

BAYVIEW HAVEN CANAL ESTATE

REPORT AND RECOMMENDATIONS

by the

**ENVIRONMENT PROTECTION UNIT
CONSERVATION COMMISSION NT**

1.0 INTRODUCTION AND BACKGROUND

1.1 DESCRIPTION OF PROPOSAL

1.2 EXISTING ENVIRONMENT

1.3 REVIEW OF DRAFT EIS

1.4 REVIEW OF FINAL EIS

2.0 ENVIRONMENTAL ASSESSMENT

2.1 WATER QUALITY

2.2 BITING MIDGE CONTROL

2.3 SERVICES

2.4 ESTATE DESIGN

2.5 HERITAGE SITES

2.6 ESTATE MANAGEMENT

2.7 CONCLUSION

1
1
2
3
4
4
4
6
6
7
8
9
10

FIGURES

FIGURE 1 LOCATION OF PROPOSAL

FIGURE 2 LAYOUT OF SUBDIVISION AS PROPOSED IN DRAFT EIS

FIGURE 3 STAGING OF THE SUBDIVISION

FIGURE 4 LAYOUT OF FRANCES BAY EXPLOSIVES COMPLEX

FIGURE 5 REVISED LAYOUT OF SUBDIVISION TO RETAIN HERITAGE SITES 5 AND 6

TABLES

TABLE 1 SUMMARY OF SUBMISSIONS ON DRAFT EIS

TABLE 2 SUMMARY OF IMPACTS, SAFEGUARDS AND PREDICTED EFFECTS

APPENDICES

APPENDIX A PORT AND HARBOUR CONSULTANTS - REVIEW OF DRAFT EIS

APPENDIX B SUMMARY OF ADVISORY BODY COMMENTS ON THE FINAL EIS

SUMMARY AND RECOMMENDATIONS

An Environmental Impact Statement (EIS) on a proposal by Dover Investments Pty Ltd to develop a residential canal estate at Sadgroves Creek Darwin Harbour has been subject to assessment under the NT *Environmental Assessment Act*, which is administered by the Conservation Commission.

This report outlines the assessment process, the issues outstanding from the final EIS and contains the list of undertakings made by the developer to minimise environmental effects.

The following summary of recommendations to the Minister for Conservation were prepared as a result of the EIS review. The background to each recommendation is discussed under appropriate sections of the report.

Recommendation 1

That:

The Instrument of Determination for the Bayview Haven Canal Estate require the developer to adhere to all the undertakings/commitments listed in Table 2. Any changes to or omissions of the undertakings to be negotiated with the Conservation Commission and other relevant authorities and approved by the Director of Conservation

The following recommendations have arisen through the assessment process and include aspects which it was considered were not adequately covered in the safeguards proposed to minimise environmental effects contained in the EIS.

Recommendation 2

That:

- (A) The developer be required to confer with the Water Resources Division of the Power and Water Authority and the Fisheries Division of the Department of Primary Industry and Fisheries with regard to detailed requirements for water, sediment and bio-accumulation monitoring. Baseline monitoring of water, sediment and bio-indicator species be commenced as soon as possible and continued throughout the various development stages of the estate in order to provide a basis for comparison with development induced impacts.
- (B) The Management Body erect signs discouraging the harvesting of marine life from the canals. If at some stage monitoring indicates that marine life is not fit for human consumption, the Management Body immediately notify the Department of Health and Community Services and take steps to erect signs banning the harvesting of marine life, as directed by the Department.

- (C) Any gross pollutant traps to be installed on stormwater outlets entering the canals be fitted with a litter screen and located within road reserves, or other Darwin City Council operated easements as agreed to by Council.
- (D) Washdown water from the boat maintenance area not be discharged to canals or Darwin Harbour unless water quality can be demonstrated to be acceptable to the Conservation Commission and the Power and Water Authority. Disposal of residues off-site be approved by the Conservation Commission.

Recommendation 3

That:

Insecticidal spraying of biting midge adults in the buffer zone be carried out under the strict supervision and direction of the Department of Health and Community Services Medical Entomology Branch, and only when midge numbers are particularly high, such as during neap tide periods.

Recommendation 4

That:

- (A) The proponent be required to provide the following standard of services:

Cycle paths to AUSTROADS standards

Street lighting to Australian standards

Adequate toilet facilities for use by marina patrons.

- (B) The proponent be required to consult with the Power and Water Authority to resolve details of the following, prior to development approval being granted:

Wet season loading of sewage from the estate on the existing sewerage system

Relocation of the 66kv powerline with regard to location and the acquisition of easements

- (C) The proponent be required to consult with the Department of Transport and Works with regard to:

Approval to construct two traffic intersections onto Tiger Brennan Drive

Fill and compaction of the roundabout intersection to the east of the estate.

The location of the cycle path between the estate and Stuart Park.

Recommendation 5

That:

- (A) The proponent ensure that the outer embankment design permits cost effective increase in height to allow for increased storm surge levels due the Greenhouse Effect, if necessary in future**
- (B) The proponent submit detailed design and operation information on the lock, entrance channel and overflow weirs to Conservation Commission, Department of Transport and Works and Department of Lands and Housing for review prior to development approval.**

Recommendation 6

That:

The revised subdivision layout which retains heritage sites 5 and 6 be adopted in preference to the layouts presented in the draft and final EIS's.

Recommendation 7

That:

- (A) Special legislation be developed to cover management of the Bayview Haven Canal Estate**
- (B) All of the management practices/strategies proposed to be the responsibility of the Management Body and/or Marina Operator and listed under "Safeguards" in Table 2 of this report, be specified as Regulations to the special legislation.**
- (C) If necessary, the marina be leased, not sold, to an operator who under the lease arrangements is bound by the management responsibilities specified in the Regulations to the Act and is also answerable to and overseen by the Management Body**

CONCLUSION

In conclusion, the Conservation Commission considers that the Bayview Haven Canal Estate EIS has adequately addressed the main environmental concerns relating to the development proposal and that, subject to the safeguards summarised in Table 2 and the recommendations given above being implemented, there are no significant outstanding environmental issues which should prevent the development from proceeding.

1.0 INTRODUCTION AND BACKGROUND

This report examines a proposal by Dover Investments Pty Ltd to construct the Bayview Haven Canal Estate, Sadgroves Creek, Darwin, and makes recommendations on safeguards to protect the environment.

Following notification of the proposal on 4 November 1987, the Conservation Commission accepted a Preliminary Feasibility report on the project for assessment as a Clause 6 report under the *Environmental Assessment Act* Administrative Procedures. Review of the report by government advisory bodies raised numerous concerns relating to environmental protection and management of the project. The Minister for Conservation therefore directed the preparation of a Draft Environmental Impact Statement (EIS) on the proposal on 10 December 1987, in order that these outstanding issues could be further investigated and assessed.

In March 1988 the proponent wrote to the Minister for Conservation submitting a modified proposal and a report for assessment, with a request that the direction for an EIS be withdrawn. The Minister accepted the report as a Clause 6 report for the modified proposal (Preliminary Environmental Report, PER) and suspended the EIS direction pending the outcome of the assessment of the PER. The review indicated that there remained significant issues which needed to be addressed through an EIS and the proponent was re-directed to prepare an EIS on 19 May 1988.

In March 1990 the proponent again wrote to the Minister for Conservation requesting that he accept a new, detailed PER on the Bayview Haven Canal Estate proposal which would be released for public comment. The reason for the request was to enable any major issues of concern to the public to be "flushed out" and to enable the company to make better informed decisions on the economic viability of the project prior to the costly preparation of an EIS. The Minister agreed to this course of action and the PER was submitted on 9 August 1990. One public comment was received relating to the proposed destruction of World War II heritage sites, and advisory body review again confirmed that an EIS would be necessary to adequately examine all the areas of environmental concern. The Minister for Conservation therefore directed the proponent prepare an EIS on the proposal on 4 October 1990.

The Bayview Haven Canal Estate draft EIS was submitted on 9 September 1991 and was available for public and government review until the 4 October 1991. All comments were forwarded to the proponent for consideration in preparation of the final EIS, which was submitted on 9 December 1991.

1.1 DESCRIPTION OF PROPOSAL

The proposal is described in detail in the draft EIS. Briefly, the proposal entails the construction of a "high quality", fully serviced, residential canal estate on Lot 4646 Town of Darwin, approximately 4km north of the Central Business District on the western shores of Sadgroves Creek (Figure 1).

The development will affect approximately 58ha of land, 19 ha of which comprises low lying littoral and mangrove areas where the main canal system will be established. The remainder of the lot is a high rocky plateau which will be reshaped to a sloping profile to provide fill for the low lying areas. In addition, marine muds in the low lying areas will be excavated, dried and compacted for use as base fill around the canals.

