Extension to Yunderup Canals Estate

Peel Waterways Pty Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 541
June 1991

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ISBN 0 7309 3502 7
ISSN 1030 - 0120
Assessment Number 21

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Summary and recommendations

Peel Waterways Pty Ltd has proposed the extension of the existing Yunderup Canal Estate which is located immediately south of the mouth of the Murray River, adjacent to Peel Inlet.

The proposed extension will include two additional canals, one located to the east of the existing development and aligned north-south (Lots 5, 6, 7, and 8 Kiap Road), and the second located to the north of the entrance to the existing development and aligned northeast-southwest (Lot 18 Warma Way). This will provide for 7.4 ha of new canal waterways, 160 residential lots, a local store with a petrol outlet, public open space, and local roads and pedestrian access ways. The proposal will be within the context of the management plan for the Peel Inlet currently being prepared by the Peel Inlet Management Authority.

The initial proposal to extend the canals, which involved only the development of Lot 18 Warma Way, was formally submitted to the Environmental Protection Authority in 1982. Since then, the canals have been subject to numerous studies and reports, prompted by concerns about the water quality of the existing Yunderup Canals. The results of these studies and reports culminated in the preparation and release in December 1990, of the current revised Public Environmental Review. This document included details of the new design plan for the canals and remedial works which would be undertaken to improve the water circulation of the existing canals.

The Authority has examined the revised proposal to extend Yunderup Canals within the context of previous assessments, and within the context of efforts being made to manage the water quality and associated problems of the entire Peel-Harvey Estuarine system. In its assessment of the Point Grey Project in 1988, the Authority expressed its concerns regarding both the impact of that development on the already stressed environment of the Peel-Harvey Estuary, and of the effect of this stressed environment on residents in the area, both existing and new. This effect would mainly take the form of a reduction in amenity, as a result of problems such as odour and unsightliness associated with macroalgal blooms. High mosquito numbers in the area were also of concern (Environmental Protection Authority, 1988).

Due to the Authority's concerns regarding new developments immediately adjacent to the Peel Inlet and Harvey Estuary, particularly in the area south of the Inlet channel, and because of the unsuitability of the poor quality Peel Inlet water to act as a source water for a canal system, the Authority would not recommend the construction of a totally new canal system in this area if it were to be proposed at this time. However, given that the Yunderup Canals have been in existence since 1971, and given that theoretical modelling studies had shown that this proposal could provide a mechanism for correcting some of the canals' existing water quality problems, the Authority was prepared to assess the proposal to extend the canals.

The Authority considers the water quality of the existing canal system to be a fundamental issue. The Yunderup Canals have a long history of documented concerns regarding the poor quality of water within the system. Problems experienced with water quality can be attributed to the poor design of the canal system and the fact that the source water for the canals is from the largely eutrophic Peel Inlet. The Authority was of the opinion that before a proposal to extend the canals could even be considered, it would have to be shown that remedial work could be undertaken on the existing canals which would result in better water circulation and as a consequence, better water quality in the longer term. It would also have to be shown that any improvement in water circulation could be maintained if the canals were to be extended as proposed by the proponent. The proponent employed consultants to undertake field studies which would provide the Authority with the necessary results. The Authority is satisfied that these results show that if remedial work is undertaken, as detailed in the proponent's commitments 1, 2, and 3 (Appendix 1), the water circulation within the current canals should improve and that this improvement can be sustained following extension of the canal system.

Accordingly, the Authority has concluded that the remedial works associated with the proposed extension to Yunderup Canals Estate will improve the unsatisfactory condition of the existing canals, and that the extension to the canals will not jeopardise this improvement.

Recommendation 1

The Environmental Protection Authority has concluded that the proposed extension to Yunderup Canal Estate, as modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and the government agencies that were consulted, should lead to an improvement of water quality in the existing canals, which should also be reflected in the proposed canals, and therefore, is environmentally acceptable.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as:

- **water quality; and**
- **physical maintenance of the canal system and its entrance channel.**

Remedial works are to be undertaken by the proponent on the existing canal system to address the above factors, to the satisfaction of the Environmental Protection Authority. These works are specified in the proponent's commitments and include:

- **installation of culvert connections at appropriate sites;**
- **altering canal depths in existing canals so that they are no greater than -2.0m AHD; and**
- **maintenance of the entrance channel to the appropriate depth required for flushing.**

The Environmental Protection Authority considers that these environmental factors are addressed adequately by either environmental management commitments given by the proponent or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the project could proceed subject to the Environmental Protection Authority's recommendations in this report and the proponent's commitments to environmental management (Appendix 1).

In order to properly manage the canals and in order to verify that this proposal has provided a satisfactory solution to the historical problems associated with the existing canals, a water quality monitoring programme will be required.

Recommendation 2

The Environmental Protection Authority recommends that the proponent prepare a water quality monitoring programme for the canals to the satisfaction of the Environmental Protection Authority, on the advice of the Peel Inlet Management Authority and the Shire of Murray, prior to completion of construction. This water quality monitoring programme is to include, but not necessarily be limited to sampling of:

- **water column nutrients, that is total phosphorus, total nitrogen, phosphate, oxidised nitrogen and ammonia;**
- **water column chlorophyll 'a';**
- **sediment total nitrogen and total phosphorus levels; and**
- **physical parameters, such as; salinity, temperature, dissolved oxygen, pH, and light penetration.**

Failure to rectify the water quality problems of Yunderup Canals in the past can be largely attributed to the lack of a clearly identified agency responsible for management of the system. This has resulted in the situation where remedial works required to improve the water circulation of the canal system have not been undertaken or have been substantially delayed. The proponent has given commitments (Appendix 1) to undertake the necessary remedial works. However, the Authority feels that in order to avoid this same problem occurring again in the future, management responsibilities must be clearly established before the canals are extended further.

Recommendation 3

The Environmental Protection Authority recommends that an agreement be entered into between the proponent, the Shire of Murray, the Peel Inlet Management Authority, and the Department of Marine and Harbours, which clearly delineates responsibility for the physical maintenance and water quality monitoring and management of the canal system, both new and existing, and of its entrance channel. This agreement is to be to the satisfaction of the Minister for the Environment on the advice of the Environmental Protection Authority and should be finalised prior to commencement of construction.

1. Introduction

Yunderup Canals Estate was constructed in 1971-72. Peel Waterways Pty Ltd (the proponent), which was not involved in the development of the original estate, first initiated a proposal to extend the Yunderup Canals Estate in 1980. The proponent prepared a Public Environmental Review (PER) on the proposal in 1986, and this was released for public review. However, the Environmental Protection Authority did not complete its assessment of the proposal put forward at that time, as a more detailed analysis of the circulation and flushing dynamics of the canal system was required before an adequate assessment of the environmental acceptability of the proposal could be made. The proponent commissioned further studies as required and prepared a new PER document which detailed the revised development proposal and discussed the potential environmental impacts of the proposal and the proposed management of these impacts. This PER was released for public review in December 1990. Therefore, this assessment is a continuation of the process initiated in 1986, rather than a separate and new assessment.

2. Description of proposal

The proposal by Peel Waterways Pty Ltd to extend Yunderup Canals involves the construction of two additional canals. One canal is located to the east of the existing development on Lots 5, 6, 7 and 8 Kiap Road (17.2 ha) and is aligned north-south, and the second canal is located to the north of the entrance to the existing development on Lot 18 Warma Way (5.7 ha) and is aligned northeast-southwest (Refer Figure 1).

The proposed development will include 7.4 ha of new canal waterway, 160 residential lots, a local store with a petrol outlet, public open space, and local roads and pedestrian access ways.

The construction of the new canals also involves some remedial works on the existing canals such as dredging of the entrance channel (already done by the proponent), filling of certain sections so that the depth profile is uniform, and appropriate siting and relocation of culvert connections. The lots to be created would be connected to reticulated sewerage, as are the established lots, and stormwater runoff would pass through silt traps prior to discharge into the canal system.

3. Existing environment

3.1 Terrestrial environment

Yunderup Canal Estate is located in the southern bank region of the Murray River delta to the Peel Inlet. The original detaic landforms within and surrounding the site have been significantly modified during construction of the existing canals in 1971-72. Soil was excavated from Lots 5, 6, 7, and 8 Kiap Road to elevate the residential allotments in the existing canal estate. Parts of this site are now permanently inundated with water. Also at the time of the original construction, spoil dredged from the entrance channel was placed on Lot 18, which now has a profile up to 1m higher than in its natural state.

Soil samples taken from the proposed eastern canal site indicate that poorly sorted sands predominate, with occasional thin layers of medium to fine sand containing small amounts of organic material.

The site has shallow surficial groundwater with direct hydraulic connection to the existing canals and Peel Inlet. There is a gradual flow of groundwater through the site to the west-southwest.

