land adjacent to the Inlet Channel for canal development, it is necessary to identify and quantify the factors which are available to exchange waters between a canal estate and the Inlet Channel. To a large extent exchange rates will be determined by the hydraulic characteristics of a particular estate, but the mechanisms must be there to drive the exchange.

The following exchange mechanisms have been identified in the Inlet Channel area:

- Winds. Data indicates that coastal localities such as the Inlet Channel area, experience relatively windy conditions. An evaluation of recorded data from comparable sites shows that for 50% of the time, winds in the order of 4 metres per second could be expected. Calm periods (below 1.5 m/sec) occur mainly in the winter season and on average a calm of over 16 hours would occur only once a year.

- Tides. The ERMP states that tide recordings at the Mandurah jetty for the period August 1977 to August 1978 indicate that for 98% of the time, the tidal range for the Inlet Channel could be considered to be from 0.5 m A.H.D. to -0.4 m A.H.D. Tidal variation in any one day was normally .2 m to .4 metres. A variation in tide levels along the Inlet Channel has been observed and it has been concluded that on this basis a tidal lag could be useful as an exchange force.

- Density Currents. Stratification has been observed in the Inlet Channel associated with waters of different salinities. The difference in density of bottom and top waters of the Channel could, on certain occasions significantly assist water exchange between the canal estate and the Inlet Channel. Although this phenomenon has been observed and recorded to a limited extent, it has not been adequately measured to accurately determine its extent or duration as an exchange mechanism.

  The Authority considers that, with suitable design, these mechanisms could be utilized to achieve adequate exchange and flushing rates within proposed canal systems adjacent to the Inlet Channel.

4.2.7 Soils

Soils vary over the project site but generally do not appear to present significant engineering problems. Test drilling was carried out, but the drilling grid was large and would not have identified local variations. With the exception of limited

areas of calcareous marls, most of the site which would require excavation for canals, consists of sandy estuarine deposits with a silt fraction. Further detailed surveys would be required prior to construction.

4.2.8 Site Suitability - Conclusion

Examination of the principal environmental factors influencing the suitability of the site for canal development reveals that the site is suitable for this form of development providing the specific project design is appropriate to the site and its environmental impact is minimal.

Notwithstanding this conclusion, the acceptability of the specific proposal cannot be ascertained until the impact has been determined in detail. This further examination is carried out in Section 4.3.

It is noted that the Management Programme for the Peel Inlet and Harvey Estuary[2] has also identified the lands adjacent to the Inlet Channel as being suitable for canal development, subject to environmental acceptance of the specific projects.

In assessing site suitability, the Authority noted that if a canal estate is developed as proposed, it would require considerable and appropriate management, monitoring and perhaps remedial works. The issue of management is addressed in more detail in Section 5. At present, a management agency to carry out these essential functions has not been determined. The Authority considers that prior to the subject land being zoned for canal development, a decision should be made on the management agency to carry out management of the artificial waterways.

The Authority recommends that:

Recommendation 1

Prior to the land being zoned for canal development the Peel Inlet Management Authority (PIMA) should be appointed as the manager for the artificial waterways.

4.3 Suitability of the Proposal

Given that, in the Authority's opinion, canal development could occur on the project site without acceptable environmental impact, more detailed examination of the actual development proposal that has been put forward is necessary to determine its suitability. A wide variety of matters has had to be examined in this context ranging from the critical issue of water circulation and quality in the canal system to consequences of the project for the social environment and anticipated environmental impacts during construction.

Many of these matters were highlighted in submissions received and although they have clear environmental implications, it is generally considered that some of them could be adequately addressed through subsequent planning or construction phases. Additionally, many of the matters either fall within the responsibility of existing agencies and the Proponent, or would be most appropriately dealt with by the yet to be designated waterways manager. In addressing these matters, the Authority has, therefore, noted concerns drawn to its attention and recommended that

appropropriate measures be taken by the Proponent and the relevant agencies.

4.3.1 Environmental Engineering : Circulation and Water Quality

The most critical of the issues requiring more detailed examination in terms of establishing the acceptability of the development proposal, is the quality of water to be expected within the canal network. It is also necessary to consider whether the development either alone, or in combination with other proposals could cause a deterioration in the quality of waters in the Inlet Channel.

Water quality in the canal network will essentially be a function of the quality of the source waters and the capacity of the canal network to allow exchange with those waters.

The consultants report on water dynamics and hydraulics was considered by the Authority to be adequate for the purposes of the study. Further details of certain aspects should, however, be provided by the Proponent in due course. PWD advice supports this conclusion.

The ERMP considered the flushing mechanisms which will operate to exchange water between the canals and the Inlet Channel. It identified (in order of importance), three factors being : winds, water level variations such as tides and long period variations, and density currents.

Water circulation, both within the canals and between the canals and the Inlet Channel, was calculated on the basis of winds and water level variations. Density currents, as an exchange mechanism, were discussed, but not quantified. It was noted that density currents have been observed in the Mary Street Lagoon.

The ERMP stated that on the basis of winds, water in the finger canals is expected to exchange with water in the main canals every few hours under normal conditions, and taking into account calms, a daily exchange could be expected. The top one metre of water in the main canals could be expected to move one quarter to one-half of the way through the estate in a six hour period under normal wind conditions.

The Authority noted that the wind data used were that recorded at the Mandurah Post Office; these data are twice-daily velocity estimations and not instrument recorded. The ERMP did not address this fact. In order to ensure that these data were appropriate, they were compared with instrument recorded data obtained for similar coastal sites in the Bunbury area as part of a Department of Conservation and Environment meteorological study. The comparison showed that the Mandurah data were acceptable for the purposes of the study and correlated favourably with the instrument recorded data. It is believed, however, that monitoring of the early stages of the project should include the use of continuously recording wind speed and direction instrument, appropriately located. This action will enable a precise understanding and quantification of wind speed and direction as one of the exchange mechanisms operating to flush the canal estate.