When completed the estate will house up to 1200 people. It is intended that 125 house lots will have canal frontage, with 161 house lots developed on the sloping and high land. Medium density (R2 & R4) housing and commercial areas are also proposed (Figure 2).

The development site was specifically rezoned for the purpose of a residential canal estate on 24 June 1988 by the Minister for Lands and Housing.

Construction of the estate will be in five stages (Figure 3). Stage 1 is expected to commence in June 1992 and the final stage is expected to be completed by the end of 1996.

1.2 EXISTING ENVIRONMENT

The Draft EIS describes the existing environment in some detail. Some additional information is given in the final EIS, including an undertaking to complete a more detailed archaeological survey.

Aspects of the existing environment of particular relevance to the project are summarised as follows:

Lot 4646 is currently undeveloped except for the World War II Frances Bay Explosives Complex comprising various types of storages and huts which are connected by a gravel road near the top of the high plateau (Figure 4). The sites are considered to be of national heritage significance and are on the Interim List of the Register of the National Estate.

The site comprises a rocky plateau vegetated by eucalypt dominated woodland and patches of monsoon vine thicket, grading to low coastal plains vegetated by coastal monsoon vine thickets and mangroves. Studies to date have not revealed any flora or fauna of particular significance on the site.

Significant numbers of biting midges are known to occur on the site, at levels which can cause severe human discomfort.

Some aboriginal shell middens have been identified during archaeological survey of the site.

Although somewhat protected by its creek/harbour location and broad buffer of mangroves, the site is subject to a tidal range of up to 8 metres and the effects of cyclones and storm surge. During 1 in 1000 year storm surge conditions tide levels may reach RL6.5AHD.

By virtue of its topography and a boundary of a major arterial road, the site is relatively isolated from other residential areas and land uses.

1.3 REVIEW OF DRAFT EIS

A total of 18 responses were received on the draft EIS. Five of the responses received were from members of the public or public organisations; the remainder were from government advisory bodies. Comments and respondents have been summarised in Table 1.

The Conservation Commission, as the government assessment agency, contracted Port and Harbour Consultants Pty Ltd, Perth, to undertake an independent expert review of technical aspects of the project as contained in the draft EIS. The terms of reference for the review and the consultant's report are included at Appendix A. The consultant's comments were included in the Conservation Commission's submission to the proponent on the draft EIS.

The major areas of concern raised during review of the draft EIS were as follows:

Biting insects, in particular biting midges, were identified as a significant problem on the site. The proposed control measures were generally considered to be ineffective in significantly reducing the problem and more effective solutions, such as filling of breeding habitat to below the neap tide zone or increased insecticidal treatment, will have significant adverse environmental impacts.

The effects of the development on water quality, both within the canals and on Darwin Harbour, were seen as a major issue. Sediments and other pollutants such as fertilisers and heavy metals were considered to have potential for accumulation, particularly in dead water areas of the canals, and cause problems with marine life. Water quality monitoring was seen as an issue requiring detailed thought and substantial commitment by the developer.

The effects of construction and maintenance dredging of marine muds in the canals and the entrance channel from Sadgroves Creek on marine life in Darwin Harbour was of concern.

The destruction of most of the World War II explosives storage complex currently on the site was of particular concern. All but two of the 12 sites were proposed to be removed for the development. Two of the most valuable and well preserved storages from a heritage viewpoint were intended to be destroyed.

Management of the estate emerged as a critical issue due to the range of responsibilities which would fall to a Body Corporate which would have implications for environmental protection, such as water quality management and monitoring, maintenance dredging and sediment control.

Concern about the effects of removal of mangroves and doubts about the stability and behaviour of mangrove muds intended for fill foundations were further important issues raised.

1.4 REVIEW OF THE FINAL EIS

The final EIS was circulated to all government respondents who made significant comment on the draft, and was forwarded to all public respondents. Six responses were received from government advisory bodies. Relevant comments are summarised in Appendix B

The final EIS was considered to have addressed many of the concerns raised during review of the draft EIS, however some areas of detail remain to be resolved before final approval is given. Where relevant these are taken up in the recommendations arising from the assessment outlined in the following section.

2.0 ENVIRONMENTAL ASSESSMENT

At the request of the Conservation Commission, the developer prepared a detailed table which summarises the predicted impacts of the proposed development, the safeguards which the developer has undertaken to implement to ameliorate those impacts, and the predicted environmental effects after the safeguards have been implemented. Table 2 combines the developer's table (Table S7, Final EIS) and additional impacts and safeguards contained in either the draft or final EIS but not included in the table. Other safeguards arising solely from the assessment process are covered from recommendation 2 in this section.

Recommendation 1

That:

The Instrument of Determination for the Bayview Haven Canal Estate require the developer to adhere to all the undertakings/commitments listed in Table 2. Any changes to or omissions of the undertakings to be negotiated with the Conservation Commission and other relevant authorities and approved by the Director of Conservation

2.1 WATER QUALITY

Some aspects of water quality management and monitoring remain of concern, either because of lack of detail in the developer's intentions or undertakings, or apparent inadequacy in what is proposed in terms of safeguarding the environment.

The following specific areas remained outstanding following review of the final EIS:

Responsibility for the maintenance and operation of the proposed gross pollutant traps on the stormwater outlets draining into the canals, and the pits and oil separators near the marina, are not specified.

The proposal for the marina operator to regularly wash down the boat maintenance area and dispose of residue off-site lacks detail. While hull maintenance in the estate will not be permitted, it is not clear what other boat maintenance will occur, what the chemical characteristics of the washdown water or residues might be or where the washdown water will discharge to.

The developer has not conferred with PAWA's Water Resources Division or DPIF's Fisheries Branch with regard to detailed requirements and amendments to the water quality monitoring programme.

There remains concern that water quality within the canals will deteriorate over time, particularly with leaching of antifoulants from boat hulls. The proposal to discourage the harvesting of marine life from canals indicates that a deterioration is anticipated and harvesting of marine life should be banned.

Baseline data on water quality and marine life on and adjacent to the site is inadequate. Baseline monitoring should commence immediately and continue for as long as possible before development proceeds to provide a base for comparison of development induced impacts.

Recommendation 2

That:

- (A) The developer be required to confer with the Water Resources Division of the Power and Water Authority and the Fisheries Division of the Department of Primary Industry and Fisheries with regard to detailed requirements for water, sediment and bio-accumulation monitoring. Baseline monitoring of water, sediment and bio-indicator species be commenced as soon as possible and continued throughout the various development stages of the estate in order to provide a basis for comparison with development induced impacts.**
- (B) The Management Body erect signs discouraging the harvesting of marine life from the canals. If at some stage monitoring indicates that marine life is not fit for human consumption, the Management Body immediately notify the Department of Health and Community Services and take steps to erect signs banning the harvesting of marine life, as directed by the Department.**
- (C) Any gross pollutant traps to be installed on stormwater outlets entering the canals be fitted with a litter screen and located within road reserves, or other Darwin City Council operated easements as agreed to by Council.**
- (D) Washdown water from the boat maintenance area not be discharged to canals or Darwin Harbour unless water quality can be demonstrated to be acceptable to the Conservation Commission and the Power and Water Authority. Disposal of residues off-site be approved by the Conservation Commission.**

2.2 BITING MIDGE CONTROL

Despite various measures proposed to control biting midges it is anticipated that they will significantly affect the outdoor activities of estate residents at certain times, particularly on the seaward edge of the estate. While the intention is that buyers will be made fully aware of the potential problem through promotional material and land titles, there is concern that there will be pressure on the Management Body from residents to increase control measures, such as spraying of insecticides, which will have implications for environmental impacts.

Recommendation 3

That:

Insecticidal spraying of biting midge adults in the buffer zone be carried out under the strict supervision and direction of the Department of Health and Community Services Medical Entomology Branch, and only when midge numbers are particularly high, such as during neap tide periods.

2.3 SERVICES

A number of servicing details for the estate are still outstanding and will need to be resolved to the satisfaction of the various servicing authorities prior to development approval. In particular, the following issues were raised during review of the final EIS:

Wet season sewage loadings from the estate are of concern in terms of the capacity of the existing sewerage system to accommodate them. Some further analysis of loadings and capacity will be required.

Cycle paths will need to be to AUSTROADS standards.

The location of the cycle path between Stuart Park and the estate will need to be determined in consultation with Department of Transport and Works (DTW).

Street lighting will need to be to Australian standards

Estate development will necessitate the relocation of a proposed roundabout intersection off the estate to a low lying area directly east of the estate. The issue of fill and compaction of the intersection needs to be dealt with in some further detail.

The proposal to provide two road access points to the estate from Tiger Brennan Drive has not been approved by DTW and if permitted specific conditions would apply.

Relocation of the 66kv powerline requires further negotiation with regard to finalisation of location and acquisition of easements.