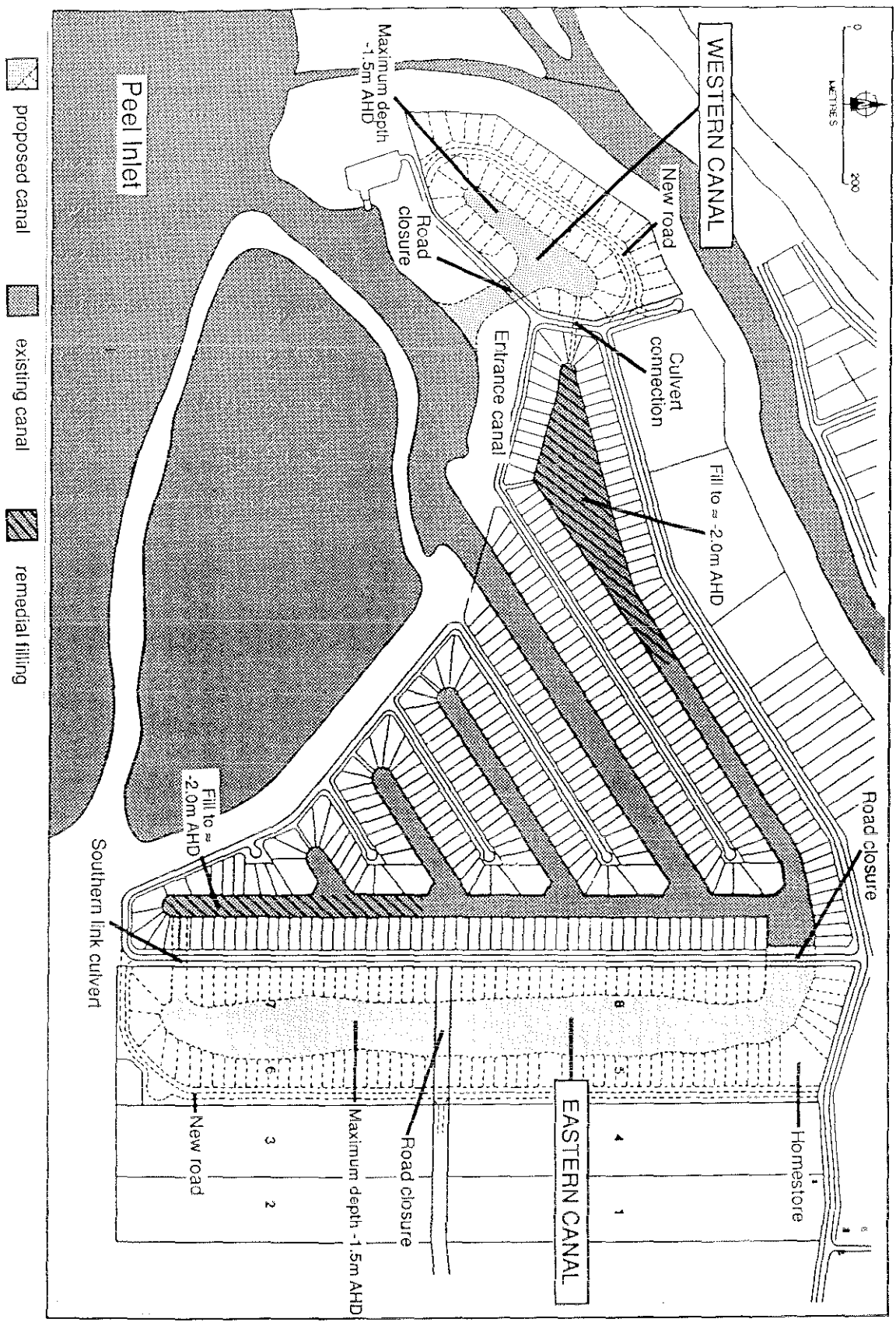

Figure 1. Existing Yunderup Canal Estate showing location of proposed development sites.

The vegetation of Lots 5, 6, 7 and 8 Kiap Road was mostly cleared during construction of the original canals in 1971-72. The site now contains only remnant *Melaleuca* thickets and sedges and marsh vegetation. Lot 18 was also substantially damaged at some stage in the past and now mostly supports introduced grasses. However, the vegetation within the adjacent Murray River foreshore reserve is of good condition and worthy of protection (Bowman Bishaw Gorham, 1990).

3.2 Aquatic environment

The Yunderup Canal system is connected to the Peel Inlet-Harvey Estuary system. This system is a broad, shallow coastal lagoon approximately 133km^2 in size. The Peel Inlet itself is a shallow basin about 10km in diameter with a central basin about 2m deep.

The Peel Inlet-Harvey Estuary suffers from severe eutrophication problems. These problems result from a combination of factors including substantial nutrient input from agricultural practices in the catchment and the physical limitation of the system such as its shallow depth, its strong seasonal riverine inflow and its very limited exchange of water with the ocean. As such, the water supply to the Yunderup Canals is of poor quality, and this, together with management problems associated with the canals has led to water quality problems within the canals. Phytoplankton concentrations within the canals are of similar magnitude to those in Peel Inlet, however, the canals have not suffered from the same degree of problems experienced with macroalgal blooms in the Peel Inlet. The latter sort of bloom is of higher nuisance value to residents. The Yunderup Canals have experienced fish kills due to deoxygenation of the water, and the sediments at the bottom of the canals are high in nutrients.

Many of the canals' water quality problems have stemmed from poor design which hinders water circulation within the canals. This has resulted in the regular occurrence of vertical salinity stratification of the water column, where relatively freshwater having a lower density overlies a distinct bottom layer of more saline water with high density. The bottom water becomes low in oxygen because it is not mixing, and because light does not penetrate deep enough to allow production of oxygen via photosynthesis. The deoxygenation of bottom waters is accelerated by the bacterial decomposition of high amounts of organic matter in the eutrophic system (Bowman Bishaw Gorham, 1990).

The water quality of the canals has worsened over time. This deterioration in water quality can largely be attributed to the fact that until recently, remedial works have not been undertaken which would allow the removal of dense bottom water.

4. Review of public submissions

Comments were sought on the revised proposal from the public, community groups, conservation groups and local and State Government authorities. The revised Public Environmental Review prepared for the proposal was available for a five week public submissions which ended on 11 January 1991. The public submissions raised a number of issues, the principal topics of which relate to:

- support for the proposal as it is seen as the best opportunity available to improve the current canal system;
- concerns that the extension of the canal system will only compound existing water quality problems;
- flushing of the canals and comments on the flushing/water circulation studies undertaken;
- maintenance of the canals;
- protection of Wellya Lagoon;

- canal design;
- public access to the foreshores; and
- construction impacts.

A detailed list of issues raised in submissions and the proponent's response to these issues is incorporated in Appendix 2 of this assessment report.

5. Environmental impacts

5.1 General

The Authority has examined the revised proposal to extend Yunderup Canals within the context of previous assessments, and within the context of efforts being made to manage the water quality and associated problems of the entire Peel-Harvey Estuarine system. In its assessment of the Point Grey Project in 1988, the Authority expressed its concerns regarding both the impact of the development on the already stressed environment of the Peel-Harvey Estuary, and of the effect of this stressed environment on residents surrounding the estuary, both existing and new. This effect would mainly be a reduction in amenity as a result of problems such as odour and unsightliness associated with macroalgal blooms. High mosquito numbers in the area were also of concern to the Authority (EPA, 1988).

Due to the Authority's concerns regarding new developments immediately adjacent to the Peel Inlet and Harvey Estuary, particularly in the area south of the Inlet channel, and because of the of the unsuitability of the poor quality Peel Inlet water to act as a source water for a canal system, the Authority would not recommend the construction of a totally new canal system in this area if it were to be proposed at this time. However, given that the Yunderup Canals have been in existence since 1971, and given that theoretical modelling studies had shown that this proposal could provide a mechanism for correcting some of the canals' existing water quality problems, the Authority was prepared to consider the proposal to extend the canals.

The proponent employed consultants to undertake field studies to demonstrate that remedial work could be done on the existing canals which would result in better water circulation, and as a consequence, better water quality in the longer term. It also had to be shown that any improvement in water circulation could be sustained if the canals were to be extended as proposed by the proponent.

Following consideration of the results of the field studies, the revised Public Environmental Review, submissions from the public and government agencies and the proponent's response to them, the Environmental Protection Authority has determined that the proponent has addressed the relevant issues associated with the proposed canal development satisfactorily and that the consequent impacts can be managed. This environmental management can be achieved by a combination of the proponent's commitments and the Authority's recommendations.

Recommendation 1

The Environmental Protection Authority has concluded that the proposed extension to Yunderup Canal Estate, as modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and the government agencies that were consulted, should lead to an improvement of water quality in the existing canals, which should also be reflected in the proposed canals, and therefore, is environmentally acceptable.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as:

- **water quality; and**
- **physical maintenance of the canal system and its entrance channel.**

Remedial works are to be undertaken by the proponent on the existing canal system to address the above factors, to the satisfaction of the Environmental Protection Authority. These works are specified in the proponent's commitments and include:

- **installation of culvert connections at appropriate sites;**
- **altering canal depths in existing canals so that they are no greater than -2.0m AHD; and**
- **maintenance of the entrance channel to the appropriate depth required for flushing.**

The Environmental Protection Authority considers that these environmental factors are addressed adequately by either environmental management commitments given by the proponent or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the project could proceed subject to the Environmental Protection Authority's recommendations in this report and the proponent's commitments to environmental management (Appendix 1).

The Authority's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have a positive effect on the environmental performance of the project. The Authority believes that such non-substantial changes, and especially those which improve environmental performance and protection should be provided for.

The Authority believes that any approval for the proposal based on this assessment should be limited to five years. Accordingly, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

5.2 Terrestrial impacts

As the proposed development will be fully connected to all utility services, the terrestrial impacts of this proposal are limited to the clearing of the lots to be developed. The lots have been subject to great disturbance during the construction of the original canals and, due to the lack of managed rehabilitation, have not recovered well from the original disturbance and are covered mainly by introduced species or isolated clumps of native vegetation.

Vegetation which should be protected does occur along the south bank of the Murray River abutting Lot 18 Warma Way. This vegetation is within a foreshore reserve, and the proponent has provided commitments to protect the foreshore reserve during development and to construct a pathway which will provide a physical demarcation between private and public land. The Authority believes that these measures will achieve the required protection of this vegetation.

5.3 Aquatic impacts

The aquatic impacts of this proposal can be separated into two main parts: impact of the proposed extension and remedial works on the water quality of the existing canals; and disposal of spoil from dredging undertaken during construction or as part of future maintenance operations.

The Peel Inlet Management Programme Review prepared by the Peel Inlet Management Authority refers to the need to resolve water quality problems of the canals and the maintenance dredging of the Canals. It makes specific references to dredging and spoil disposal options, and to the preparation and implementation of a management plan to ameliorate water quality problems in the canals. The Peel Inlet Management Authority also provided more specific comment and advice at the public submission stage (refer Appendix 2).