On the basis of water level fluctuations, the ERMP suggested that water entering the shortest main canal would flush within one tidal cycle and that there would be a net circulation of one-fifth to one-third of the total volume entering and leaving the estate every day. In addition, tidal pumping is suggested as

being significant.

Long period water level variations which occur on a five to 20 day cycle would provide further flushing and it was estimated that these variations would flush up to one quarter of the total water volume of the canals each time it occurs. The Authority believes that the calculation of circulation rates based upon winds are adequate for the purposes of the ERMP. It should be noted however, that additional information should be provided on this aspect when circulation of individual stages is considered in greater detail.

The Authority noted the consultant's discussion on density currents in the evaluation of mechanisms which will exchange the canal water with that of the Inlet. The consultant did not quantify this mechanism, rather it was seen as a bonus to the primary forces of wind and water level variations.

Several submissions called for a physical model to be constructed to prove that the calculations put forward on exchange rates and ultimately water quality are correct. The Authority has been advised that, because of the characteristics of the Peel-Harvey Estuary, particularly the small tidal range and the large surface area of the estuary relative to the width of the Inlet Channel, any model would have to be so large as to be prohibitively costly.

Although the Authority has accepted that waters of the Inlet Channel are generally adequate as source waters for a canal estate, it should be noted that periodic episodes of low quality water associated with algal blooms during tidal flushing of the Estuary in summer, have been recorded in the Inlet Channel. These events occurred in the Estuary in the summers of 1978-79, 80-81, 81-82 and an extensive phytoplankton bloom commenced in October 1982. These events were recorded in the Inlet Channel for durations of approximately seven weeks. The characteristics of this poor quality water are high turbidity, green colouration, high biological oxygen demand and at times an unpleasant odour. Due to the suggested flushing rates between the canals and the Inlet Channel, whatever water quality is found in the Inlet Channel will also be found (probably at a lower level) in the canals. This reduced quality water can only be detrimental to the proposal; however, the exact extent of this is not known at present. Should the proposal proceed, it will be necessary to carefully monitor the effect of these episodes to determine their impact on the canal estate to enable decisions to be made on subsequent stages.

The proposal has been specifically designed to minimise pollutant input to canal waters. The 'curtain walling' system, stormwater disposal systems, deep sewerage, boat pump-out facilities, and reduced garden areas are all aspects proposed to limit nutrient and pollutant input to the canals.

The question of fuel and oil spillages as possible pollutants was noted by the Authority. Public education and the implication of contingency plans appear to be the most appropriate form of limiting this potential problem. This issue is addressed further in Section 4.3.2.

The Authority believes that the development philosophy used by the Proponent will assist in minimising the addition of any deleterious material into the canals.

The Authority noted that calculations on exchange were based upon the project as a whole and no information was provided to show that each stage or several stages would operate satisfactorily in isolation. The Proponent has subsequently provided some additional information on this aspect, which indicates that exchange would be adequate. The Authority believes, however, that further consideration of this aspect is required prior to approvals for each stage being granted.

The Authority accepts the arguments put forward in the ERMP, that for the whole project, exchange rates as calculated are a reasonable assumption. The flexible staging approach proposed will allow for monitoring to verify calculations on exchange rates and mechanisms and if rates are not adequate, to carry out remedial works prior to the construction of further stages.

The ERMP discussed the question of water quality both in the canal system and its effect on the Inlet Channel. It concluded that the quality of canal waters would be similar to that of the Inlet Channel and that it would be satisfactory in terms of beneficial uses of the canals. In addition, it would not have a detrimental effect on the Inlet Channel or the Peel Inlet.

The basis of the argument put forward in the ERMP on water quality was that the waters of the Inlet Channel are of a known and acceptable quality (except for unqualified short periods of time), the canal waters will have an adequate flushing time, and there will be no major sources of pollutants from the canal estate.

Although the basic argument on circulation and water quality is accepted, some degree of uncertainty was expressed in submissions as to the adequacy of water exchange in the early stages of the development. The Authority believes that the flexible staging approach accompanied by comprehensive environmental monitoring is an acceptable method of identifying the exact performance of each stage and identifying any problems as they arise. Modifications to subsequent stages of alterations to the staging sequence can then occur, to ensure that any problems identified can be adequately resolved prior to the approval of further stages. In view of this approach, there is a need for firm undertakings to be given by the Proponent to modify subsequent stages in the light of monitoring results.

The Authority considers, therefore, that the evidence put forward in the ERMP generally provides a reasonable basis, upon which to conclude that acceptable water quality can be achieved in the canals for most of the year and that the canals will not have a significant detrimental effect on the waters of the Inlet Channel or the Peel-Harvey Estuary.

The Authority recommends that:

Recommendation 2

Approval to the development concept proposed in the ERMP should be granted. Development should be on a stage by stage basis with comprehensive environmental monitoring being undertaken to adequately assess the operation and impact of each stage. Approval to develop the next stage or stages should only be granted on the basis that the earlier stage is operating satisfactorily and that data is available to show that the next stage will be acceptable in environmental terms.

The Authority noted that the through canal shown as Stage 5 will have a considerable influence in increasing the flushing rates in the earlier stages of the project. The importance and effect of the through canal is such that it may be desirable to bring forward its construction time to maximise flushing during the earlier stages of the project. Accordingly, the Authority believes that the Proponent should be prepared to bring forward the construction of the through canal whenever monitoring indicates that this action is required to improve water quality in the canals.

The Authority recommends that:

Recommendation 3

Prior to subdivision approval being granted, the Proponent should provide an undertaking that if in the opinion of the waterways manager (PIMA) there is inadequate flushing of the estate and unacceptable water quality and there is a demonstrated need to bring forward the construction time of the through canal, he will do so.

The Authority noted that calculations on water quality in the canals, circulation and exchange were for the project as a whole and no data was provided in the ERMP for each stage in isolation. As the project could take ten years to complete, it could be that a one opening system will exist for four or five years. It is essential therefore, that each stage be shown to be satisfactory in an engineering and environmental sense; this is particularly important in the early stages of the project and also with respect to the north western section of the project area which may experience reduced flushing times. Monitoring of the early stages will be critical. It is also possible that for a number of reasons, portion of the project may not be developed as proposed or even with canals. The section of the project completed must therefore be able to function adequately should this occur.