The provision of public toilets in the marina area is considered necessary. The Australian Environment Council in its report 24 "Impact of Marinas on Water Quality" recommended that adequate toilet facilities be located in marina areas to encourage their use by marina patrons and to reduce the possibility of illegal discharges from moored vessels.

Recommendation 4

That:

(A) The proponent be required to provide the following standard of services:

Cycle paths to AUSTROADS standards

Street lighting to Australian standards

Adequate toilet facilities for use by marina patrons.

(B) The proponent be required to consult with the Power and Water Authority to resolve details of the following prior to development approval being granted:

Wet season loading of sewage from the estate on the existing sewerage system

Relocation of the 66kv powerline with regard to location and the acquisition of easements

(C) The proponent be required to consult with the Department of Transport and Works with regard to:

Approval to construct two traffic intersections onto Tiger Brennan Drive

Fill and compaction of the roundabout intersection to the east of the estate.

The location of the cycle path between the estate and Stuart Park.

2.4 ESTATE DESIGN

Many details relating to estate design will not be finalised until the final design stages, some of which will follow project approval. The proponent has undertaken to seek the Conservation Commission's review of new information and any changes to design as information becomes available through the planning, design and construction stages. Several points relating to design which should be considered or noted at this stage are as follows:

The height of the outer embankment at 6.5AHD is considered to allow for secondary storm surge heights without any increase in sea level rise due to the Greenhouse Effect. It is important that the embankment be designed and constructed at this stage to permit easy and cost effective increase in height at a later stage should this become necessary.

The proposed final design and operation of the lock, entrance channel and overflow weirs will require more detailed examination prior to final approval being given.

Recommendation 5

That:

- (A) The proponent ensure that the outer embankment design permits cost effective increase in height to allow for increased storm surge levels due the Greenhouse Effect, if necessary in future**
- (B) The proponent submit detailed design and operation information on the lock, entrance channel and overflow weirs to Conservation Commission, Department of Transport and Works and Department of Lands and Housing for review prior to development approval.**

2.5 HERITAGE SITES

Review of the draft EIS indicated that the proposal to retain World War II heritage sites 3 and 4 (Figure 4) only was unacceptable for the following reasons:

Site 3 is within the railway reserve and is not part of the development. Its long term protection cannot, therefore, be guaranteed unless government is considerably constrained in its ability to utilise the railway reserve.

Site 4 is a minor storage, although relatively intact, and is located in the estate buffer strip. It would effectively be the only site offered full protection if the development proceeded as proposed in the draft EIS.

Site 6, and to a lesser extent Site 5, are considered to be the most valuable storages both in terms of their state of repair (Site 6 is relatively intact, Site 5 is less so due to recent vandalism), and significance of design and construction.

In the final EIS the proponent proposed a compromise whereby Sites 11 and 12 would be protected in a heritage precinct in addition to the retention of Site 4. This proposal was still unacceptable to the Commission's Heritage Unit as Sites 11 and 12 are in a state of ruin and not as significant as Sites 5 and 6 in terms of design and construction. In subsequent negotiations between the Commission and the proponent, the proponent agreed to the protection of Sites 5 and 6 in preference to 11 and 12, and a redesign of the subdivision layout (Figure 5).

Recommendation 6

That:

The revised subdivision layout which retains heritage sites 5 and 6 be adopted in preference to the layouts presented in the draft and final EIS's.

2.6 ESTATE MANAGEMENT

Responsibility for management of the estate, including many aspects which have implications for environmental protection such as water quality, is proposed to fall to a Management Body and/or a marina owner/operator. The Management Body would be a type of Body Corporate comprising residents of the estate and established under special legislation such as that developed for the Cullen Bay Marina. The specific functions, powers and procedures of the Management Body would be prescribed in Regulations to the special legislation.

It is proposed that the marina site be either leased or sold to a Marina Operator who would be responsible for the overall management of the canal system. It is unclear how the responsibilities of the Management Body in relation to overall estate management would relate to the role of the Marina Operator.

Clearly many of the long term environmental impacts of the Bayview Haven proposal will be related to operation and maintenance of the estate and will be largely influenced by the effectiveness of the management practices proposed to minimise effects. It is therefore essential that the management responsibilities of the Management Body are clearly spelt out and are enforced through legislation to ensure that these responsibilities are met.

The specific responsibilities falling to the Management Body and/or Marina Operator are listed under safeguards in Table 2 of this report.

Recommendation 7

That:

- (A) Special legislation be developed to cover management of the Bayview Haven Canal Estate**
- (B) All of the management practices/strategies proposed to be the responsibility of the Management Body and/or Marina Operator and listed under "Safeguards" in Table 2 of this report, be specified as Regulations to the special legislation.**
- (C) If necessary, the marina be leased, not sold, to an operator who under the lease arrangements is bound by the management responsibilities specified in the Regulations to the Act and is also answerable to and overseen by the Management Body**

2.7 CONCLUSION

In conclusion, the Conservation Commission considers that the Bayview Haven Canal Estate EIS has adequately addressed the main environmental concerns relating to the development proposal and that, subject to the safeguards summarised in Table 2 and the recommendations given above being implemented, there are no significant outstanding environmental issues which should prevent the development from proceeding.