5.3.1 Water quality/circulation

The field and modelling studies undertaken on the Yunderup Canals indicate that the dredging of the entrance channel (which has already been done), together with other remedial works which include the filling of deep holes in the existing canals so that there is a unified depth profile which is shallower than that of the entrance channel, and the connection of ends of canals by pipe culverts to remove "dead ends", will significantly improve water circulation problems within the canals. The proponent has given specific commitments to undertake the required remedial works. An improvement in water circulation has already been observed since the the entrance channel was dredged to remove the mound which was preventing heavy saline waters from flowing out of the canals. This improvement in water circulation should eventually lead to an improvement in long term water quality as it reduces the residence time of water in the canals.

The flushing studies have also shown, through interpretation of the data collected, that the addition of Lots 5, 6, 7 and 8 Kiap Road to the canals will not have an adverse impact on the improved circulation of water within the system. The addition of Lot 18 Warma Way will also not have an adverse impact on the existing system because it opens onto the entrance channel in the Peel Inlet and is not directly connected or dependent on the rest of the canals for water circulation. In fact, Lot 18 will help to improve the flow of water through existing northern canal arm (F) by pipe or culvert connection.

5.3.2 Dredging and spoil disposal

Studies undertaken on the Yunderup Canals show that it is essential that the entrance channel has a unified depth profile with the Peel Inlet. In this way, the driving mechanism for water exchange, that is, a density gradient between the canals and the Inlet, will allow for gravitation exchange of water. In the past, the entrance channel has been allowed to silt up significantly hindering this exchange mechanism, and therefore contributing to the water quality problems of the canals.

In recognition of the need to maintain the Yunderup Canals water exchange mechanism, it is anticipated that the entrance channel will require further dredging at some stage in the future. The Authority received many submissions on the extension proposal discussing the specific issues of disposal of dredge spoil which would result from this type of maintenance. The submissions mainly expressed concerns over the option of pumping the spoil into Wellya Lagoon as outlined by the proponent in the Public Environmental Review, and as discussed by the Peel Inlet Management Authority in its management plan. The Authority is of the view that dredge spoil should not be pumped into Wellya Lagoon nor into the Peel Inlet, and that other options should be considered at the appropriate time. This should be recognised in any agreement reached in accordance with Recommendation 3. All other dredging which will take place during construction will be used for fill to create the new lots.

5.4 Drainage

The Department of Planning and Urban Development's draft policy No. DC 1.7 "Procedures for Approval of Artificial Waterways and Canal Estates", states that "no industrial or residential waste or effluent of any nature should be be discharged directly or indirectly into canal

waterways.". The Authority supports this position, and therefore does not believe that it is acceptable to direct stormwater runoff directly to the canals via silt traps as has been proposed in the Public Environmental Review. However, the Authority is of the opinion that this matter can be adequately addressed through the proponent's commitments, particularly commitment numbers 2 and 6 (Appendix 1), and through detailed consideration of the subdivision design by the Department of Planning and Urban Development and the Shire of Murray, on advice from the Environmental Protection Authority.

5.5 Monitoring and management

The Authority feels that it is essential that a water quality monitoring and management programme be developed to prevent the problems experienced in the past from recurring. It is anticipated that monitoring results will aid in determining specific management requirements. Management responsibilities will also have to be clearly defined. The proponent is expected to conform to the design and management requirements set down by the Department of Planning and Urban Development's draft policy document, "Procedures for Approval of Artificial Waterways and Canal Estates", and has given a commitment to do so.

Recommendation 2

The Environmental Protection Authority recommends that the proponent prepare a water quality monitoring programme for the canals to the satisfaction of the Environmental Protection Authority, on the advice of the Peel Inlet Management Authority and the Shire of Murray, prior to completion of construction. This water quality monitoring programme is to include, but not necessarily be limited to sampling of:

- **water column nutrients, that is total phosphorus, total nitrogen, phosphate, oxidised nitrogen and ammonia;**
- **water column chlorophyll 'a';**
- **sediment total nitrogen and total phosphorus levels; and**
- **physical parameters, such as; salinity, temperature, dissolved oxygen, pH, and light penetration.**

Recommendation 3

The Environmental Protection Authority recommends that an agreement be entered into between the proponent, the Shire of Murray, the Peel Inlet Management Authority, and the Department of Marine and Harbours, which clearly delineates responsibility for the physical maintenance and water quality monitoring and management of the canal system, both new and existing, and and of its entrance channel. This agreement is to be to the satisfaction of the Minister for the Environment on the advice of the Environmental Protection Authority and should be finalised prior to commencement of construction.

6. Conclusion

The Environmental Protection Authority considers that all environmental impacts associated with the proposal to extend Yunderup Canals Estate, as identified in this assessment report, are manageable subject to the recommendations made in this assessment report and the commitments provided by the proponent.

7. References

Bowman Bishaw Gorham (1990) Revised Public Environmental Review, Extension to Yunderup Canal Estate.

Environmental Protection Authority (1988) Report and Recommendations Point Grey Project, Bulletin 306.

Department of Planning and Urban Development (draft) Policy No. DC 1.7, Procedures for Approval of Artificial Waterways and Canal Estates.

Waterways Commission (1990) Draft Peel Inlet Management Programme Review Area Recommendations (prepared for Peel Inlet Management Authority).

Appendix 1

Proponent's commitments

9.0 SUMMARY OF COMMITMENTS

Project design and environmental management commitments given by Peel Waterways Pty Ltd include the following.

Canal Design

1. The proposed canal estate will incorporate, to the satisfaction of the EPA in consultation with the Shire of Murray and PIMA, all of the Centre for Water Research (CWR) recommendations to ensure the maintenance of adequate water quality. Specifically, the CWR recommendations are as follows:

   1.1 The proposed eastern canal to have a depth no greater than -1.9mAHD. (The proposed depth is -1.5mAHD).

   1.2 Connections to be installed between the proposed eastern canal and the existing eastern canal (Canal E) at both the northern and southern ends.

   1.3 The connection where Kiap Road crosses the southern link to the proposed eastern canal to include full depth box culverts.

   1.4 The proposed western canal to have a depth no greater than -2.0mAHD. (The proposed depth is -1.5mAHD).

   1.5 A bottom pipe or culvert connection to be installed between the western end of the existing northern canal (Canal F) and the proposed western canal.

   1.6 The deepest parts of the existing canals, near the closed ends of Canal F and Canal E, to be filled to a depth consistent with the remainder of each canal (-2.0mAHD).

   1.7 The depth of the entrance sill to be maintained. (Note: This will be accomplished through an agreement that is currently being negotiated between the Shire of Murray and the Minister for Transport, described in Appendix C to this PER).

1.8 The culvert connection between Wellya Lagoon and the entrance channel to the canal estate to be closed and relocated to the western side of the lagoon.

2. The design of the proposed canals will accord with the recommended specifications described in the DPUD Policy Document DC 1.7 "Procedures for Approval of Artificial Waterways & Canal Estates", in consultation with PIMA and to the satisfaction of the EPA.

3. Shire access to the north-eastern corner of the canals will be provided to the Shire's requirements to allow removal of occasional quantities of weed and other debris that will accumulate at this location.

Subdivision Design

4. Design building levels for the proposed allotments will be above the 1:100 year flood level, as required by the Shire of Murray.

5. The development will be deep sewered.

6. Stormwater drainage will include a suitable arrangement of silt traps to ensure that any water discharged to the canals is of adequate quality, in consultation with PIMA and to the satisfaction of the EPA.

7. Public access to all areas of foreshore reserve adjacent to the estate will be preserved, save at the entrance channel to the western canal. Alternate vehicle and pedestrian access to the boat ramp and foreshore reserve near the western canal will be provided around the northern side of the canal, to the satisfaction of the Shire of Murray.

8. Landscaping of the development to be undertaken by Peel Waterways prior to the sale of the blocks will include appropriate use and placement of topsoil and the widespread establishment of salt tolerant tree species adjacent to roads and the canals, to the satisfaction of the Shire of Murray.

9. The minimisation of nutrient application within future residential gardens and the preferential use of slow release fertilisers and native plant species will be encouraged as follows:

9.1 An information brochure describing the use of slow release fertiliser and suitable native plants for residential gardens will be issued at the time of sale to all purchasers of lots.

9.2 With the purchase of each residential lot the proponent will supply, free of charge, sufficient slow release fertiliser to establish a native garden. This will be achieved by the issue of a voucher which will be negotiable at nominated local hardwater suppliers for specific slow release fertilisers only.

Project Construction

10. The proponent will ensure to the Shire of Murray's satisfaction that construction contractors do not encroach upon the adjacent foreshore reserves.

11. During construction of the project, the proponent will assist the Shire of Murray where practicable to ensure the ongoing protection of the foreshore reserve. To assist this objective and to encourage continued public use, the proponent will construct a concrete footpath along the Murray River foreshore reserve adjacent to the western site (Lot 18).

12. The proposed canals will be excavated in a land-locked basin. Bunds and settling basins will be used to prevent the flow of turbid water into the existing canals, in consultation with PIMA and to the satisfaction of the EPA. The final opening of the connecting links will be controlled to prevent scour during the initial inflow of water.

13. The proposed canals will be constructed, and the remedial works proposed for the existing canals undertaken, to the satisfaction of the Shire of Murray and EPA upon advice from PIMA and the Department of Marine and Harbours.

14. Construction activities will be restricted to normal daylight hours. If found to be necessary, appropriate techniques will be employed to suppress any noise or dust nuisance to nearby residents, to the satisfaction of the Shire of Murray.

Ongoing Management

15. Upon completion of development of the canal estate, the canal waterways will be ceded to the Crown for vesting with the Shire of Murray. The Shire will accept responsibility to ongoing maintenance of the canal waterways, which will be undertaken in consultation with PIMA and which will be done to the satisfaction of the EPA. The Shire will impose a differential rating scheme upon Yunderup Canal Estate to provide specific funding for this purpose.