The Authority recommends that:

Recommendation 4

Prior to subdivision approval being granted, the Proponent should provide a firm undertaking that modifications to the proposal or staging will be carried out in the light of monitoring results from the preceding stage or stages and the predictions made on the operation of the next stage.

The Authority considers that when a water quality monitoring programme is commenced for the canals, it should also include the Inlet Channel. This would provide an improved understanding of the Channel water quality and enable a better assessment of the impact of the canal development on those waters, or, at certain times of the year, the impact of the Channel waters on the canal estate. This issue of monitoring will be dealt with further in Section 6.

With regard to episodes of reduced water quality in the Inlet Channel caused by blue-green algal blooms from the Peel-Harvey Estuary, the Authority notes that an early solution of these occurrences should not be anticipated and the future extent and duration of these blooms cannot at present be predicted.

The Authority noted that PIMA and the Shire of Mandurah expressed opposition to the proposed piped connection between the north western corner of the project and the Mary Street Lagoon. This opposition was based on the possible adverse impact that such action could have on the lagoon and public usage of it. The Authority noted that some additional flushing of the north western stage of the project was considered necessary by the consultant.

Insufficient information was available for the Authority to determine the benefits or impact of the proposed connection, however, in view of the opposition expressed it is believed that the Proponent should provide additional information on this aspect and resolve the question of improved circulation for that stage. This should be done prior to approval being granted for this stage.

The Authority recommends that:

Recommendation 5

The Proponent should provide additional information to PIMA and PWD on the proposal to hydraulically link the project with the Mary Street Lagoon including the likely impact of such action. This aspect should be resolved prior to approval being granted for the north western stage of the project. Should approval for the connection not be forthcoming, then some other form of improved flushing for this stage should be found.

In considering the aspects of circulation and water quality, the Authority noted that the ERMP did not adequately address the following issues.

- The possible effect on water quality as a result of changes in the geometry of the Inlet Channel resulting from increasing exchange between the ocean and the Inlet.

- The aesthetic implications which organically stained canal waters may have on the Inlet Channel.

- Contingency planning for oil spills or failure of sewage pumping facilities,

- Details of discharges of waters into the Inlet Channel during the construction period.

- Details of a monitoring programme to assess water quality in the canals and the effect on the Inlet Channel.

- Details of the stormwater disposal system to show that it will function adequately.

These matters should be dealt with at subsequent stages in the planning process.

4.3.2 Environmental Engineering - Other Issues

- Canal Design

The Authority noted that certain aspects of this project were dealt with in broad terms and limited detail was provided. This approach is acceptable for the project to be considered at the conceptual level but further details will be required at later stages.

There were some variation in the width of canals between the text and plans contained in the ERMP. It is believed that canal widths should not be below those suggested in the Report of the Steering Committee on Canal Developments[6].

Several submissions also pointed out that further design information on engineering structures, canals and beaches will need to be provided. The Authority accepts this need and believes that this information can be provided at subsequent stages in the planning process.

The Authority recommends that:

Recommendation 6

As planning proceeds, the Proponent should provide further details on engineering structures, canals, connecting channels and beaches to PWD, Shire of Mandurah and the waterway manager (PIMA). The design of these facilities should have due regard to the recommendations of the Steering Committee on Canal Developments.

In view of the undesirable implications of canal wall failures, the Authority supports the findings of the Steering Committee on Canal Developments[6] that canal walls should be designed and constructed so as to achieve a design life of 30 years.

The Authority recommends that:

Recommendation 7

Wall structures should be constructed so as to achieve at least a 30 year design life as advocated by the Steering Committee on Canal Developments.

- Connecting Channels

The PWD in its submission indicated that it may be necessary to review the width and orientation of the connecting channels between the canal estate and the Inlet Channel. Because of the implications of altering the connecting channels after they are constructed, it is suggested that they be reviewed as part of the detailed engineering studies and design which will occur

prior to construction. This matter can be dealt with as planning proceeds but should be resolved to the satisfaction of PWD and the waterway manager (PIMA).

The Authority recommends that:

Recommendation 8

As part of the detailed engineering design associated with the connecting channels, their width and orientation to the Inlet Channel should be reviewed to ensure that the maximum and most efficient exchange of water occurs. This matter can be resolved between the Proponent, PWD and the waterway manager (PIMA) as planning proceeds.

The Authority has been advised of the need for a survey of connecting channels and the associated natural waterways on completion of dredging, the object being to provide baseline data against which results from future monitoring could be compared. The Authority agrees that such a need exists.

The Authority recommends that:

Recommendation 10

On completion of dredging of a connecting channel, a survey of the channel and the associated natural waterway should be carried out at the Proponent's expense and in accordance with PWD and PIMA requirements.

A firm proposal for the maintenance dredging of the northern connecting channel should be made by the Proponents. The consultants report discusses a series of options and suggests a preferred one, but a decision was not made in the ERMP as to which option would be adopted.

The Authority recommends that:

Recommendation 11

The Proponent should provide a firm proposal for the maintenance dredging of the northern connecting channel to the satisfaction of the waterways manager (PIMA).

. Cutting the Western Foreshore

The Authority noted the submissions opposing the cutting of Leighton Road and the western foreshore by the connecting channel, however, the Authority believes that these were based on social, rather than on the engineering or environmental implications. No consideration was given in the ERMP to any alternatives connecting channel which would not involve cutting the western foreshore. One of the prime aspects of the proposal is to allow for direct access by large yachts from the canals to the ocean. The Authority considers that this matter should be determined through the planning process.

. Floods

In terms of flood impact, the Authority has been advised and has accepted the opinion that the proposal will not have a significant

impact on flood levels, as the canal nature of the project and the floodways along the Inlet foreshore will compensate for any loss of flood plain. It is essential that foreshore areas which have a floodway role should not be filled, and any development on these areas must be approved by PIMA and PWD in addition to any other approvals required.