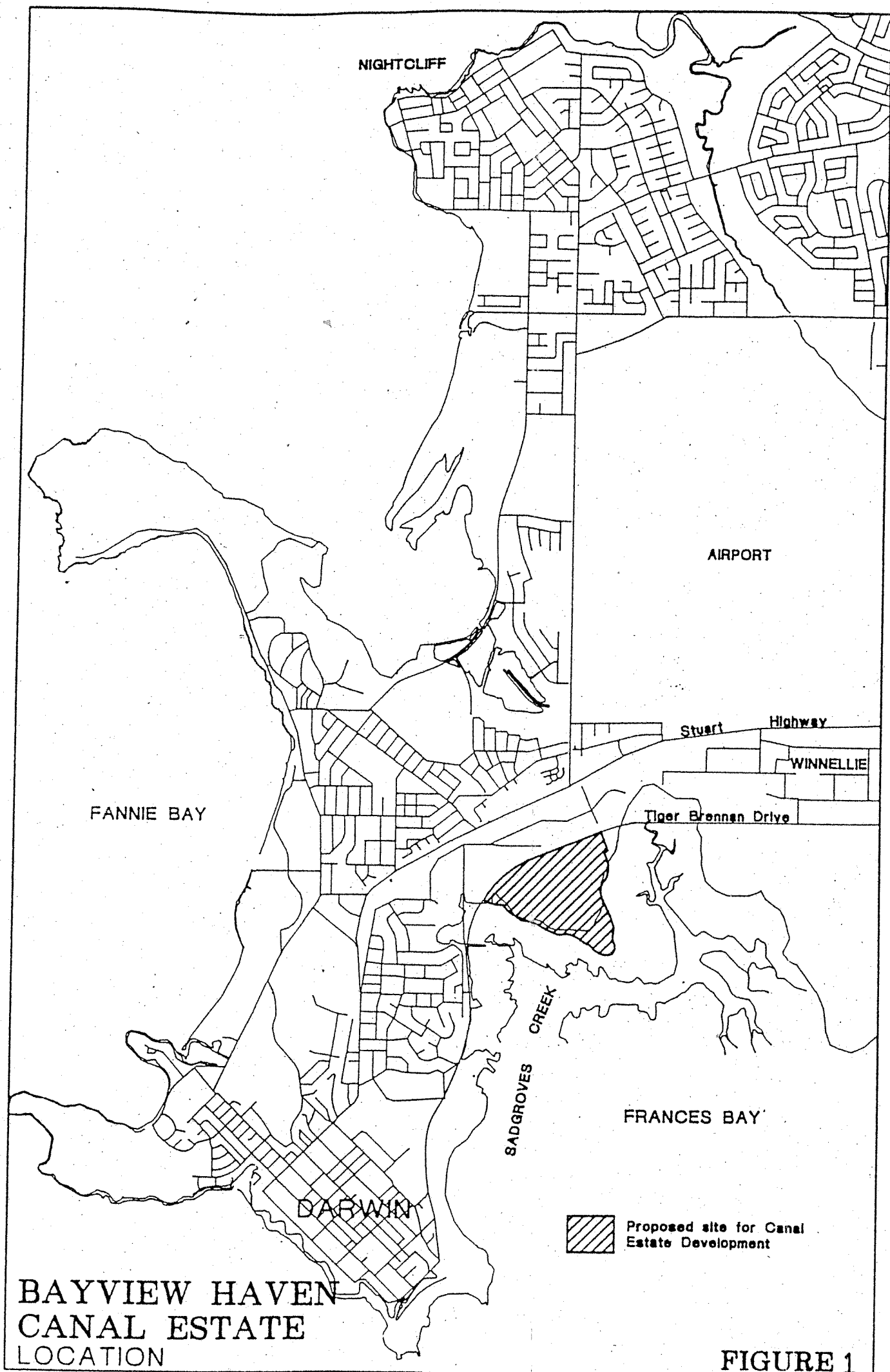


FIGURE 1

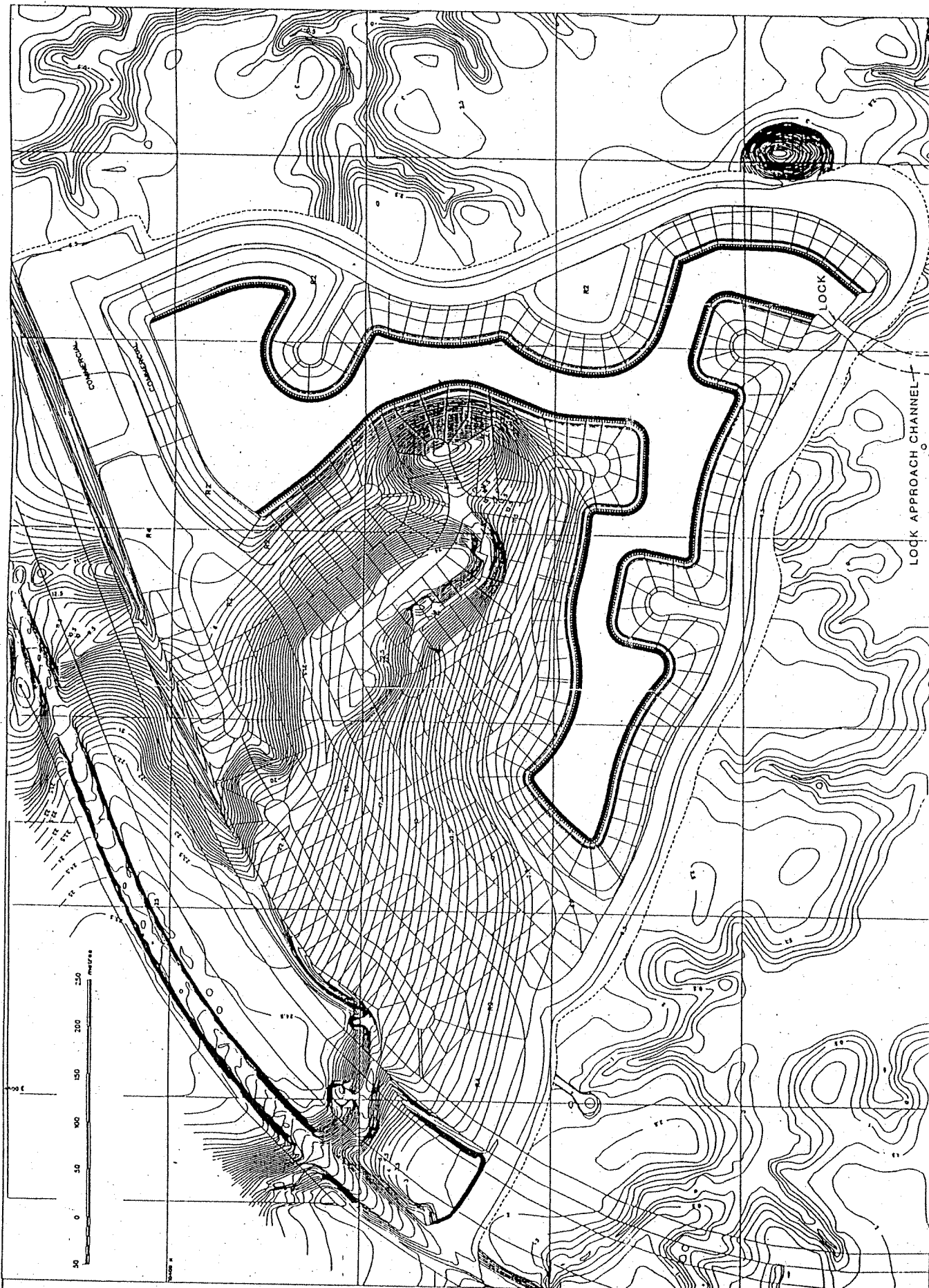
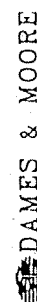


FIGURE 2 LAYOUT OF SUBDIVISION AS PROPOSED IN DRAFT EIS

BAYVIEW HAVEN
CANAL ESTATE



EARL JAMES & ASSOCIATES
LAND & WATER CONSULTANTS
1000 JAMES STREET, SUITE 100, VANCOUVER, B.C. V6C 1A1



DAMES & MOORE
ENVIRONMENTAL & METEOROLOGICAL
CONSULTANTS



W.D. HILL & PARTNERS
CONSULTING ENGINEERS

NOTE - THIS PLAN WAS PRODUCED PHOTOGRAPHICALLY FROM PHOTO SCALE PHOTOGRAPHY DATED 10-1-87. CONTROLS SPACING - 0.3 METRE VERTICAL DATUM - A.M.S.L. HORIZONTAL DATUM - U.T.M.

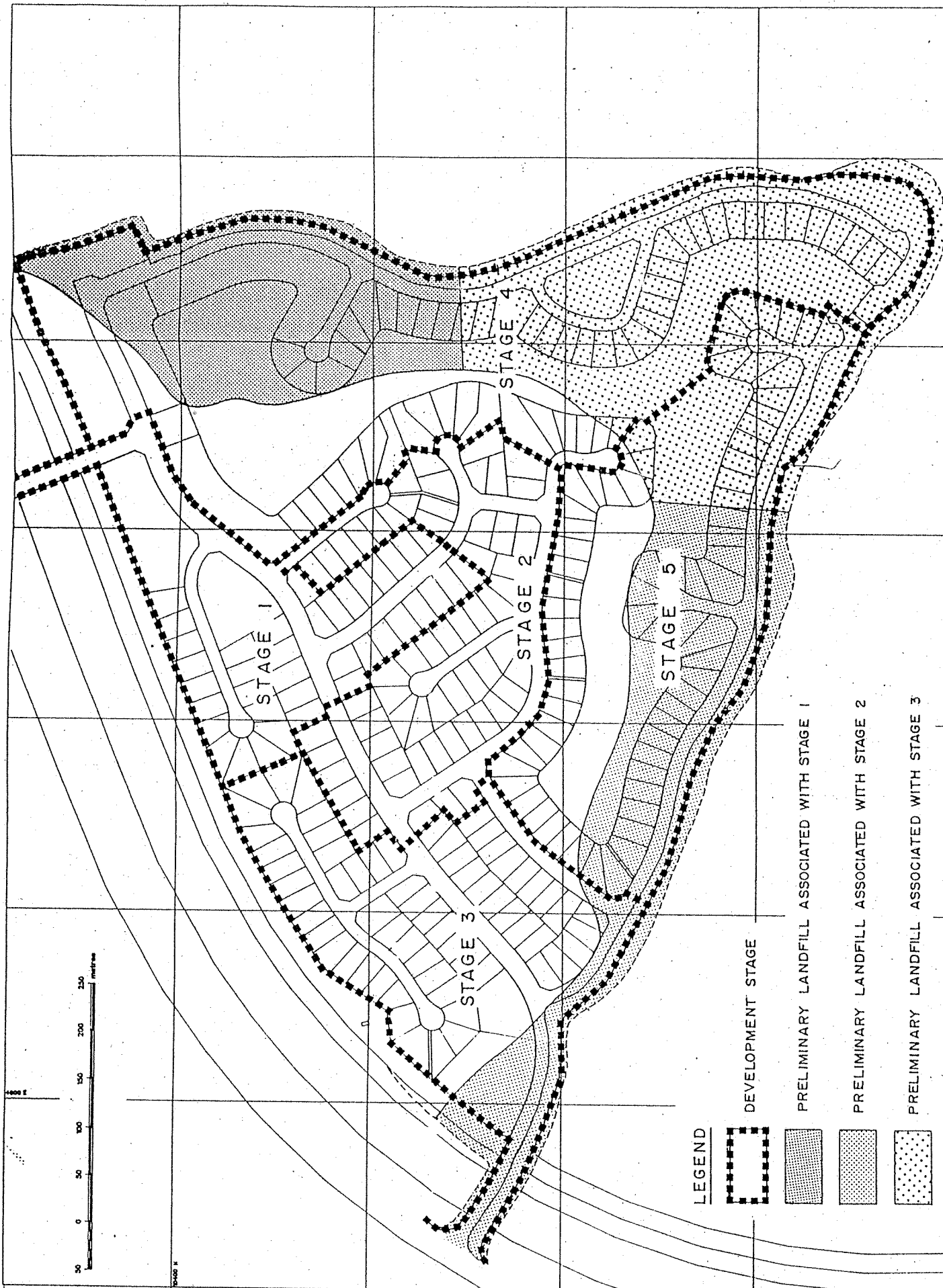


FIGURE 3 STAGING OF THE SUBDIVISION

BAYVIEW HAVEN
CANAL ESTATE

EARL JAMES & ASSOCIATES
LAND & SURVEY ENGINEERS
INCORPORATED
1000 WEST 10TH AVE. SUITE 100
VANCOUVER, B.C. V6H 2G6

DAMES & MOORE
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

W.P.
WILLIAMS & PARTNERS
CONSULTING ENGINEERS

NOTE - THIS PLAN WAS PRODUCED PHOTOGRAPHICALLY FROM
AERIAL PHOTOGRAPHY DATED 11-1-87.
CONTAINER WIDTH - 0.3 METRE
VERTICAL SCALE - 1:100
HORIZONTAL SCALE - 1:100