16. Following construction of the canals and the proposed remedial works, the proponent will implement an environmental monitoring program as described in Section 7.3.2 of the PER, designed in consultation with PIMA, to the satisfaction of the EPA.

Appendix 2

Summary of submissions and responses

PROPONENT'S RESPONSES TO ISSUES RAISED IN PUBLIC SUBMISSIONS RECEIVED BY THE ENVIRONMENTAL PROTECTION AUTHORITY

Peel Waterways Pty Ltd are pleased to provide herein our responses to issues that have been raised in public submissions received by the EPA upon our amended proposal.

General Issues

1. Submission: There were a number of submissions received from residents of the Yunderup Canals in support of the proposal stating that it would result in an improvement in water quality conditions of the canals and would result in the "clean-up" of Lots 5, 6, 7 and 8 Kiap Road. Conversely, there was also a petition received containing numerous signatures of residents from and surrounding the Yunderup Canals opposed to the proposed extension to the canal system, stipulating that a loss of property value and the loss of Lot 18 and thereby the last remaining natural bushland on the south bank of the Murray River would result.

Response: We acknowledge the supportive submissions that have been received. Peel Waterways addressed a meeting of the South Yunderup Ratepayers and Residents Association on Sunday, 2 December, 1990 to explain the proposal and to address issues of local concern. Our proposal generated significant interest, with a total of 80 ratepayers and residents in attendance. At a show of hands following the discussion of the meeting, 79 of the 80 attendees expressed their support for the project, and it was agreed that the Association should write to the EPA to advise of the keen support by local residents for the proposal. A copy of the letter confirming this support is appended.

We are also aware of individual submissions to the EPA that similarly expressed strong support for the project, and append a copy of one such submission.

We have been very pleased to receive such overwhelming support, especially from the local residents.

We note the petition opposing the proposal. The issue regarding Lot 18 is discussed below in response to Submission 4.

2. Submission: Given that: (i) houses on the Yunderup canals have a reputation of being hard to get rid of once bought, (ii) that the extra canals will be a means of introducing a great deal of water from Peel Inlet, already polluted, into new areas of South Yunderup, and (iii) that it will also introduce 160 more urban homes into close proximity to mosquito breeding sites and wetlands which although they may be termed "degraded" certainly play a more important role in the Yunderup environment in general than the proposed canal estates will, the proponents have not shown any real need for the proposal.

Response: We refute each of these statements, as follows:

(i) Recent sales of residential lots in the existing Yunderup Canal Estate support our confidence in the anticipated high demand for affordable waterfront housing in the area. Of a total of 19 lots that were offered for sale by us during 1990, 18 were sold. There are currently 16 houses being offered for sale within the estate, two of which are under offer. There are presently 13 houses under construction, a strong indicator of public confidence particularly in these difficult economic times. As discussed in Section 3 of the PER, we consider the supply of affordable land offering a water-oriented lifestyle adjacent to Peel Inlet to be substantially less than the potential demand, and are confident of the proposal's commercial viability.

(ii) As described in Appendix B and summarised in Section 5.2.2 of the PER, the proposal should result in a substantial improvement to the water quality of the canals. This improvement will extend to the proposed canal extensions as well as the existing canals. Considerable improvement in canal flushing has already been achieved as a result of dredging the entrance channel to the canals, funded by Peel Waterways. Detailed assessment by the Centre for Water Research (CWR) has concluded that additional remedial works that are proposed will further improve the canal flushing dynamics, and attach recent correspondence from CWR confirming their conclusions..

(iii) Lots 5, 6, 7 and 8 Kiap road were excavated during 1971-72 to provide additional fill material during development of the existing Yunderup Canal Estate. They are seasonally or permanently inundated with water to depths of up to 1m, and provide a breeding area for nuisance plagues of mosquitoes. The existing vegetation is substantially degraded and offers little or no conservation value.

Section 3 of the PER outlines the need for the proposed extension to Yunderup Canal Estate, and the considerable benefits that will be derived.

3. Submission: The Yunderup Canals exist in a backwater of the Inlet and flushing has been a continuous problem. To consider extending the problem by further additions, or more than one entrance, is to succumb to the soaring fancies of developers who get up and go elsewhere once the disaster is in place.

Response: As discussed in response to Submission 2 above, implementation of the proposal will substantially improve the flushing dynamics of the canals. The CWR assessment concluded that the improvement will extend to the canal extension. Therefore, the proposal will ameliorate rather than exacerbate previous problems associated with extended water residence times (refer to attached correspondence from CWR).

Ongoing responsibilities for environmental management are clearly defined in Section 7 of the PER.

4. Submission: The extension of the canals onto Lot 18 will destroy finally last remaining natural bushland on the south bank of the Murray River in South Yunderup. All stretches of wetland and bushland in this areas will have disappeared affecting egret and duck roosting and nesting and turtle laying areas.

Response: Lot 18 was fully cleared and received up to 1m depth of fill material during excavation of the entrance channel to the canals in 1971-72. Regrowth is predominantly introduced grasses, and has no conservation value (Refer to Section 5.1.4 and to Plate 1 in the PER). Lot 18 is currently zoned for tourism development.

The vegetation within the 40m wide river foreshore reserve that is adjacent to Lot 18 is mostly in good condition, and we assume that this is the area to which the submission refers. The conservation status of this reserve is recognised in the PER, and to this end we propose the following measures:

- Earthworks on Lot 18 will be managed to avoid any incursion of machinery into the foreshore reserve. Temporary fencing will be constructed to clearly mark this boundary.

- Management of the foreshore reserve will remain the responsibility of the Shire of Murray. However we propose to construct a concrete footpath along the boundary of Lot 18 in order to encourage continued and controlled public enjoyment of the reserve and to assist in preventing the encroachment of exotic plants from the future adjacent residences.

- During construction, we will assist the Shire where otherwise practicable to ensure the ongoing protection of the foreshore in its present condition.

Flushing Study

5. Submission: The dye used by the Centre for Water Research lingered in the water for 3 days on one occasion after the dredging. We are not technical persons, and for all we know 3 days could equate with 2.3 days on a chart.

Response: The flushing (or e-folding) time estimate of 2.3 days is an average for the canals. It is defined as the time required for the average dye concentration to fall to a value of 37% (e^{-1}) of the initial concentration. The visibility of the dye may last well beyond the flushing time and depends on the initial concentration. It is therefore not surprising that people could see the dye after 3 days and this has no bearing on the flushing estimate. As shown in the CWR report, the average flushing time of 2.3 days varied between 2.2 and 2.5 days around the canals in the post-dredged situation. This is a substantial improvement on the pre-dredged situation where the average flushing was 5.4 days, varying between 4.5 and 6.5 days around the canals.

6. Submission: The recommendations regarding improved flushing being achieved and maintained over time seem to hinge on precise measurements in relation to water depth. How is the water depth to be maintained? People have been known to illegally dump fill. What on-going methods would be employed to maintain the precise depth measurements of the canals and the sill? To the technically uninformed, like ourselves, yet having been canal watchers for a very long time, we find it quite ludicrous, impossible to believe, that pipes or culverts under roads will create circulation of water sufficient to justify further extensions to this canal system.

Response: Prior to the recent dredging of the sill in the entrance channel (funded by Peel Waterways), the canals were an average 1m deeper than the entrance channel. Basins at the extremities of canals F and E were almost 1.5m deeper than the entrance channel. This resulted in the entrapment and prolonged residence of dense saline bottom water within the canals, which was the primary cause of poor water quality.

The entrance channel dredging to -2.2m AHD has substantially overcome this design problem. The studies conducted by CWR that are described in the PER (Appendix B) demonstrated a dramatic improvement in the flushing dynamics due to this dredging program. Additional remedial works to the existing canals that are proposed will further improve the flushing dynamics.

It is acknowledged that the canals and entrance channel depth will need to be maintained to ensure adequate flushing of the canal waterway. We attach correspondence from CWR that reconfirms the conclusions to their study, provided the entrance channel is maintained within 0.5m of the present depth.

Ongoing management commitments defined in the PER include the maintenance of the entrance channel depth to ensure adequate flushing (commitment 1.7, Section 9). This will be achieved through an agreement that is currently being negotiated between the Shire of Murray and the Minister for Transport, described in Appendix C to the PER. It is proposed in the PER (Section 7.3.2) that depths will be monitored by the Shire to determine the need for dredging. When required, the Shire will submit plans for dredging to PIMA for approval.

There is minimal concern regarding siltation or erosion causing reduced depth in the canals themselves. The depth of the existing canal waterways have remained stable since they were constructed twenty years ago, with the minor exception of localised erosion from vacant lots causing a small amount of infill along a few sections of the canal embankments. The proposed canal extensions have been designed to overcome this problem, to the satisfaction of the Department of Marine and Harbours.

With regards to the query regarding the efficiency of circulation via pipes or culverts under roads, CWR have advised us that they have addressed this issue using known engineering principles, and are confident in their assessment (refer attached correspondence from CWR).

7. Submission: The PER does not agree with Canal Guidelines for water quality criteria.

Response: The proposal accords fully with the guidelines for the design of canal estates.

The guidelines for canal water quality require, among other things, that the source water quality should be adequate to support the following beneficial uses:

- occasional human immersion and wading
- boating
- adjacent development
- passive recreation.

The applicable water quality criteria (EPA Bulletin 103, 1983) have recently been revised (Talbot et al., 1990 draft). Although the revised criteria have only draft status, they reflect up-to-date knowledge of water quality criteria necessary to protect nominated beneficial uses.