Short term blockages to flood flow caused during the construction phase will need further evaluation and approval by the PWD at the time of development. Until further studies on the efficiency of the Inlet Channel and the evaluation of flood data have been completed, the minimum flood level that should be considered safe is RL 1.5 metres AHD.

. Deep Sewerage

The Authority supports the ERMP in concluding that deep sewerage is required and will accordingly be provided. Two different systems were proposed and it should be specifically noted that the PWD is unlikely to accept the vacuum system due to the associated high operational costs. Further discussions between the Proponent and PWD should take place to resolve the type of facility and constructional standards of the preferred system.

The Authority considers that because of the canal basis of the project, it is essential that adequate contingency plans are prepared to prevent the pollution of the canals with sewage in the event of a mechanical failure. This aspect should be the subject of further study and can be resolved between the Proponent and the Peel Inlet Management Authority.

The Authority noted the proposal to provide a sewage pump-out facility for boats. This aspect is supported as the Authority considers it is essential that developments of this type and scale should provide such facilities.

The Authority recommends that:

Recommendation 12

As planning proceeds, the Proponent should provide contingency plans for the prevention of pollution of the canals, in the event of a failure of the sewage disposal system. These plans should be to the satisfaction of the Peel Inlet Management Authority.

. Stormwater Drainage

The Authority noted the proposed drainage system of subsoil disposal with overflow from paved areas during extreme events. The Authority considers that this attempt to reduce pollution of the canal waters from stormwater should be supported. However, additional information should be provided by the Proponent to show the long term adequacy of the system and its maintenance requirements.

Some doubt has also been expressed regarding the build up of water levels under the residential islands as a result of this system of stormwater disposal. This matter should be the subject of discussions between the Proponent, the Shire of Mandurah and the waterway manager (PIMA).

In terms of maintenance of the drainage system, the Authority was concerned that the Strata Title Body Corporates may, because of the location of drains be responsible for their maintenance. The Authority considers that this aspect should not be left to such groups, but rather to an agency with appropriate skills and equipment. This issue should be resolved to the satisfaction of the Shire of Mandurah and PIMA prior to subdivisional approvals being issued.

Monitoring of the disposal system should be undertaken to assess their effectiveness, maintenance requirements and operating costs. Modification to the drainage facilities for subsequent stages should be carried out if problems are identified from monitoring.

The Authority recommends that:

Recommendation 13

As planning proceeds the Proponent should provide further engineering and management details of the proposed stormwater disposal systems to satisfy the requirements of the Shire of Mandurah and the Peel Inlet Management Authority.

. Scour and Siltation

The possibility of scour and siltation of the canals and the Inlet Channel have been examined and it was concluded that the effects would be minimal. Adequate provision for these effects appear to have been made in the design of the project, but monitoring should be carried out to assess actual performance, and if problems are identified they should be rectified prior to the hand over of responsibility from the Proponent to the management authority.

. Tidal Prism

Several submissions expressed concern that the tidal prism of the Inlet Channel would be altered by the project and could result in an undesirable change to the water flow of the channel. The increase in the tidal prism has been calculated at less than one percent and as such is considered to be insignificant. An increase of this magnitude in the prism would, due to the advantages of obtaining greater exchange between the ocean and the Peel-Harvey Estuary, be seen as a positive impact of the project.

. Staging

Staging of the project has been addressed in Section 4.3.1 and in essence, the Authority accepts the flexible staging approach accompanied by comprehensive monitoring. The results of monitoring will indicate the operation and impact of particular stages, and can then be used to evaluate the effects and characteristics of subsequent stages. One major implication of

staging is the possible need to bring forward the construction of the through canal if monitoring results indicate that it is warranted.

Two submissions were received which suggested that Stage 1 should be relocated to the area on the foreshore of the Inlet Channel between the marina and the proposed by-pass bridge. Whilst the Authority can see the social advantages of this suggestion, it is believed that it would have few benefits from the environmental viewpoint. The Authority considers that this matter is one which should be decided by the Local Council through the planning process, as it essentially relates to the issue of cutting the western foreshore and relocating Leighton Road.

. Road Tunnel

The ERMP suggested the possibility of a future road tunnel under one of the main canals. Whilst this was seen only as a possibility the Authority wishes to point out that very high maintenance and lighting costs would be associated with such a structure.

. Soils

It was noted that although the soils in the project area would not generally present major engineering problems, the soil sampling reported in the ERMP was based on a very large grid and would not have identified or quantified local variations or the soils in the old river meander and the samphire marsh area. These two areas may contain soils which have characteristics that are less suitable for fill than soils over the majority of the site. The Authority considers that before construction approvals are issued, the Proponent should carry out more detailed field testing of soil conditions to identify soil types and engineering suitability for fill purposes.

The Authority recommends that:

Recommendation 14

The Proponent should be required to document options for disposal of spoil unsuitable for residential landfill.

. Fuel and Oil Spillages

Measures to safeguard against pollution from fuel and oil spillages has already been mentioned. Necessarily, all possible safeguards such as the bunding of any land based boat fueling and servicing facility should be incorporated in detailed design. In addition, programmes to educate the users of both public and private boating facilities throughout the development concerning the need for care in the handling of fuels and oils should be implemented.

The responsibility for development and implementation of such programmes should rest with the Proponent, although particulars of the actual programmes and their implementation would need to satisfy the relevant management agencies.

In addition to the education programmes, the Authority considers that there is a need to develop plans to combat major spillages of fuels and oils. Containment would appear the most satisfactory

premise for such plans and again, the need for these plans to be acceptable to all agencies involved with management of the development is apparent. Although the need for fuel and oil spill contingency plans has been raised as a separate issue, the Authority believes that appropriate safeguards could be incorporated in the overall management plan developed for the estate.

4.3.3 Conservation

The ERMP reviewed the flora and fauna of the project area and concluded that generally the site had been heavily degraded by past agricultural activities. The remnants of an old meander form a seasonal wetland at the northern part of the site, but evaluation of this wetland showed that it had limited conservation value.