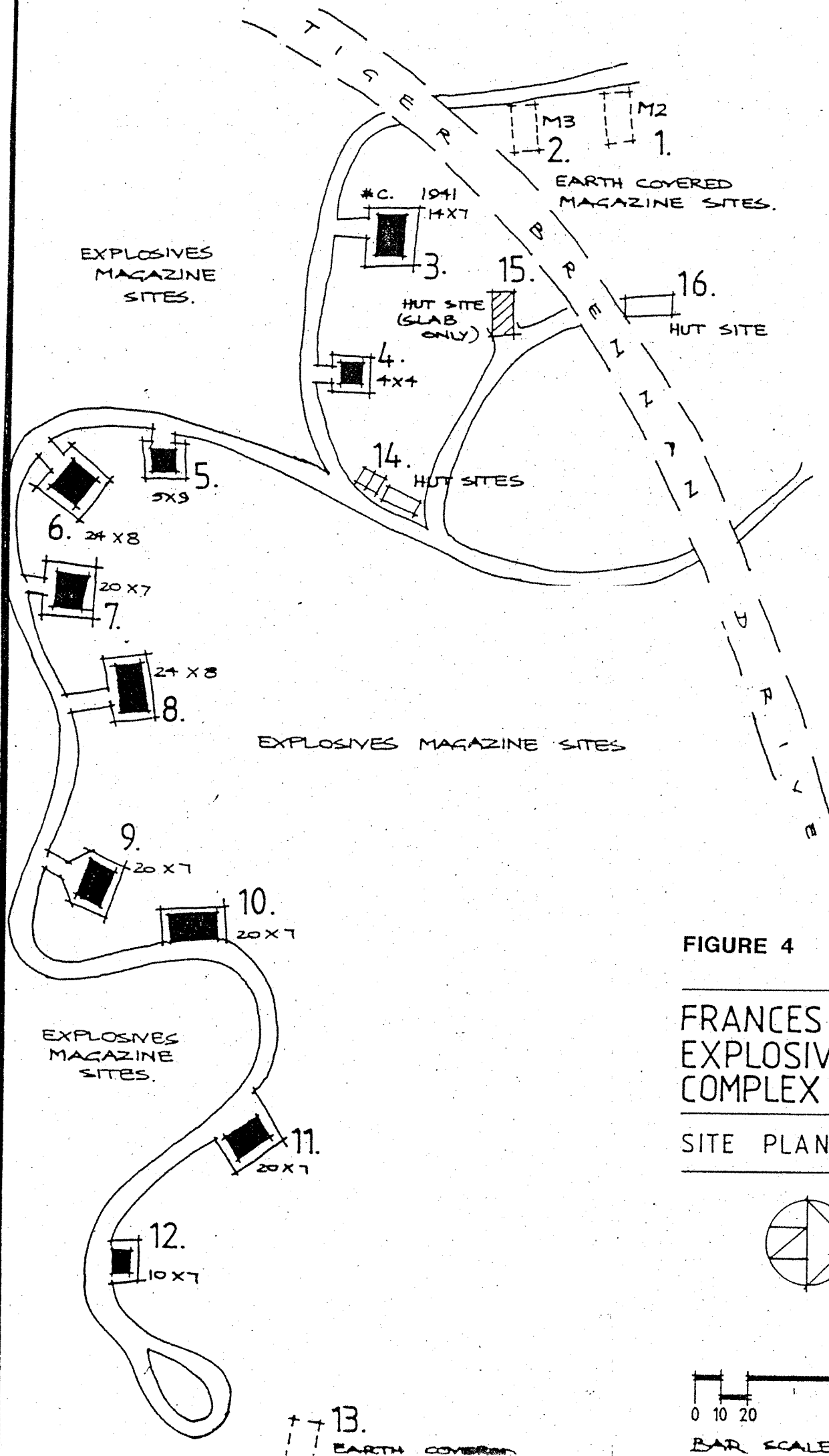
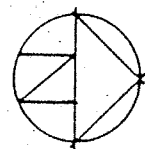