The water quality in Peel Inlet, together with the anticipated water quality in the extended Yunderup Canals following implementation of the proposal, are fully compliant with the draft water quality criteria for secondary contact (Schedule 1 (2)). Algal blooms in Peel Inlet can occasionally reduce the source water quality to a level that is unsatisfactory for primary contact recreation (i.e swimming) but they do not effect secondary contact recreation (eg. wading, boating, fishing) in which some direct contact may occur but the probability of bodily immersion or the intake of significant amounts of water is minimal.

The guidelines for canal water quality also require that a canal estate should not have an unacceptable impact on the passage of fish in the natural water body. Occasional fish kills have been recorded in the existing Yunderup Canal Estate, although these have been localised and have never extended throughout the canal system. As discussed in the PER (Section 5.2.2), the proposal will greatly improve water quality in the canals, so will have a beneficial impact on fish passage.

It is concluded that the proposal complies fully with the Canal Guidelines on water quality.

Maintenance

8. Submission: The cost of maintenance will be exorbitant, and who will pay? If these canals cannot be made to function at their present size then the Government should cut the losses now and fill them in.

Response: The proposal incorporates appropriate planning and design to ensure minimal requirements for ongoing maintenance. The proposed environmental management program, including identification of responsibilities, is described in Section 7 of the PER.

Wellya Lagoon

9. Submission: The value of the bund wall and the lake in it to the rest of the canals cannot be stressed too much. The wall keeps tons of weed away from our doorsteps and the smell that goes with it. The migrating Black Wing Stilts, Snipe and Dotterals feed within the bunded area. The bunded area should be left as it is. If the culvert has to be moved every care should be taken that it is put at the correct depth and sited in a place where it will remain free of weed. Water depth within the bunded area should be maintained.

Submission: The developer should be wary about using pipes for culverts. In the past the original pipe culvert here on the bund completely blocked up with coral after a short time. The pipe was shortened to about a metre - long enough to hinge a flap valve and can be easily cleaned. Box type are the only answer in salt water conditions. Sometimes, the existing flap through lack of maintenance and its poor installation in the first instance by the Murray Shire stays open and the water escapes leaving mud flats and dead fish in the lagoon.

Submission: We want the water quality of Wellya lagoon maintained and even improved. At present, deep water from the entrance channel mixes with lagoon water. We cannot see how relocating the culvert to the western side of the lagoon (to the Peel Inlet itself) will allow the same interchange of water. To the layman, the water levels seem wrong. That shallow water on the inlet shoreline will not provide any flushing of Wellya Lagoon entering the canals should not be solved by sacrificing the lagoon which is the main water view of present canal residents. Moreover, opening Canal E by culvert at the southern end of Kiap Road into Wellya Lagoon should be matched by efficient water interchange as at present at the northern end of the lagoon.

Response: The intrinsic value of Wellya Lagoon, including the requirements to maintain the minimum water depth and adequate flushing, is fully acknowledged. The CWR study (PER Appendix B) identified concern that dense saline outflows from Wellya Lagoon to the canals' intake channel reduces the canals' flushing dynamics, and the study recommended that the culvert be relocated to the western bund. We agree that there is a need for care in the relocation of the culvert, and will ensure that detailed engineering design studies for the project review this aspect. Specific design criteria that are proposed for the relocated culvert will include the following:

- The base of the relocated culvert to be level with the base of the existing culvert, in order to maintain existing minimum water levels.
- Flushing efficiency to be maintained or improved.
- Maintenance requirements should be minimal, with provision for easy access if maintenance is required.

The culvert specifications will be defined during detailed engineering studies for the project, which will be submitted to PIMA for approval prior to construction. A box culvert will be used.

A connection between Wellya Lagoon and the canals is not proposed.

10. Submission: Most of the residents of the southern section of the canals would have view of Wellya lagoon and would object to dredged spoil (see page 37) being pumped into Wellya lagoon. We also cannot agree with pumping spoil to the south of the bund wall if this means infilling the shoreline of the inlet. The present shoreline has a natural curved shape. There must be plenty of inland sites in low lying areas which need buildup as per your second option on Page 37.

Submission: No silt or dredged material to be dumped or pumped inside the bund of Wellya Lagoon. It is like a bird sanctuary. There are up to 1000 birds using the area, as a feeding ground, and sleep there at night in the sheltered bund. It is merely a cheap convenient way for the developer to dump the silt closely. The excavation silt could be better used as filling along the South Yunderup Road.

Response: We agree. We will dispose of no silt or other fill into Wellya Lagoon. The disposal of dredged material from the entrance channel is a matter to be determined in consultation between the EPA, the Shire of Murray, the Department of Marine and Harbours and PIMA when dredging of the entrance channel again becomes necessary.

11. Submission: In Figure 2, please advise the significance of the dotted lines around the entrance channel and inside Wellya Lagoon.

Response: They designate the boundaries of lots that are vested in the Crown.

Canal Design

12. Submission: Page 16 Section 4.2 2nd last paragraph, ref. culvert connection with existing Canal E. Design proposes a box-type culvert to the same depth as the new canal, but with insufficient above-water clearance to permit boat traffic. I suggest that this culvert should be re-designed so as to allow the passage of at least small power-dinghies: propeller action and traffic will ensure water agitation and movement, and this will be an essential ingredient of the success of the design in improving water exchange, particularly at this remote end of the longest canals.

Response: This culvert will be approximately 20m wide and to a depth of -1.5m AHD, in order to assure flushing performance. The specifications will be defined during detailed engineering studies for the project, and we will review the opportunity to provide for the safe passage of small craft. We agree on the desirability of providing for small craft passage.

Water movement due to boating activity is not necessary to assure efficient flushing, and would have only a very marginal effect.

13. Submission: The proposed culverts have not been explained too well and do not fit in generally with the "Canal Guidelines" set out by Government.

Response: Works approval will be required from PIMA prior to construction of the canals. The culvert specifications will be defined during detailed engineering studies for the project, and will be submitted to PIMA with the required application for works approval.

The design of the proposed canal estate accords fully with the recommended design specifications for canal developments described in the Canal Guidelines.

14. Submission: Page 17 2nd paragraph. "minimum building set-back of 6m from the canal frontage". The existing canals require a 9m set-back from canal frontage and this should be retained in the new canals to maintain uniformly.

Response: We acknowledge that the PER is in error. The minimum building set-back will be 9m, to retain uniformity with the existing canals and to comply with the Canal Guidelines.

15. Submission: Minimum building levels at 2m AHD seems to be far too low for this area. WAWA recommended levels for Port Mandurah were for 2m AHD without any allowance for Greenhouse or Dawesville cut. A figure of 2.3m minimum floor level should be imposed here.

Response: Maximum water levels are determined by 1:100 year flood levels for Peel Inlet at Yunderup (which is a minimum of +1.6m AHD) with a provision for sea level rise of +0.3m by 2040 AD. Floor levels are proposed to be +2.0m AHD which is 0.1m higher than the required height. The Department of Marine and Harbours consider this to be adequate, and it is consistent with EPA advice on other proposals.

Public Access

16. Submission: Page 34 Para 4 "Public access will be interrupted by the proposed entrance to the western canal". Public pedestrian access could be provided at this point by the construction of an arched wooden footbridge similar to the existing one over the entrance to the Murray Lakes canals.

Response: The cost of providing an arched footbridge would be prohibitive, and is not justified. Alternative access that will be provided around the northern side of the western canal will add only 100m to the accessible distance between the existing canal estate and the public boat ramp. Very few people walk to the boat ramp, and a foot bridge at this location would be very seldomly used.

17. Submission: With reference to footbridges, the plans in the PER do not show a pedestrian/cycle access-way connecting the northern end of Kiap Road to Allambi Way. It is understood such a "bridge" was previously proposed. Certainly such a structure would be more than highly desirable at this location - in fact it should be considered essential to provide access to the Homestore.

Response: The span over this connection will be 66m. The cost of providing a footbridge would be prohibitive and cannot be justified by the low level of public use that would occur. None of our previous plans have proposed such a bridge. There is alternative access to the local store via the new entrance road, and the accessible distance along this route will be equal or shorter for all but a few houses towards the northern end of Kiap Road.

Construction Impacts

18. Submission: The anticipated heavy cartage traffic along both Allambi Way and Kiap Road could result in vibration damage to existing homes on these roads. Should any blasting be required, this too could cause structural damage to nearby homes. The developer should arrange prior inspection of homes in Allambi Way and Kiap Way to establish existing condition, so that any claims can be verified.

Response: The project has been designed to have a balance of cut and fill. The fill will be placed directly within the subdivision during excavation of the adjacent canal. Trucking of minor quantities of material to fill Lots 5, 6, 7 and 8 using material excavated from Lot 18, as specified in the PER, is no longer anticipated. Only small quantities of topsoil will be imported to the site.

Truck traffic along the local roads to transport topsoil will be only occasional, of low tonnage, and will be required to travel at only low speeds. The risk of vibration damage to existing homes in the Yunderup Canal Estate is considered to be negligible. However we will be pleased to arrange prior inspection of homes as requested, and will invite any interested residents to request an inspection prior to initiation of construction earthworks.

Blasting will not be required.

Other Approvals

19. Submission: There is no mention in the PER of the requirement to gain approvals to clear the land from the Department of Agriculture.

Response: Lot 18 and Lots 5, 6, 7 and 8 were fully cleared in 1971-72, and support only minor regrowth vegetation. We will notify the Commissioner for Soil Conservation of the proposed clearing. If approval for re-clearing is required, we will certainly accomodate such.

Canal Design and Stability

20. Submission: Clarification of the cross section shown at Figure 4 is required. The RL for channel seabed appears to be incorrect and should be -1.5m AHD.

Response: The error in Figure 4 is acknowledged. The RL for the canal bed should read -1.5m AHD, as stated in Section 4.2 and reitterated in Commitments 1.1 and 1.4 of Section 9 in the PER.

21. Submission: The 1:4 side batters for the channel will be adequate only if sand or silty sand is encountered at that level. It will be necessary for the surface 0.5 metre thickness to be replaced with sand if finer grades are encountered.