The samphire area east of the Old Coast Road was the main area of study, but it also is seriously degraded over a major portion. The section of samphire at the southern end of the area was, however, considered to have conservation value, and the ERMP proposed that it be reserved for conservation of flora and fauna. This same area has also been identified in the System 6 Study as worthy of protection and the proposal in the ERMP is similar in size and location to that recommended in the System 6 'Green Book'. The Authority supports the proposal to reserve this land because of its conservation value.

Although other portions of samphire vegetation in this area have some conservation value, it is considered that their retention would not appear to be a practical proposition. This opinion is supported by the Department of Fisheries and Wildlife.

The Authority noted the probability of the conservation areas as breeding sites for salt water mosquitoes (Aedes vigilax and Aedes camptorhynchus). Both species breed in salt to brackish water. They will bite fiercely day or night and will readily be dispersed towards settled areas by the south westerly winds.

By placing a human population even closer to the breeding sites, the proposed development could increase pressures for elimination of these areas. Inappropriate, abatement techniques could downgrade the ecological values of the conservation areas. It is therefore important that abatement measures which should be incorporated in the management programmes are compatible with the conservation value of these areas.

The Authority noted that options for widening the Inlet Channel in order to improve exchange between the Peel-Harvey Estuary and the Ocean could affect the proposed conservation reserve and the manager of this reserve should recognise this fact. Because conservation is the prime reason for reserving this land, it is considered that the Western Australian Wildlife Authority should be responsible for it, but recognition of other roles that the land has, such as river management and floodway should be recognised by W.A.W.A. Because of this multiple function, it is suggested that the land be vested for the purposes of Conservation of Flora and Fauna and River Management.

The Authority believes that the conservation area should be excluded from any canal zone and transferred to the Crown prior to, or as a condition of subdivision of the first stage of the project. In addition, the Proponent should liaise with and

assist W.A.W.A. in the preparation of management plans for this land as certain aspects of the proposed development could, in some cases, affect the conservation of the reserves.

It is noted that a wide pedestrian accessway is proposed to be taken out of the conservation area, this would appear to be inappropriate and the question of public access to or through this area should await the preparation of management plans in conjunction with W.A.W.A.

The Authority noted that 'soft edges' are proposed for the conservation areas, yet no consideration appears to have been given to the effect of boat wash on those edges, or appropriate beach slopes. The Authority considers that additional studies should be carried out on this aspect to ensure that the edges of the reserve will not be subject to erosion and that these studies and proposals be submitted and approved by the waterways manager prior to the commencement of construction.

The Authority has concluded that the project will not result in a major loss of land considered to have a viable long term conservation value, and the proposal to reserve certain areas for conservation purposes is supported.

The Authority recommends that:

Recommendation 15

The conservation areas proposed should not be included within any canal zone and should be transferred to the Crown prior to or as a condition of subdivision for the creation of the first stage of the project.

Recommendation 16

The areas for 'Conservation of Flora and Fauna' should be vested in the W.A. Wildlife Authority. Management of these areas should accept the need for possible future Channel widening options as may be required to increase water exchange between Peel-Harvey Estuary and the Ocean. Some limited public access to the conservation areas should be considered as part of their management.

Recommendation 17

The Proponent should provide additional information to show that the 'soft edges' proposed as foreshores of the conservation areas will be stable and not require excessive management. This information should be provided to the waterway manager (PIMA).

4.3.4 Groundwater

The effect of canal estate proposals on the groundwater of adjacent areas is a major consideration which must be thoroughly evaluated. The ERMP covered this aspect and a comprehensive, well-balanced report was prepared by the consultant firm of Rockwater Pty Ltd.

Evaluation of the report by the Authority, Geological Survey and PWD has shown that it adequately indicates the likely effects of the proposal on the hydrogeology of the locality. It is considered that the proposal will not have a major impact on the water resources of the area.

In assessing this matter, the Authority noted that the Proponent had specifically modified the proposal in order to minimise the likely undesirable impact on water resources. These matters relate to the use of a continuous 'curtain' walling system, and in minimising dewatering operations.

The proposal will have the effect of moving the present saline interface closer to McLarty Road. The continuous walling system will help to reduce this movement and it will also assist in the thickening of the freshwater lens on the upstream side of the wall. Studies carried out thus far indicate that little or no effect to existing bores will occur; however, these studies were based on idealised data and, due to variations in actual ground conditions, the effect may be different to that predicted. There is no doubt that fresh, shallow groundwater will not be obtainable within the canal estate, although thin lenses of freshwater will build up under the developed islands. Purchasers of canal lots should be advised that fresh bore water will not be obtainable within the canal estate.

The fresh groundwater resources of the Halls Head area generally are limited, and owners of land should not expect to obtain fresh groundwater for each lot. Already, increased salinity levels are being noted in existing bores in the locality, and the consultant considered that whether or not the project proceeds, future problems with salinity will increase. Geological Survey supports this conclusion.

The Authority believes that the effect on fresh groundwater supplies of the Halls Head area should be minimised as much as possible and that a comprehensive monitoring programme should be implemented to assess any changes which occur.

The ERMP suggests that water drawn from the Leederville Formation will be used for reticulating the open space areas of the estate. No consideration appears to have been made as to the quantity or quality required, or of the availability of supply. The Public Works Department has advised the Authority that supplies from this formation are very limited.

As nutrient inputs are a major concern with respect to this project, the quality of groundwater discharging into the canals, either from the Halls Head area or the developed islands, should be included in any monitoring.

4.3.5 Estuarine Fishery

The ERMP also considered the impact of the proposal on the fisheries of the Peel system and suggested that it would not have an adverse effect. Advice received from the Department of Fisheries and Wildlife supports this belief, subject to the predictions made in the ERMP with respect to frequency of water exchange, water quality in the canals and the effectiveness of stormwater disposal systems being realised. In addition, that Department emphasized that the cumulative effects of further

development in the area need consideration, rather than each project in isolation. On this basis, monitoring of changes to the system through the various stages of this and other projects is of great importance.