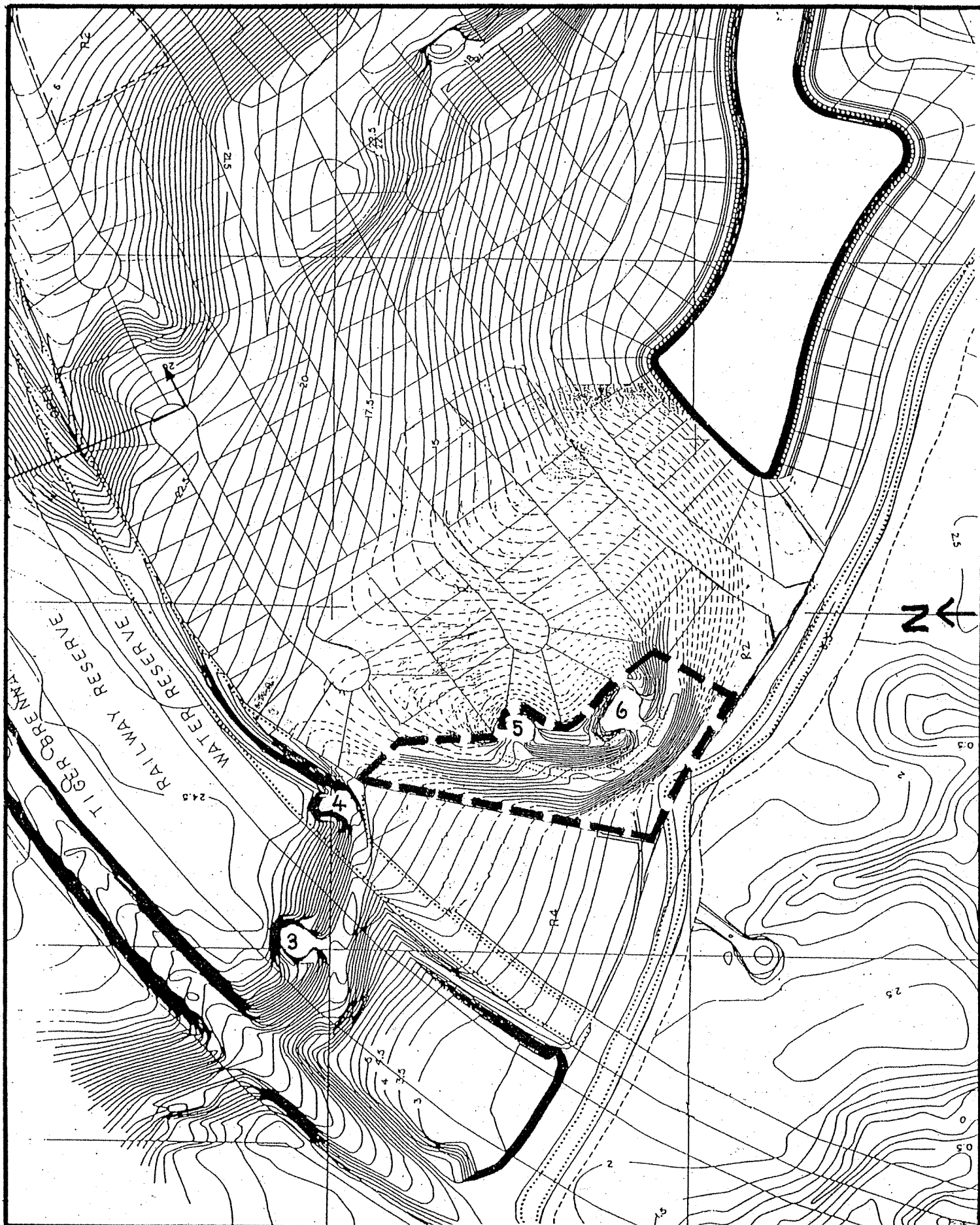
FIGURE 4

FRANCES BAY EXPLOSIVES COMPLEX

SITE PLAN



BAR SCALE



HERITAGE PRECINCT

REFORMED LANDSURFACE

FIGURE 5 REVISED LAYOUT OF SUBDIVISION TO RETAIN HERITAGE SITES 5 AND 6

TABLE 1 SUMMARY OF SUBMISSIONS ON DRAFT EIS

CATEGORY OF COMMENT	PUBLIC COMMENTS				GOVERNMENT ADVISORY BODIES												TOTALS		
	DARWIN CITY COUNCIL	NATIONAL TRUST	ENVIRONMENT CENTRE NT	JACK ELLIS	JAN HILLS	ABORIGINAL AREAS PROTECTION AUTH.	NT EMERGENCY SERVICE	DARWIN PORT AUTHORITY	OFFICE OF LOCAL GOVNT.	WORK HEALTH AUTHORITY	DEPT HEALTH & COMMUNITY SERVS	DEPT OF LAW	DEPT PRIMARY IND & FISHERIES	MUSEUM OF ARTS & SCIENCES	DEPT T & W AND PAMA	DEPT INDUSTRIES & DEVELOPMENT		CONSERVATION COMMISSION	DEPT LANDS & HOUSING
WATER QUALITY - sediment levels may be higher than predicted. Contaminants will occur and absorb onto fine sediments. Flushing to the harbour is a safeguard for the canals only, not the environment as a whole.	X		X	X									X	X	X		X	X	8
WATER QUALITY MONITORING - more detailed monitoring programme needs to be outlined and commitment made to carrying it out.	X		X								X			X	X		X		6
CANAL WATER CIRCULATION - some dead water areas anticipated, some alteration to flushing may be required.			X												X		X		3
WATER QUALITY MANAGEMENT - further detail required on aspects such as contaminated runoff from commercial areas.																	X		1
DREDGING - concern with potential effects of dredging on marine environment.			X								X			X			X		5
ENTRANCE CHANNEL - insufficient information provided on channel construction/maintenance																	X		1
JUSTIFICATION - the need for the project has not been adequately established nor alternatives adequately assessed.			X		X										X				4
ENVIRONMENTAL MANAGEMENT - doubt that existing and proposed management mechanisms are adequate to ensure environmental protection.			X																1
SAFEGUARDS - are generally vague, unrealistic, difficult to measure and audit.			X																2

TABLE 1:
SUMMARY OF PUBLIC AND
ADVISORY BODY COMMENTS
ON BAYVIEW HAVEN CANAL
ESTATE DRAFT EIS

CATEGORY OF COMMENT

SUMMARY OF PUBLIC AND
ADVISORY BODY COMMENTS
ON BAYVIEW HAVEN CANAL
ESTATE DRAFT EIS

CATEGORY OF COMMENT

SUMMARY OF PUBLIC AND ADVISORY BODY COMMENTS ON BAYVIEW HAVEN CANAL ESTATE DRAFT EIS	PUBLIC COMMENTS				GOVERNMENT ADVISORY BODIES												TOTALS		
	DARWIN CITY COUNCIL	NATIONAL TRUST	ENVIRONMENT CENTRE NT	JACK ELLIS	JAN HILLS	ABORIGINAL AREAS PROTEC- TION AUTHORITY	NT EMERGENCY SERVICE	DARWIN PORT AUTHORITY	OFFICE OF LOCAL GOVNT.	WORK HEALTH AUTHORITY	DEPT HEALTH & COMMUNITY SERVS	DEPT OF LAW	DEPT PRIMARY IND & FISHERIES	MUSEUM OF ARTS & SCIENCES	DEPT T & W AND PAMA	DEPT INDUSTRIES & DEVELOPMENT		CONSERVATION COMMISSION	DEPT LANDS & HOUSING
CATEGORY OF COMMENT																			
MANGROVES - concern over effects of mangrove clearance and effects on adjacent mangrove/marine areas.			X	X	X														3
FAUNA - impacts on fauna within and adjacent to development inadequately addressed.			X																1
BASELINE DATA- inadequate baseline data on the harbour and existing er quality makes predictions of impacts and future monitoring results analysis difficult.			X										X						2
MONSOON VINE THICKET - on western side of development site should be preserved.	X		X	X															3
TOPSOIL MANAGEMENT - proposed management and restoration for revegetation considered inadequate, topsoil will be required.	X																X		2
LANDSCAPING - inadequately addressed particularly with regard to sediment control.	X	X																	2
BITING INSECTS - proposed management and control may not significantly reduce insect members. May necessitate increased mangrove clearance, increased mangrove clearance, increased insecticide use.	X	X	X	X	X				X		X		X	X			X	X	11
O'FERRALS ROCK - concern about impacts on integrity of site from development.	X		X											X					3
DRAINAGE - drains with dry season low flows to have concrete inverts, not left open unlined.											X								1
BOX JELLYFISH - will occur in canals therefore swimming dangerous.													X						1

SUMMARY OF PUBLIC AND ADVISORY BODY COMMENTS ON BAYVIEW HAVEN CANAL ESTATE DRAFT EIS	CATEGORY OF COMMENT	PUBLIC COMMENTS				GOVERNMENT ADVISORY BODIES												TOTALS		
		DARWIN CITY COUNCIL	NATIONAL TRUST	ENVIRONMENT CENTRE NT	JACK ELLIS	JAN HILLS	ABORIGINAL AREAS PROTECTION AUTHY	NT EMERGENCY SERVICE	DARWIN PORT AUTHORITY	OFFICE OF LOCAL GOVNT.	WORK HEALTH AUTHORITY	DEPT HEALTH & COMMUNITY SERVS	DEPT OF LAW	DEPT PRIMARY IND & FISHERIES	MUSEUM OF ARTS & SCIENCES	DEPT T & W AND PAMA	DEPT INDUSTRIES & DEVELOPMENT		CONSERVATION COMMISSION	DEPT LANDS & HOUSING
	FINAL LANDFORMS - some areas to steep for normal housing.																	X		1
	MANGROVE MUDS - concerns with stability of muds and effectiveness of handling techniques proposed.			X											X	X		X		4
	DESIGN AND CONSTRUCTION - further detailed investigations required to assure stability of engineering structures.																	X		1
	LOCK GATES - need to be operated by a lock master. Details on design and operation require expansion.																	X		1
	STAGING - of the project needs to be presented in more detail.																	X		1
	RECREATIONAL FISHING - impacts of development not fully assessed in this area.															X	X	X		3
	WASTE REMOVAL FROM BOATS - night soil from boats moored in canals needs consideration.																			1
	IMPACTS OF CONSTRUCTION - on residents of Stuart Park not fully covered.																	X		2
	SADGROVES CREEK MOORINGS - effect of entrance channel on existing moorings not mentioned.																			1
	OPEN SPACE - amount of open space/ recreation area provided is inadequate.	X	X			X														3
	SERVICING - details relating to supply of power, water and sewage need clarification.															X				1

SUMMARY OF PUBLIC AND ADVISORY BODY COMMENTS ON BAYVIEW HAVEN CANAL ESTATE DRAFT EIS	CATEGORY OF COMMENT	PUBLIC COMMENTS					GOVERNMENT ADVISORY BODIES												TOTALS			
		DARWIN CITY COUNCIL	NATIONAL TRUST	ENVIRONMENT CENTRE NT	JACK ELLIS	JAN HILLS	ABORIGINAL AREAS PROTEC- TION AUTHORITY	NT EMERGENCY SERVICE	DARWIN PORT AUTHORITY	OFFICE OF LOCAL GOVNT.	WORK HEALTH AUTHORITY	DEPT HEALTH & COMMUNITY SERV	DEPT OF LAW	DEPT PRIMARY IND & FISHERIES	MUSEUM OF ARTS & SCIENCES	DEPT T & W AND PAMA	DEPT INDUSTRIES & DEVELOPMENT	CONSERVATION COMMISSION	DEPT LANDS & HOUSING			
	RESIDENTIAL ZONINGS - R4 zoning : permitting high rise development should be deleted.														X							1
	VISUAL IMPACT - this aspect received little attention in the EIS.			X														X				2
	ACCESS - problems with vehicle and pedestrian access to subdivision not considered adequately resolved.				X											X	X		X			4
	STORMSURGE - in case of extreme event evacuation of residents below height of seawall recommended. Structures need to be higher to withstand storm surge.							X											X			2
	FIRE IN COMMERCIAL AREA - concern with fumes from fires in boat maintenance areas.							X														1
	SAFETY - construction and handling of materials such as asbestos to be under relevant legislation to ensure worker safety.									X												1
	PUBLIC TOILETS - no facilities proposed for public areas.									X												1
	LEGISLATION - new legislation will need to be introduced to cover the development.												X									1
	ARCHAEOLOGICAL SITES - the significance of sites needs further and more thorough assessment.														X							1
	CULTURAL HERITAGE - the WWII explosive storages recommended for preservation by the consultant's report should be retained.		X	X		X												X				5

SUMMARY OF PUBLIC AND ADVISORY BODY COMMENTS ON BAYVIEW HAVEN CANAL ESTATE DRAFT EIS	CATEGORY OF COMMENT	GOVERNMENT ADVISORY BODIES												TOTALS								
		PUBLIC COMMENTS					ABORIGINAL AREAS PROTEC- TION AUTHORITY	NT EMERGENCY SERVICE	DARWIN PORT AUTHORITY	OFFICE OF LOCAL GOVNT.	WORK HEALTH AUTHORITY	DEPT HEALTH & COMMUNITY SERVS	DEPT OF LAW		DEPT PRIMARY IND & FISHERIES	MUSEUM OF ARTS & SCIENCES	DEPT T & W AND PAMA	DEPT INDUSTRIES & DEVELOPMENT	CONSERVATION COMMISSION	DEPT LANDS & HOUSING		
		DARWIN CITY COUNCIL																				
		NATIONAL TRUST																				
		ENVIRONMENT CENTRE NT	X																			
		JACK ELLIS																				
		JAN HILLS																				
	ESTATE MANAGEMENT - details of various management costs, responsibilities and who they will fall to are required. Maintenance, operation and rehabilitation should not be at public expense.																					
	PLANNING - need for appropriate planning and strategy for development of whole of Frances Bay.																					