Submission: The retaining wall is located at about high watermark and should be clear of the waterway most of the time (the new structure must be submitted to and approved by the Department of Marine and Harbours). The wall will be detailed to prevent material from washing into the canals. A building set back of 6m is proposed giving a minimum height of backfill to the retaining wall of 0.5m. Final design details of the foreshore are to be made in consultation with PIMA and DMH, but at this stage a condition should be set requiring the foreshore landscape treatment and appearance to be in context with the existing canal estate.

Response: These comments are acknowledged. The detailed foreshore design specifications will be determined in consultation with PIMA and the Department of Marine and Harbours and to the satisfaction of the Shire of Murray.

As noted in our response to Submission 14, the minimum building set-back will be 9m, not 6m. We accept the recommendation that the foreshore landscape treatment and appearance should be in context with the existing canal estate. With the exception that the corrugated "Super-six" fencing along the edge of the existing canals will not be used, our proposal accords with this recommendation.

Water Quality

22. Submission: Algae growth rates for Peel Inlet are typically in the range of 3 to 5 days. Flushing times for the extended canal estate should therefore be less than 3 days. This represents an allowable increase in flushing time of less than 30%. While this may be considered to be achievable, confirmation on site by field tests should be required as well as a contingency plan for any remedial works.

Response: Further advice from CWR (attached) has confirmed their confidence in their conclusions that:

(i) dredging of the entrance sill to the canals resulted in dramatic improvement in flushing of the canals.

(ii) additional remedial works that are proposed in the PER will result in further improvement in the canals' flushing efficiency.

(iii) the improvement in the flushing efficiency will equally apply to the proposed canal extensions.

(iv) the improvement will be maintained over time.

(v) the dominant flushing mechanism (gravitational exchange along density gradients) is likely to exist at all times, so the improved flushing is not dependent upon specific conditions (e.g. strong winds, tides).

On the basis of their research, CWR expresses high confidence that flushing times of less than 3 days will be achieved following implementation of the proposal. This confidence is based upon field studies of the results of dredging of the entrance sill, not upon a predictive modelling assessment. Therefore, the CWR study has documented confirmed results, and the request for additional confirmatory field testing would involve unnecessary duplication. Because the results are confirmed, contingency planning is also unnecessary.

23. Submission: The proponent indicates that poor light penetration of the water column may be a reason for the canals resilience to algae blooms in the past (p. 27). Clarification is required as to whether increased light penetration can be expected and if this would represent an increased risk of algae blooms.

Response: The statement in the PER that is referred to is as follows:

"The reasons for this (the canals' apparent resilience to nuisance impacts from eutrophication) are not clear but are probably related to the depth of light penetration relative to the water column depth, which is less in the canals than in Peel Inlet".

It is agreed as likely that implementation of the proposal will result in improved water clarity in the canals: indeed, the CWR study observed improved water clarity following dredging of the entrance sill. However the depth of the canals (existing and proposed) will be deeper than most of the adjacent Peel Inlet, and it is doubtful that light penetration to the bed of the canals will be sufficient to support nuisance blooms of macroalgae. Blooms of planktonic algae are usually phosphorus limited rather than light limited so should be less than at present.

In any case, we consider it illogical to cast doubt upon remedial works to improve water quality in the canals because there might be occasional negative implications. The exact implications of improved water quality in Yunderup Canals are unclear, but the anticipated improvement is expected to produce overall benefit. The Government's recommended management strategy for Peel Inlet and Harvey Estuary is based on similar expectations and logic.

24. Submission: It is not clear that water quality has improved since dredging of the entrance channel sill. Neither is it clear that water quality will be improved or maintained following construction of new canals and associated works as presented in the PER. The ameliorative works may well, however, improve water quality in the existing canal system.

Response: Monitoring studies to compare the canal flushing regime before and after dredging of the entrance sill showed a clear improvement in flushing efficiency, consistent with expectations based on computer modelling studies conducted by CWR. CWR have concluded that this improvement in flushing would apply equally to the proposed canal extensions, that the additionally proposed remedial works will further improve the canals' flushing, and that the improvement will be maintained over time.

The pre- and post-dredging monitoring studies also showed significant improvement in canal water quality following dredging of the entrance sill. Total phosphorous concentrations (mean ± standard deviation) decreased from 186 ± 23 mg/L to 60 ± 26 mg/L, and total nitrogen concentrations decreased from 2651 ± 515 mg/L to 1533 ± 305 mg/L. These improvements are statistically significant at 95% confidence.

We accept that there is scientific uncertainty regarding anticipated water quality improvements and the associated biological responses that would result from the proposed development. However our environmental management consultants and the Waterways Commission have discussed this issue further and agree on the following:

1. Water quality in the canals would be reasonably expected to improve if the anticipated improvement in flushing efficiency was achieved and maintained.

2. Within the limited bounds of scientific confidence that can attach to them, the available pre- and post-dredging monitoring data do indicate that physico-chemical water quality has improved. Following dredging of the entrance sill, dissolved oxygen levels in the bottom water were higher and nutrient concentrations appear to have declined.

3. The translation of these improvements in physico-chemical water quality into predictions regarding the biological system's response is too uncertain to support definitive predictions.

Peel Waterways submit that, although the implications of improved water quality upon the biological health of Yunderup Canals is unclear, the anticipated improvement is reasonably expected to produce overall benefit. The Government's recommended management strategy for Peel Inlet and Harvey Estuary is based on similar expectations and logic.

Murray River Foreshore

25. Submission: The position of Lot 18 Warma Way, adjacent to the Murray River foreshore, requires that vegetation adjacent to this lot be protected from the effects of development. The proponent proposes to build a concrete path through the reserve on this boundary. This alone would not provide sufficient separation and delineation between private land and the foreshore. A high, solid fence would be necessary to prevent incursion into the reserve.

Response: Management of the foreshore reserve adjacent to the canal estate will remain the responsibility of the Shire of Murray. As stated in the PER, we will construct a concrete footpath along the Murray River foreshore reserve adjacent to Lot 18, which will encourage continued and controlled public enjoyment of the reserve and assist to prevent the encroachment of exotic plants from the adjacent residences.

During construction of the development, we have also offered to assist with the Shire where practicable to ensure the ongoing protection of the foreshore in its present condition. However the suggested requirements to construct a high, solid fence to prevent incursion into the reserve offers no real environmental benefit and involves considerable social, planning and cost detriment.

Stormwater Disposal

26. Submission: There should be no direct disposal of stormwater runoff to canal waters.

Response: Detailed engineering design for the development will aim to minimise direct discharge of stormwater into the canal system, in order to minimise movement of silt, nutrients and rubbish into the canals.

The detailed drainage design for the development will be defined in consultation with the Shire of Murray and PIMA. We are aware of PIMA policy in this regard. We attach correspondence from the Shire of Murray addressing this issue.

Maintenance Access

27. Submission: It would be prudent to include several additional accessways to the canals for maintenance and debris clearing purposes on each side down the length of the canal.

Response: Experience with the existing canals has shown that a single accessway in the north eastern corner of the canals is adequate for bulk removal of weed that is occasionally blown into the canals from Peel Inlet.

However, with regard to the fact that the proposed canal extensions will have soft edges rather than the walling of the existing canal estate, we accept that occasional temporary weed stranding may occur elsewhere along the canal foreshore.

We have discussed this aspect with the Shire of Murray, who offer experience based on their responsibility for weed removal from existing canal estates. As a result of these discussions, we have agreed to provide additional accessways for weed removal as follows:

- Lots 5, 6, 7 and 8
  - from Kiap Road to the western shore of the eastern canal, approximately mid-way along the canal;
  - from the proposed new eastern road to the eastern shore of the eastern canal, approximately two-thirds of the way down the canal;

- Lot 18
  - from the proposed new road to the northern section of the western canal.

The attached correspondence from the Shire of Murray confirms their agreement that these additional accessways will be adequate for removal of weed or debris from the canals. The accessways will be fitted with locked gates at the road and will be vested in the Shire of Murray.

Carparking

28. Submission: It is recommended that there be a small carpark (10-12 cars) at the terminus of Warmer Way at the foreshore, at the north-east of the western canal.

Response: We acknowledge the advantage of a carpark in this vicinity, but consider a more suitable location to be at the northern terminus of Warma Way, located in the road reserve. This area is presently used as an informal car parking area, and provides more convenient access to the Murray River and Peel Inlet foreshore reserves.

Unsuitable Fill

29. Submission: No provision has been made for disposal of excavated spoil that is unsuitable for fill on residential blocks.

Response: The project has been designed to have a balance of cut and fill. Preliminary soil testing and experience from the development of the existing canal estate has confirmed the suitability of the excavated material for residential fill. Any unsuitable material would be used to fill areas near the roads, outside the building envelopes.

This aspect will be addressed further within the detailed engineering design studies.

Bank Stabilistion

30. Submission: No details are given of the types of canal bank stabilisation or spoil stabilisation to be employed. The revised procedures for Approval of Artificial Waterways and Canal Estates should be adopted and details of all walling etc must be submitted to PIMA and DMH for approval.

Response: This is acknowledged. As stated in Section 4.2 of the PER, the foreshore design specifications will be determined in consultation with PIMA and DMH, and to the satisfaction of the Shire of Murray.

Ongoing Management

31. Submission: Development approval should not be given in the absence of satisfactory arrangements regarding the ongoing monitoring and maintenance of works and water quality.

Response: Arrangements for ongoing management are clearly defined in Sections 4.9, 7.2 and 7.3 of the PER.

Conclusion

We would like to reitterate our consultant's conclusions to the PER, to provide a concluding perspective for the Minister for Environment's consideration.

"The proposed extension to Yunderup Canal Estate will provide affordable holiday and residential properties oriented towards recreational enjoyment of Peel Inlet. The commercial opportunity to extend the canal estate will enable the proponent to undertake substantial capital works to remedy previous water quality problems in the existing canal estate, which are inherent in the present canal configuration.