It may be that some fish species will utilise the canals area for limited periods of time, but the extent of this is unknown. As the project is to be developed in small stages, ample opportunity will exist to monitor migration of fish and colonisation of the new canals. It is possible that at certain times of the year, or when there is poor water quality in the Peel Inlet, biota which normally shelter in the Inlet Channel will, if the development proceeds, be able to utilize an increased area to that currently available. This aspect should also be monitored through the staged development.

Concern was expressed by the Mandurah Licenced Professional Fishermen's Association and several private individuals over the possible effect the project could have on the commercial fishery of the Peel-Harvey Estuary. The Department of Fisheries and Wildlife indicated that in the early stages of the project with only one opening to the Inlet Channel, migrating fish may congregate in the canals. The Authority considers that this concern is valid and if monitoring indicates it is occurring at an undesirable level, the early construction of a through canal (thus providing two openings to the Inlet Channel) may be warranted as a means of overcoming the problem. The Proponent should provide a commitment to construct this through canal at any time if the need for such action is identified.

In order to minimise the impact on fish migration, the Proponent has concluded that connection of the estate to the Inlet Channel should be made at a time when turbidity levels in the channel are naturally at their highest (late autumn to early winter). The Authority concurs with this approach.

In terms of maintenance dredging, it is considered that the amount envisaged for the project will not have a substantial effect on fisheries, provided it is carried out at an appropriate time of the year.

Recommendation 18

A programme of monitoring should include regular observation of fish movements. Redesign of the canal waterway to complete a through-canal should be considered as a means of minimizing disturbance to fish movements.

4.3.6 Open Space

Several submissions were received which criticised the amount and location of open space areas proposed in the ERMP. The Authority agrees that the areas proposed are inadequate but believes that local open space systems are essentially the responsibility of the Town Planning Board and the Shire of Mandurah. Sufficient provision for negotiating this aspect exists through the statutory planning system.

Foreshore reserves along the Inlet Channel were also the subject of several submissions and the Authority believes that the amount and location of proposed reserves are inadequate.

The foreshores of the Inlet Channel are of regional significance in terms of recreational opportunities, aesthetics, conservation and floodways. The PWD has advised that land along the foreshore of the Channel will be required as a floodway and accordingly, it should not be filled, although some sections could be used for recreational activities at the discretion of the responsible authorities.

The Authority notes that the northern access channel will remove portion of the foreshore from public use; this should be compensated for by the addition of alternate foreshore and not by way of inland open space. In addition, the area southwards from the existing bridge to the southern access channel has not been included in the ERMP and no foreshores in this area are proposed. The Authority believes that an adequate foreshore should be provided in this area and along the northern edge of the southern access channel. The exact dimensions of this reserve can be the subject of later negotiation, however, the Authority considers that a minimum reserve width in the order of 50 metres would be appropriate. Adequate vehicular and pedestrian access to this reserve would be in addition to reserves already given in this area. The implications of possible widening of the Inlet Channel should be considered when the width of this reserve is determined between the Proponent and responsible authorities.

The Authority considers that adequate foreshores along the edge of the Inlet Channel are essential, as the conservation areas, together with the form of development proposed on adjacent lands could excessively limit public access to, and public usage of the foreshores. Management plans for these areas should be prepared and approved by the waterway manager (PIMA) and the PWD.

The ERMP indicates that the proposed waterways will be ceded free of cost to the Crown upon their creation on a Diagram or Plan of Survey. This approach is in line with the recommendations of the Steering Committee on Canal Developments. The Committee also recommended that the Town Planning and Development Act should be appropriately amended.

The Authority recommends that:

Recommendation 19

The proposed foreshore area along the Inlet Channel south of the traffic bridge should be increased to compensate for the loss of foreshore area brought about by the construction of the northern and southern connecting channels.

Recommendation 20

Additional foreshore areas should be provided between the existing bridge and the northern shore of the southern connecting channel to allow for adequate public access, recreation and floodway. Vesting of these areas should include the purpose of River Management.

Recommendation 21

The foreshore areas, as ultimately agreed upon, should not be zoned for canal development when zoning occurs and their transfer to the Crown should take place prior to, or as a condition of final approval to the first stage of the project. Prior to subdivisional approval being issued, the Proponent should prepare a management programme for the shore areas acceptable to the waterway manager (PIMA), these plans should be implemented as a condition of approval.

Recommendation 22

The Authority endorses the recommendation of the Steering Committee on Canal Developments that appropriate amendment should be made to the Town Planning and Development Act to allow for transfer, free of cost, of canal waterways to the Crown.

4.3.7 Social Environment

Several submissions, both from the public and Government, raised concerns with respect to the social impact of the proposal. Open space provision as a social issue has already been discussed, however the following issues were also identified.

- Severing Leighton Road and the Foreshore Reserve. This aspect was raised in several submissions, however, public response to the ERMP was inadequate to obtain a clear understanding of the community's views on this matter. The question, appears to be one of convenience of access and it should be handled by the Shire of Mandurah.

- Housing Densities. The proposal is for residential development densities greater than normal, the Authority notes this, but believes that in environmental terms this aspect is not significant. The Proponent has demonstrated an awareness of the implications of the density proposed and appears to have planned adequately for it. This matter is essentially a planning one and can be addressed via the planning process. A review of this aspect on the completion of stage one will provide a better understanding of the social implications.

- Landscape. Two submissions referred to the anticipated loss of the existing open character of the project site. Regardless of the type of residential development which occurs on the site, its present character will change. This should not always be seen as a loss, but rather as a change from one landscape to another. In fact, the development of the site as a canal estate could add a new and interesting component to the landscape and it may in fact provide for more views into the project than would be expected if a traditional residential development was carried out. This question however relates to personal perception and the Authority believes that it should be resolved at a local level.

- Increased Boating Congestion. Concern over this implication of the proposal was raised in several submissions. Suggestions were made that the ecological value of the Inlet Channel could suffer from added boating traffic and that congestion would

reduce recreational opportunities and enjoyment. The Authority believes that congestion of the Channel will increase regardless of this particular development and that there is little evidence available to show that a significant effect on the natural environment will occur through increased boating. The Authority considers that this matter is essentially one of management, and an inevitable by-product of increased population and boat ownership.