TABLE 2

**SUMMARY OF IMPACTS, SAFEGUARDS AND PREDICTED EFFECTS
TAKEN FROM THE BAYVIEW CANAL ESTATE EIS**

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
A. BIOPHYSICAL			
1) Loss of landform and habitat for terrestrial fauna.	(a) Retention of a buffer zone between the canal estate and Tiger Brennan Drive. (b) Avoidance of damage to the surrounding terrestrial areas during construction. (c) Retention of vegetation where possible, particularly in the eastern part of the estate.	Complete change in landform and removal of habitat from the developed area of the site. Some change in landform and habitat in the buffer zone, and possibly in areas adjacent to the site.	CCNT
2) Loss of mangrove community (19ha) and mangrove feeding areas.	(a) Finalisation of the site boundary along Sadgroves Creek to minimise the zone of mangroves affected by the development. (b) Avoidance of direct damage and minimisation of indirect damage to mangroves outside the estate boundary during construction. (c) Mangroves will not be cleared to eliminate biting midge breeding habitat.	Nineteen hectares of mangroves will be covered by the development. It is predicted that a further 8 to 12 hectares of mangroves will be indirectly affected by construction and operation of the estate services and facilities.	CCNT
3) Possible decrease in salinity and increased pollution due to mangrove removal.	(a) Control of drainage, discharges and water quality during construction and by the management body and marina operator.	The biological buffer afforded by the mangroves affected by construction will be removed.	CCNT/PAWA

NOTE: Bold type indicates safeguards or effects not included in Table S7 of the final EIS, but contained in the text of either the draft or final EIS.

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
4) Disturbance of marine fauna and erosion due to the increase in boat traffic.	(a) A restriction will be imposed on boat speed in Sadgroves Creek, the entrance channel and the marina canals. (b) A community education programme will be provided by the developer to promote public awareness of the use of Sadgroves Creek by marine fauna. (c) Erosion of the external batters of the seawall will be minimised by the use of appropriate rock protection on the wall.	Increased boat traffic travelling at below the speed restriction limit will have a limited effect on marine fauna. Boat wakes will not cause seawall erosion; however, erosion of mudbanks in Sadgroves Creek and the entrance channel may result from the increase in boat traffic.	DPA/CCNT
5) Reduction of water quality in canals and the adjacent creek and harbour waters.	(a) Canal design, pumping capacity and low residence time will ensure adequate flushing of the canals and prevent nutrient enrichment and oxygen depletion in canal waters. (b) Estate housing, landscaping and services design will minimise the runoff of sediment into the canals. (c) The management strategy will ensure that there is minimal use of fertilisers by canal estate residents and that uncontrolled discharges into the canals will be prohibited. (d) Public awareness programmes will be carried out and signs will be erected to control litter. (e) The marina operator will be specifically responsible for litter cleanup in the marina. (f) Hull maintenance will not be permitted in the canals, marina or hardstand areas. (g) Water quality testing will be carried out before the release of water from inside bunded areas during construction and corrective action taken if necessary.	A building-up of fine silt is predicted in the canals from the pumped flushing water and rainfall runoff. Isolated but infrequent algal blooms are predicted due to adverse weather conditions leading to inadequate mixing and temperature gradients in near surface canal waters. Water quality will remain relatively high.	DPA/CCNT

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
5) CONT	(h) Ensuring residents and canal users are aware of the requirements of the four legislative instruments which regulate the disposal of pollutants into canals and Darwin Harbour. (i) Boats moored in canals will be required to have chemical toilets or sewage pumpout facilities. (j) Bilge discharge will not be permitted in canals. (k) Signposting of canal water regulations. (l) Public education and publication of appropriate interpretive material outlining water management strategy. (m) Outlet pipes will be incorporated into the base of the bund wall below the overflow weirs to facilitate water circulation in canals and improve water quality. (n) A water quality monitoring strategy has been prepared which includes sampling at six locations, inside and outside the canal system three times each year. A range of parameters including heavy metals and pesticides will be analysed for at least once per year.		
6) Pollution from sewage overflow, stormwater discharges, oil and other hydrocarbons.	AS FOR ITEMS (g) - (n) ABOVE, AND (a) Sewage pump stations will be located outside the canal catchment area and any overflows will be dispersed and diluted in the tidally flushed areas of Sadgroves Creek.	It is not intended that there will be any pollution of the canals from sewerage overflow. The predicted effects from stormwater discharge will be no greater than the effects for the current uncontrolled land use of the area.	CCNT/DPA/NTES

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
6) CONT	(b) Regular street cleaning will be carried out and grated pits and oil separates will be installed to separate solids and liquids near the marina. (c) Regulations will be included in the body corporate documents to prohibit uncontrolled discharges of oils, etc. into the canals. (d) An approved oil spill contingency plan will be prepared by owner/operator which will require the marina operator to be prepared for a clean up in the marina and/or the canal areas. (e) Marina fuelling infrastructure including storage tanks, automatic cut-off systems, bunds and sumps will be designed and operated with appropriate safety procedures as approved by supplier, CCNT, WHA and DTW and will be the responsibility of the owner/operator.		
7) Pollution from anti-foulant chemicals and other substances used for boat maintenance and operation resulting in an increase in heavy metal concentrations in marine sediments.	(a) The marina operator will be required to carry out a regular washdown of the boat maintenance area and disposal of the residue off-site. (b) There will be a government ban on TBT based anti-foulants by the time the canals are operational. (c) Swimming and harvesting of fish and crustaceans in canals will be discouraged by appropriate signs/brochures. (d) Hull maintenance will not be permitted in the canals, marina or hardstand areas.	There is no predicted effect on the marina, canals or Sadgroves Creek from chemical substances used in the boat maintenance area. There may be some effect on marine organisms in Sadgroves Creek or Darwin Harbour from anti-foulant chemicals, but this will be controlled by Government regulation.	CCNT/DTW/DPIF

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
7) CONT	(d) Hull maintenance will not be permitted in the canals, marina or hardstand areas.		
8) Dust generated during construction affecting the local air quality.	(a) No blasting will be carried out during construction. (b) Suppression of dust on haul routes by the use of water carts and sprays. (c) Limitation of work by the contractor in certain areas when dust is generated by strong adverse winds. (d) Wet season rainfall will remove dust from trees.	Dust produced during construction will have no long-term effects on the surrounding environment. No dust will be generated from the project area after the completion of earthworks and landscaping.	CCNT/DTW
9) Noise pollution during construction and noise from the estate housing and boat traffic affecting the local environment.	(a) Modern construction machines are fitted with air-conditioned cabins and noise attenuation mufflers. (b) In Stage 1, machines will be working on the eastern side of the site "behind" the high ground and in Stages 3 & 4 the machines will be working below the outer bund wall level. (c) There is a railway easement, buffer zone and vacant land to the north west of the site which will attenuate noise when the dry season south easterly winds are blowing. (d) The management body will establish guidelines and penalties for boat noise emissions.	'Normal' noise associated with construction site activities. 'Normal' noise from a residential area. Boat traffic noise will affect the canal-side lot residents.	DCC/DPA

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
10) Visual impact from the removal of natural vegetation, reshaping the landform and construction of the canal estate.	(a) Landscaping will be carried out by the developer along the buffer strip. (b) Landscaping will also be carried out by the developer on areas of public open space along the bund walls as each stage of the development is completed. (c) The management body will ensure reasonable aesthetics within the development by the application of covenants and their enforcement by the management body. (d) Building height in the R4 zone will be limited to four storeys. (e) Landscaping plans will be developed in consultation with CCNT and DCC.	Bare areas will eventually be replaced by landscaped lots and street scapes. A well developed, aesthetically pleasing residential development will be established.	CCNT/DCC
11) Increased mosquito breeding during construction.	(a) Grading and draining the site so that water does not pond during the wet season. (b) Following guidelines to prevent mosquito breeding (Whelan 1988). (c) Stormwater drains will have concrete inverts to minimise vegetation growth and water ponding. (d) Spraying programme for specific areas if warranted after consultation with DHCS.	Minimal short term effects predicted from possible increased mosquito breeding on the site during construction. Long term effects expected to be negligible within the estate.	DHCS