In combination, the development of new waterfront housing allotments and the alleviation of previous water quality concerns will provide existing and future residents with a highly desirable residential estate.

The project will not cause any major adverse impact upon the environment. The development area was substantially degraded by earthworks during construction of the existing canal estate in 1971-72, and is generally derelict. In its present condition it has no conservation value.

The development will remedy previous water quality concerns in the canal estate. Detailed monitoring and assessment studies by CWR have confirmed that, subject to recommendations regarding canal design and remediation of design anomalies in the existing canals, efficient water exchange with Peel Inlet will be maintained over time. All of the CWR recommendations to achieve this objective have been incorporated in the present proposal.

It is concluded that, with appropriate environmental management, the proposed extensions to Yunderup Canal Estate can be accommodated within the existing natural and social environment to considerable benefit and without any significant adverse impacts".

The University of Western Australia

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7 March 1991
L092

Mr C E Day
Chairman
Peel Waterways Pty Ltd
11/16 Mill Point Road
SOUTH PERTH WA 6151

Dear Mr Day

RE: Response to Yunderup Canals PER

I have recently read the summary of the public response to the PER and am pleased to offer clarification of some of the technical issues, associated with the flushing, raised by the various responses.

Many of the concerns illustrated a lack of understanding of the basic flushing mechanisms that operate within the canals and that were detailed in our reports, which I gather may not have been available to all those submitting responses.

The flushing (or e-folding) time estimate of 2.3 days is an average for the canals. It is defined as the time required for the average dye concentration to fall to a value of 37% (e^{-1}) of the initial concentration. The visibility of the dye may last well beyond the flushing time and depends on the initial concentration. It is therefore not surprising that people could see the dye after 3 days and this has no bearing on the flushing estimate. As shown in our report the average flushing time of 2.3 days varied between 2.2 and 2.5 days around the canals in the post-dredged situation. This is a substantial improvement on the pre-dredged situation where the average flushing was 5.4 days, varying between 4.5 and 6.5 days around the canals.

One response to the PER suggested that the proposed extension with its additional length of canal will require a slightly longer travel path for exchanging water parcels. The distance from the entrance canal to the end of the proposed eastern canal is almost identical with the existing northern canal and therefore it is our opinion that the flushing time of the proposed eastern canal will be of similar magnitude to the existing canals. Further, the planned implementation of the recommendations listed in our report should also enhance flushing. These improvements are shown in Figure 3 of the PER. Following their implementation it is likely the flushing time will decrease slightly. Given that these improvements are implemented, that the sill depth is maintained so that the baroclinic mechanism remains the dominant flushing process, we would not expect the flushing time to change significantly. We would anticipate the flushing time would remain at less than 3 days. The effect of channel infill may be estimated by assuming a linear relation between sill depth and canal flushing time. Using the available pre- (sill

depth -1.1mAHD, flushing time 5.4 days) and post-dredged (-2.0mAHD, 2.3 days) data suggests that for an infill of 0.2m the flushing time will increase from 2.3 to 3 days and for an infill of 0.5m the flushing time would increase to 4 days.

Finally the planned culvert connections provide an adequate means of enhancing water exchange between the canals.

Yours sincerely

David van Senden

David van Senden
Director, Coastal and Hydraulic Engineering Laboratory
Centre for Water Research

SHIRE OF MURRAY

PINJARRA ROAD, PINJARRA, W.A., 6208. TELEPHONES: 531 1755, 531 1088
FACSIMILE: 531 1981

All Communications to the Shire Clerk, P O Box 21, Pinjarra, 6208.

Office Hours: Monday to Friday
8.30 a.m. to 4.30 p.m.

Your Ref:

Our Ref: NFG:jk 5.6.1.6

If telephoning or calling with reference to this letter please ask for

Mr GRIFFITHS

28 February 1991

Mr C Day
Managing Director
Peel Waterways
11/16 Mill Point Road
SOUTH PERTH WA 6151

Dear Sir

RE: YUNDERUP CANALS - STORMWATER DRAINAGE SYSTEM

.. Forwarded herewith is a copy of the Council resolution of 14 February
.. 1989 together with a copy of PIMA policy concerning stormwater run off in canal estates.

As discussed with the Shire Engineer, it is intended that all stormwater be collected in a specially designed underground system which caters for road run off and where necessary, run off from private property. This system is to discharge into the waterway but is to be so designed with baffles and traps so that as much as possible of the detrimental substances are trapped.

Please liaise closely with the Shire Engineer during the development of your proposed stormwater system so as to avoid abortive design effort.

Yours faithfully

D A McCLEMENTS
Shire Clerk

.. Enclosure

6.17 STORMWATER RUN-OFF IN CANALS

P.I.M.A. 29/12/88.

Copy of Letter

"Attached for your information is copy of the above policy, which was arrived at after discussion between the local authority engineers and PIMAs Works and Structures Committee."

Shire Engineer's Comment

A copy of the new PIMA Policy regarding disposal of stormwater run off in canal systems is attached at APPENDIX 5. The policy provides that in the older canal developments run off may be discharged into the canal system via a closed system as has been the previous Shire of Murray practice. Any new canal subdivision should include the requirement for adequate underground drainage which can be used to dispose of all stormwater run off from private land, houses and buildings.

(31) MOVED Cr Nancarrow, SECONDED Cr Menara: To recommend to Council that the PIMA policy regarding disposal of stormwater run off in canals is noted and that all new canal subdivisions should take account of this policy. CARRIED

PEEL INLET MANAGEMENT AUTHORITY.

POLICY FOR DISPOSAL OF STORMWATER RUNOFF IN CANALS.

Single residential development:

From 1/7/88 there shall be no direct disposal of stormwater runoff to canal waters.

All land and buildings within canal subdivisions:

Roof and surface runoff to be contained on site to the satisfaction of the Local Authority if possible.

In the event of this not being possible, i.e. roof and surface runoff, all runoff must be directed to an approved Local Authority drainage system.

Under no circumstances shall any airconditioner bleed-off be disposed of via the stormwater disposal system.

Rider: Rainwater runoff from single residential developments constructed prior to 1/7/88 may be disposed of on site if practicable, or if this is not possible, to be disposed of direct into the canal via an approved sealed system, provided there is no interference to the canal walls and where the new policy cannot be complied with.

SHIRE OF MURRAY

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Office Hours: Monday to Friday
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FACSIMILE TRANSMISSION

ADDRESSEE: PEEL WATERWAYS

ATTENTION: COLIN DAY FAX NO: 381 7362)
493 1178) FAX TO BOTH

SUBJECT: YUNDERUP CANALS - PROPOSED PEEL WATERWAYS DEVELOPMENT

Further to the telephone conversation between the Shire Engineer and Mr Colin Day on 19 March 1991, it is confirmed that the Shire of Murray requires access for maintenance, plant and vehicles from the roadways through to the waters edge at the following locations:

(a) at the northern end of the proposed new canal;

(b) approximately mid-way along the new canal length; and

(c) at the southern end of the new canal.

This access is required for maintenance of the beaches, future dredging works, weed removal and other such activities.

N GRIFFITHS
Shire Engineer

MURRAY SHIRE COUNCIL
..... DEPUTY SHIRE CLERK

Sent by:

Date: 21 MARCH 1991 (10.35 am)

Reference:

No. of Pages: ONE (incl. this page)

Fax No.: 531 1981

George Halpin.

John Potter.

3 [illegible] Way,
Murray Lakes,
South Yunderup, 6208.
537 6916.

The Chairman,
Enviromental Protection Authority,
1 Mount Street,
PERTH 6000.

re Extension to Yunderup Canal Estate.

Dear Sir,

At the recent meeting of the South Yunderup Ratepayers and Residents Association held on Sunday December 2nd 1990, the developers made a presentation explaining the proposed extension.

The subject generated a lot of interest in the district as shown by the large attendance at the meeting (in excess of 70) and the keen interest shown in the questions raised.

At the end of the presentation Mr. Day, of Peel Waterways Pty. Ltd. asked the President to gauge the feeling of the meeting towards the proposed extension. The agreement for the proposal was unanimous but for one person.

It was further agreed that the Association write to you to let you know of the keen support of the local residents to this proposal, which is seen by many of them who live on the canals as a fine means of overcoming a number of problems which have arisen in the past by improving the flushing of the system.

We hope that by showing you that this proposal has strong local support will assist in you giving favourable consideration to this project.

Yours faithfully,

John Potter,
Hon. Secretary.

December 19, 1990.

100 Kiap Road,
Yunderup Canals. 6208
Phone: 537 6335

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH. 6000

ATTENTION Ms JACKIE BOYER

ref. Extension to Yunderup Canals Estate - PER

I have been a resident of Kiap Road for over six years, and have been Secretary of the very active South Yunderup Ratepayers & Residents Association for three years, and currently am President. Therefore I am well aware of general attitudes and wishes of residents. I am also a member of Peel Inlet Management Authority (PIMA) and consequently I am au fait with the ongoing problems which have been experienced in the Yunderup Canals in the past.

While in general strongly supporting the proposal of Peel Waterways P/L as outlined in the PER of November 1990, I have the following comments to make.

1) The area of lots 5, 6, 7 & 8 Kiap Road were left by the original developer in a very bad state, and remains a very unprepossessing outlook for residents of Kiap Road, and for visitors and others using the road. The proposed development will greatly improve the general aspect of the area, but in particular, as outlined in the report, it will greatly improve the water quality of the whole canal system.

2) Page 16 section 4.2 2nd.last paragraph, ref. culvert connection with existing canal E. Design proposes a box-type culvert to the same depth as the new canal, but with insufficient above-water clearance to permit boat traffic. I suggest that this culvert should be re-designed so as to allow the passage of at least small power-dinghies: propeller action and traffic will ensure water agitation and movement, and this will be an essential ingredient of the success of the design in improving water exchange, particularly at this remote end of the longest canals.