The Authority does however consider that the impact of increased boating activity on the estuarine system is a matter which should be kept under close review.

The increased boating activity resulting from this proposal will impose additional workloads upon PIMA and the Department of Marine and Harbours.

. Noise. One aspect peculiar to canal estates is the noise levels generated and propagated within the development, and the effect that these levels will have on the residents.

The Proponent considered this problem and made suggestions relative to commercial vessels. It is noted that boats generally can be noisy and it is difficult to single out noise levels on the basis of commercial use. The Authority believes that boat noise and low sound attenuation rates over water are basic characteristics of canal estates and that to a certain extent, must be accepted by those who wish to live in such estates.

4.3.8 Environmental Impacts During Development

Environmental impacts during the construction phase could arise from noise and other disturbance to existing communities, disturbance of wildlife, release of suspended sediments to the Inlet Channel, seepage of saline water from the dredge spoil during dewatering, disturbance of vegetation in the foreshore and conservation areas and, possibly dust from spoil heaps and filled areas.

. Effects of Noise on Existing Communities. Noise associated with construction of the canals and other earthmoving operations may have an adverse effect on adjacent residential areas. The ERMP addressed this issue and appeared to appreciate the factors involved. Suitable provisions were made to reduce noise levels to a minimum, however the Authority believes that discussions should take place between the Proponent and the Shire of Mandurah on this matter especially in terms of hours of operation.

The Authority recommends that:

Recommendation 23

Before construction commences, the Proponent should discuss with the Shire of Mandurah the question of noise levels and hours of operation, and he should follow the 'Procedure for Assessing the Noise Effect of Proposed Noise Sensitive Developments' as prepared for the Noise and Vibration Control Council[7].

. Soil Stabilization. It is possible that earthmoving activities and the creation of large areas of exposed sand could cause problems of increased dust levels and wind blown sand. These matters are generally easily managed and are not expected to be significant.

The Authority recommends that:

Recommendation 24

The Proponent should liaise with the Commissioner for Soil Conservation on appropriate methods to minimise dust levels and stabilize soils during and after earthmoving operations.

. Protection of Conservation Areas. During construction of the project or buildings, it is essential that conservation areas and foreshores are adequately protected. To achieve this protection, spoil or other materials should not be deposited on these areas, vehicles should be excluded, seepage from adjacent areas should be prevented and changes to groundwater levels or quality should be avoided. Fencing of the conservation areas should be considered as a means of achieving some of these objectives.

The Authority recommends that:

Recommendation 25

The Proponent include in the management programme, suitable provisions to protect the conservation areas, floodways and foreshore areas from any adverse effects during the development of the estate. Agreement to this aspect of the plan should be obtained from the waterway manager (PIMA), PWD and WAWA.

. Release of Impounded Waters. See 4.3.5.

4.3.9 Other Development Issues

Several submissions pointed out that the ERMP did not include proposals for two parcels of land south of the traffic bridge. One area, is owned by the Mandurah Shire Council and accordingly the Proponent has not put forward proposals as it is not within his ownership. It would be appropriate that some early consideration be given to the use of this land as development of canals adjacent to it should have regard to its ultimate use of development. This is a matter for Council to resolve.

The other portion of land for which no proposal was put forward is the land surrounding the Mandurah Marina. The question of foreshore reserves and floodways as effecting this area have already been discussed, however, it would be appropriate for a concept plan to be put forward for the balance of the site.

The proposal has made no provision for boat storage, servicing or repair, but indicated that facilities would be available in the future. Submissions cast doubt upon this statement and it would appear that the Proponent should make provision for boat servicing facilities on this land. Any boat servicing facilities should be specifically designed so as to prevent contamination

of adjacent waters from oil, fuels, sewage, paint and anti-fouling preparations. An intercept drain across the frontage of the slipway together with proper stormwater disposal, may be appropriate mechanisms to prevent pollutants from these sources entering the Inlet Channel.

Recommendation 26

Detailed planning for Stage 1 of the project should include provision of a boat waste water pumpout facility connected directly to the reticulated sewerage system.

Some concern was expressed over public access to the 'islands' in the estate. It is suggested that public access from the water should be permitted in emergency situations. In addition if access to the islands from the local road system is controlled, adequate provision should be made for entry by emergency vehicles.

4.3.10 Suitability Of The Proposal - Conclusions

The Authority believes that provided the recommendations made are implemented, the project could proceed in an environmentally acceptable form.

5. MANAGEMENT

5.1 Management Structure

The Authority noted that a major portion of the project area, i.e. the area west of the Old Coast Road, is not within the Management Area of the Peel Inlet Management Authority as described under the Waterways Conservation Act 1976. The Authority believes it is essential that the Management Area should be extended to include the whole project area to ensure that PIMA has adequate control over the development of the project.

Recommendation 27

Prior to subdivision or construction approvals being granted to the project, the boundary of the Management Area of the Peel Inlet Management Authority should be extended to include the whole of the project site.

Long term management of the artificial waterways could be potentially costly and benefits accruing to the community at large would be minimal. The ERMP anticipated that funding for management would be raised from owners of units in the development. This is consistent with the recommendation of the Steering Committee on Canal Developments[6] which stated that funds for management and maintenance should not be drawn from Government or Local Government agencies but from owners of lots in the completed development. The Authority supports this philosophy. It is noted that at present there is no legislation which would be adequate for this to be achieved.

The Authority recommends that:

Recommendation 28

The appointment of the waterways manager would need to consider the manner by which funds for management will be raised and the adequacy of resources available to the manager to carry out its responsibilities.

Because of the staging proposed, it is possible that during the early stages of development funds raised from landowners within the estate may not be sufficient to meet the full cost of maintenance and management, it is essential therefore that the Proponent should meet any short fall of funds.

5.2 Management Plan

Several submissions criticized the manner by which the ERMP covered management. The Authority noted that the Proponent considered management and maintenance would be minimal due to appropriate design and that if monitoring revealed the need for management plans, they would be developed and implemented at that time.