3) Page 17 2nd.par. "Minimum building set-back of 6m from the canal frontage". The existing canals require a 9m set-back from canal frontage and this should be retained in the new canals to maintain uniformity.

4) Page 27. Residential experience supports the statement that the Yunderup Canals provide a biologically healthy system, offering high-amenity value to its residents, and that the fears of deterioration have not developed as rapidly as expected - if indeed they will develop. Nevertheless, scientific studies show there are a number of concerns which may end in deterioration, and therefore the improvements offered by the proposed development can only be a strong benefit to the whole system. These improvements should also greatly reduce management costs in the future for the designated canals manager.

5) Page 34 Par.4. "Public access will be interrupted by the proposed entrance to the western canal". Public pedestrian access could be provided at this point by the construction of an arched wooden footbridge similar to the existing one over the entrance to the Murray Lakes canals.

Such a structure has aesthetic as well as practical advantages.

6) With reference to footbridges, the plans in the PER do not show a pedestrian/cycle access-way connecting the northern end of Kiap Road to Allambi Way. It is understood such a "bridge" was previously proposed. Certainly such a structure would be more than highly desirable at this location - in fact it should be considered essential to provide access to the Homestore.

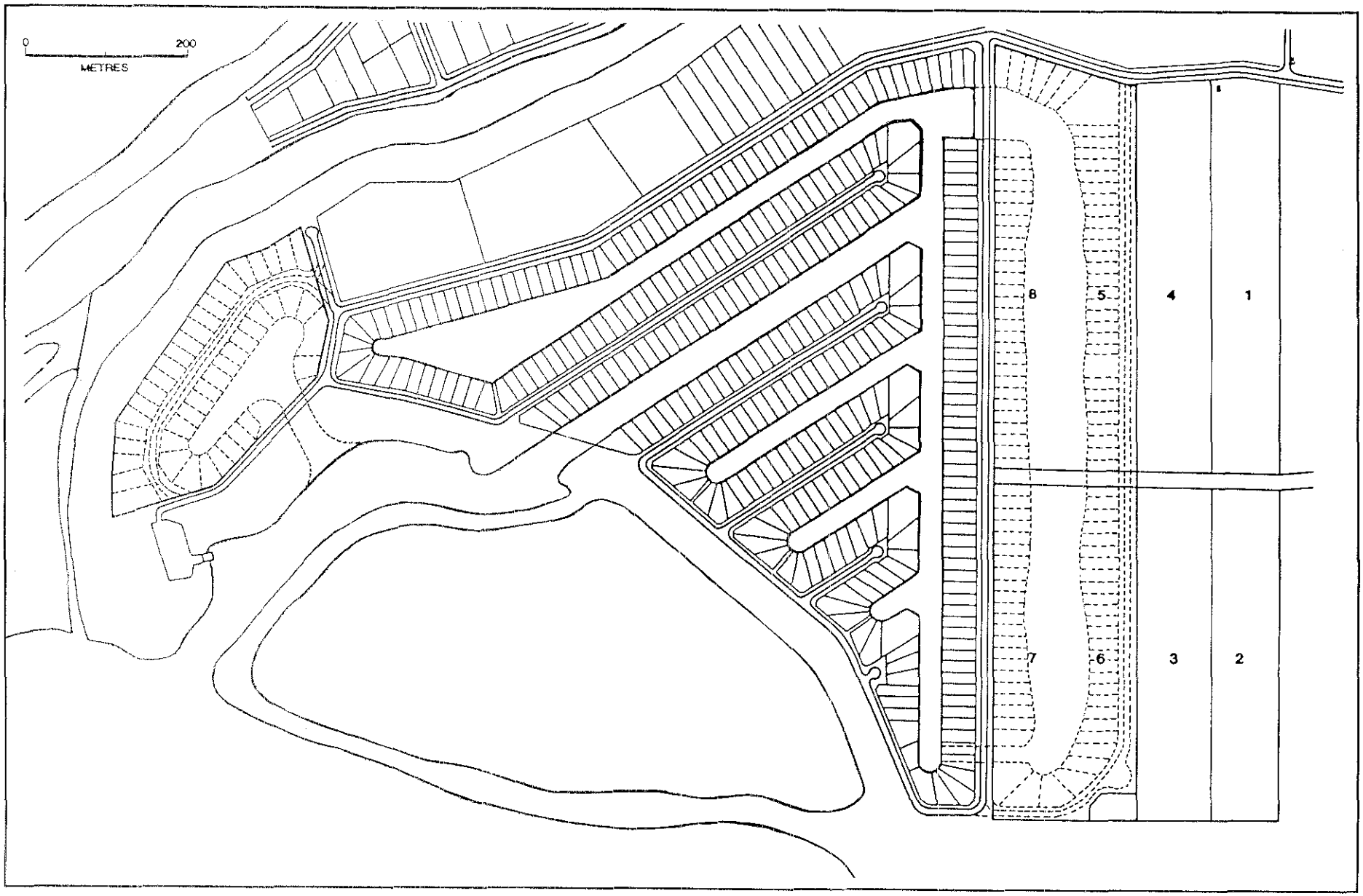
Trusting these comments are of assistance in achieving a satisfactory final design and approval of this worthwhile development, which is strongly supported locally.

Yours faithfully,

G.T. HALPIN

January 3, 1991

Subsequently, an addendum was forwarded proposing that houses fronting Kiap Rd & Allambi Way should be inspected by developer's engineers before work commences - vibration from heavy traffic and earth movers may lead to claims of structural damage, and pre-inspections would restrict such claims to valid cases.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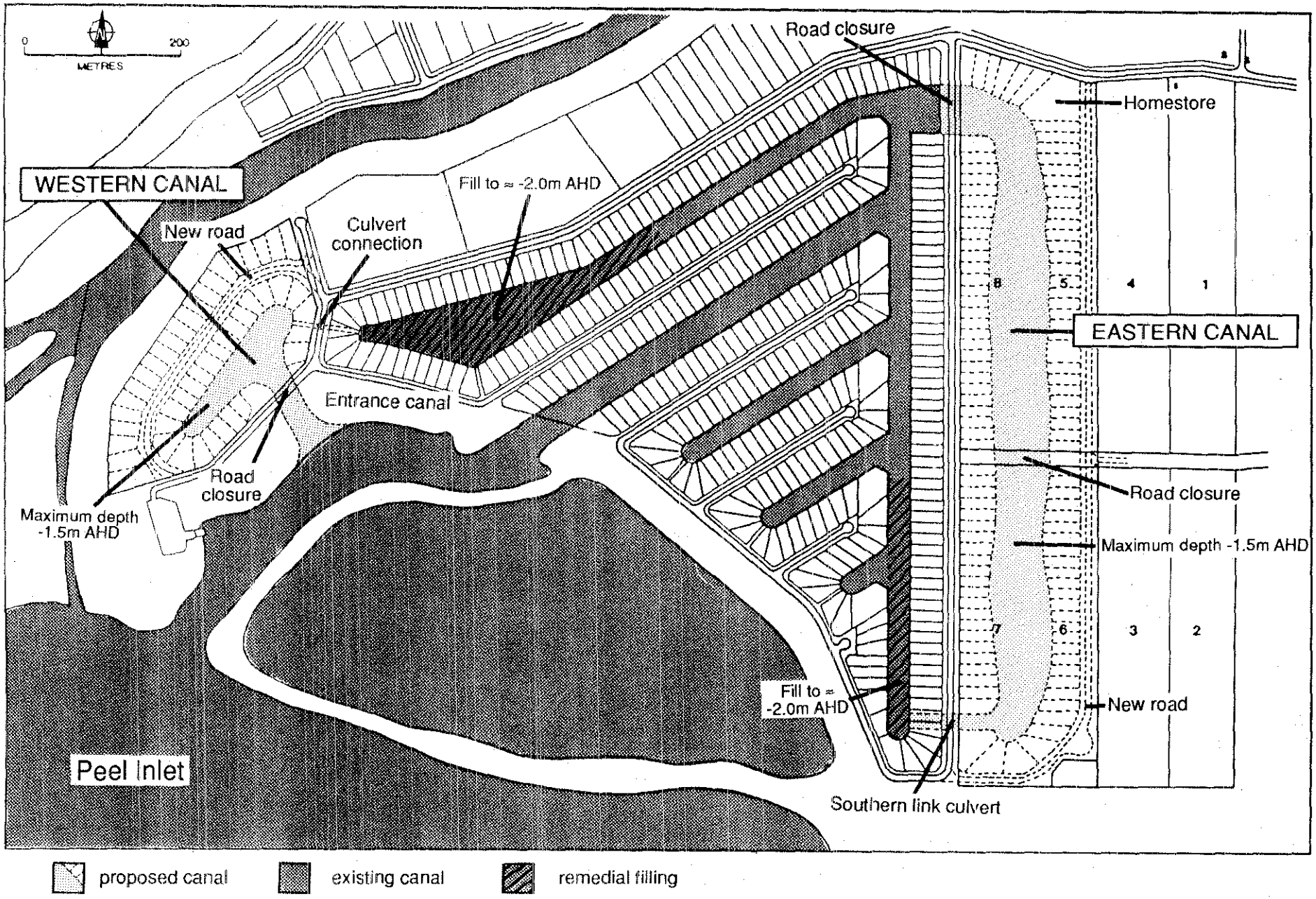
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Road closure
Homestore
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Fill to ≈ -2.0m AHD
New road
Culvert connection
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EASTERN CANAL
Entrance canal
Road closure
Road closure
Maximum depth -1.5m AHD
Maximum depth -1.5m AHD
7
6
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Fill to ≈ -2.0m AHD
New road
Peel Inlet
Southern link culvert
proposed canal
existing canal
remedial filling