The Authority believes that the approach taken by the Proponent is not appropriate and that a flexible management plan should be developed prior to construction of the project. Monitoring results can then be used to indicate where changes to that established plan are warranted.

Although a management plan has not been developed, the ERMP reflected an understanding of most management issues. These issues include management of water quality, monitoring of a range of parameters, maintenance dredging, maintenance of walls and banks, erosion control, servicing and repair of navigation aids, and removal of rubbish or other pollutants from the waterways.

Of particular importance to the waterway management is the estimated cost of management for the project. Whilst such estimates may not be exact, monitoring of actual costs and requirements of management prior to the 'hand over' period will provide firm figures.

Management and maintenance of the project should include sections of the adjacent Inlet Channel which the project will have an impact upon. This is especially important in terms of maintenance dredging. It is necessary therefore that an appropriate management area should be determined and agreed upon by all agencies involved as part of the overall management programme. It may be necessary to modify the management area at the 'hand over' period to ensure that it has been proven as appropriate.

The Authority recommends that:

Recommendation 29

The Proponent should develop a management plan which satisfies the Peel Inlet Management Authority.

The Authority recommends that:

Recommendation 30

The management area for the project should include sections of the adjacent Inlet Channel that in the opinion of PWD and PIMA may be affected by the existence of the project.

The ERMP did not address in an adequate manner, the question of length of time the Proponent would be responsible for management, maintenance and monitoring. Vague terms such as 'for the early stage' were used to indicate that the Proponent was aware of the issue but would make no firm commitments.

The Authority believes that an essential part of the management programme is an agreement between the Proponent and the waterway manager on the 'hand over' of responsibility from the Proponent to the manager. At the time of hand over, the estate should be shown to be functioning well and capable of meeting management costs. Management tasks and costs need to be clearly identified and quantified. This issue is essentially one of resolution between the parties involved.

Because of their importance and location, the connecting channels between the project and the Inlet Channel should be the responsibility of the Proponent until it has been clearly proven by monitoring results that they are adequate, in terms of design, function and manageability. The Authority noted that PWD suggested that this period of responsibility should be in the order of ten years.

The Authority recommends that:

Recommendation 31

The Proponent should reach an agreement with the waterway manager (PIMA) as to a time, or performance level at which the responsibility for all or parts of the project are handed over to the waterway manager. This agreement should be reached prior to subdivisional approval being issued.

The ERMP suggests that the owners of units in the canal estate will be expected to play some informal role in the management of the estate and that maintenance responsibilities for retaining walls and moorings would essentially fall upon these owners. As the residential units will be Strata Titled, the Authority believes that prospective purchasers of the units should be advised that corporate body maintenance costs will be considerably higher than those normally expected for such units.

The Authority noted the Proponent's intention to provide information to purchasers of residential units, on the implications of living in a canal estate. The Authority supports this concept and suggests that the Proponent liaise with the waterway manager (PIMA) and appropriate agencies on the type and extent of information provided.

5.3 Management Implications For Government

As previously identified, this and other similar projects in the locality, will generate additional workloads for Government agencies which may require additional funding to meet those demands.

Apart from increased workloads on various agencies, the Authority advises that as both Halls Head Waterways and Waterside Mandurah estates have used a design vessel of 10 metres length, and the former proposal in particular is designed for ocean going yachts; it is probable that if the proposals are developed, increased demands will be made to Government to maintain a 1.5 metre depth through the Mandurah Bar. The implications in financial terms for such a depth to be achieved for most of the year are considerable and Government should be fully aware of this.

Other additional requirements would be:

- Expertise, labour, administration and equipment for the waterway manager (PIMA).

- Additional labour and equipment for the Department of Marine and Harbours to police the Navigable Waters Regulations.

- Resources for the W.A. Wildlife Authority to provide for the proper management of the conservation areas being given to the State.

- Any monitoring or evaluation of data on the impact of the project on fish migration into or habitation of the canal areas.

The Authority draws the aforegoing to the Government's attention.

6. MONITORING PROGRAMME

The ERMP discussed the need for monitoring as part of the overall project and as an integral component of the staging approach put forward. Whilst commitments are made in the ERMP to carry out monitoring, no details of the monitoring programmes were provided. In addition, the ERMP was not specific in terms of the length of time monitoring would be undertaken.

The Proponent indicated that monitoring results would be used to assist in the planning and evaluation of future stages and if any problems were shown up through the monitoring they would not be repeated. There was, however, no commitment to carry out corrective works if they are necessary.

The Authority believes that the monitoring programmes to be developed should include the issues of interpretation of data, reporting and commitments to undertake changes to the project, staging, management and monitoring in the light of results.

Recommendation 32

The Proponent should develop a monitoring plan which satisfies the Peel Inlet Management Authority.

7. CONTINGENCY GUARANTEES

Several submissions expressed concern over the possibility of expensive remedial works being required as a result of the project. Suggestions of monetary bonds were raised as one means of ensuring that the community is protected from having to meet the cost of such works.

The Authority has previously expressed the opinion that the beneficiaries of the canal estate should be responsible for maintenance and management of the estate after 'hand over' period from the Proponent to the waterway manager. The Authority has also stated that the Proponent should be responsible for necessary remedial works. The question of time limit for such works to be carried out and ultimate contingency guarantees remain to be addressed.

The Authority considers that adequate guarantees should be provided by the Proponent to ensure that necessary corrective works are carried out during the period of his responsibility. This aspect is of particular importance if an early need is identified to construct a through canal to improve flushing of the canal estate.

The Authority does not wish to enter the debate as to what form the guarantees take, but only that they should be provided in a form acceptable to the Government.

The Authority recommendst therefore that:

Recommendation 33

The Proponent should provide guarantees in a form acceptable to Government for remedial works which may be required as a result of failure of the project to achieve the standards required by the waterways manager.

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9. PUBLIC AND GOVERNMENT SUBMISSIONS

Eighteen public and thirteen government submissions were received and the views given to the Authority considered in its analysis of the proposal.