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
12) The impact of biting midges and the insecticides used to control the biting midges.	(a) Provision of an open wind area 50-100m wide between the mangroves and the residential estate. (b) Provision of a vegetation strip on the landward side of a light barrier on the outer edge of the wind belt. (c) Slight reduction in the area of biting midge breeding grounds by estate construction and operation. (d) The management body will conduct a public education programme to alert residents to the biting midge problem and control programme. (e) The management body will arrange monitoring of biting midge numbers and investigate control measures in conjunction with government agencies. (f) When necessary to use insecticides, the less environmentally damaging chemicals will be used and application will be under strict control. (g) A statement will be included in the land title document which states that biting insects are present in the area in large numbers at certain times and may be of concern to some residents. The statement will also make it clear that biting midges will not be controlled by government either by spraying or removing breeding habitat.	Biting midges will effect residents' outdoor activities at certain times, particularly on the edge of the estate.	DHCS/CCNT/DCC

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
13) Soil erosion and loss of topsoil during earthworks construction and site building activity.	(a) The main earthworks construction will be carried out during the dry season to minimise erosion. (b) Each stage of the development will be separately bunded to prevent loss of soil. (c) Silt traps will be placed at the location of outlets to Sadgroves Creek. (d) Rehabilitation and landscaping of each completed stage will be planned for completion before the onset of the wet season storms. (e) Temporary grading and drainage will be provided in areas not completed by the end of the dry season. (f) Any adverse environmental impacts caused by erosion during any stage of construction will be rectified during the subsequent stage. (g) During the later stages of the development, silt fences, sediment trenches and silt traps will be strategically placed to prevent erosion from canal front lots before the lots are developed and landscaped.	It is predicted that wet season storms will cause some erosion on undeveloped blocks and areas adjacent to roads and services during the construction period. Erosion will continue to occur in drainage paths and stormwater channels after construction until a stable drainage system is reached.	CCNT/DTW
14) Increased turbidity from runoff and erosion and increased sedimentation in the estate canals and Sadgroves Creek.	SAFEGUARDS AS FOR IMPACT NO.13 ABOVE, AND (a) The management body will provide and enforce guidelines to prevent erosion and runoff from canal side lots from entering the canals. (b) The management body will monitor siltation in the canals, entrance channel and Sadgroves Creek and initiate remedial maintenance to mitigate any problem.	It is predicted that the turbidity and sedimentation in Sadgroves Creek caused by the construction and operation of the estate will be reduced to an acceptable level by the safeguards and will continue to reduce as the estate becomes landscaped and the new landform stabilises.	CCNT/DTW

POTENTIAL
IMPACTS

SAFEGUARDS

PREDICTED EFFECTS
AFTER SAFEGUARDS

OVERSEEING
AUTHORITY

14) CONT

- (c) Gross sediment traps will be constructed near stormwater outlets into the canals.
- (d) A benchmark survey in the channels will be undertaken during site surveys prior to construction so that siltation can be monitored and remedial action planned.

(15) Susceptibility of the development to cyclones, storm surge and greenhouse effects.

- (a) Design levels of the lock and external perimeter embankment are RL + 6.5m (AHD) to prevent inundation by a 1 in 1000 year storm surge.
- (b) The management body will prepare and implement an emergency response plan in co-operation with NTES.
- (c) Commercial and domestic buildings in the estate will be designed for Category 1A terrain as prescribed in the wind loading code.
- (d) Temporary bulkheads will be provided at the lock gates as protection during cyclone and storm surge events.
- (e) Allowance for increase in height of outer portions of perimeter embankment. Design of the outer lock gates will also allow for future vertical extension.

The estate will be protected from inundation by a storm surge up to the level of a predicted 1 in 1000 year event.

CCNT/DPA/NTES

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
(16) Placement of earth fill over mangroves and marine mud creating acidic and saline conditions and possible settlement problems.	(a) The outer boundary of the estate has been limited by the criterion to construct the perimeter wall on mud less than 3m deep and for most of the length of the wall on mud less than 2m deep. (b) Settlement of the bund wall will be monitored and appropriate pre-loading applied to reduce long term total and differential settlements. (c) For internal earthworks, the mud will be removed, solar dried and replaced as compacted engineered fill to eliminate consolidation settlement. (d) The marine mud will be covered with a minimum of 2.5m of terrestrial fill to prevent swelling and to reduce oxidation of sulphides and the potential for acid generation. (e) Mangroves will be cleared and removed before placement of fill on the bund wall alignment to reduce settlement and the production of methane gas associated with the decomposition and compression of organic matter. (f) Further geotechnical investigations and testing will be carried out on the final alignment of the bund wall to determine mud depths and compressibility for consolidation and long term settlement predictions prior to construction commencing. (g) Woven geotextile fabric will be placed over unconsolidated marine muds prior to construction of initial bund and sea walls.	It is predicted that the methods proposed for reclamation of the area of mangroves and mud will result in minimal adverse engineering or environmental impacts either inside or outside the boundaries of the canal estate.	CCNT/DTW

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
(17) Subsidence of allotments over underground munitions site 13.	(a) The underground bunker will be exposed and filled with compacted engineered fill and the natural surface contours will be re-established around the site. Other munitions sites to be destroyed will be similarly treated to conform to natural surface contours.	No subsidence or appreciable settlement will occur.	DTW
(18) Erosion of sea wall through wave impact, leaching of lines from wall core.	(a) The outer bund wall will have a toe protection apron. The face will consist of large rocks excavated from the site and designed to resist maximum waves predicted for design life of structure. (b) Filter layers of intermediate sized rock or geotextile fabric will be placed between the core of the bund wall and the outer layer of armour rock.	The sea wall will resist erosion and remain stable.	DTW
(19) Differential water heads inside and outside canals will place pressure on sea wall.	(a) Initial bund walls for each stage will be designed as earthfill dam walls to withstand head difference. (b) The inner slope of the bund wall will be designed for the "end of construction" and "rapid drawdown" cases, and the outer slope will be designed for "end of construction" and "steady seepage" cases. (c) The completed sea wall will have a differential head of between 1-2 metres. The bulk fill will have low permeability to reduce seepage losses from canals.	Seepage gradients across the sea wall will be low and not sufficient to initiate piping or internal erosion.	DTW

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
(20) Unpredictable behaviour of dried marine muds to be used for consolidated fill/effects of drying of muds.	(a) Drying and replacement of saturated soils encountered during construction earthworks. (b) The area used for drying of mud will be approximately twice the area from which the mud was excavated at any one time. (c) The mud will be dried to about 30% moisture content then compacted in layers to a target density of 1.4t/m³ at an air voids ratio of 5-10%. Further geotechnical investigations will be undertaken to determine the compaction, strength and consolidation properties of solar dried mud so that stability can be confirmed and long-term settlement predicted.	Behaviour of dried muds will be predictable and settlement/stability problems minimal.	DTW/CCNT
(21) Groundwater seepage may soften compacted mud and develop a perched water table. May cause capillary rise of salts.	(a) The low permeability and low air voids ratio of the compacted mud will prohibit ingress of groundwater and preclude mud softening and loss of strength. Laboratory testing before final design phase will be carried out to determine the saturated strength and permeability of compacted mud. (b) If a perched water table forms it will be at least 3.5m below ground surface and below the level of water in the canals. (c) Monitoring bores will be installed in the fill after the completion of earthworks to monitor the groundwater levels and provide water samples for testing.	Compacted mud will not soften or lose strength. Perched water table will not affect upper soils of canal lots.	DTW

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
(22) Effects of construction and maintenance dredging on the marine environment.	(a) Dredge spoil from construction of the Sadgroves Creek approach channel will be disposed of within the confines of the development. (b) Maintenance dredging requirements should be slight due to control of sedimentation from runoff, flushing of entrance channel through outflow from lock operation, and experience with other dredged channels in the vicinity. (c) Any maintenance dredging would be undertaken according to the requirements of the responsible authorities, on appropriate tidal cycles, and spill disposed of as directed by the authorities. (d) Maintenance dredging of canals will be infrequent due to mechanisms to control sediment runoff. Dredging could be done by dewatering canals first.	Short term increased turbidity levels in Sadgroves Creek during dredging operations.	DPA/CCNT
(23) Maintenance and proposed automatic operation of lock could cause problems.	(a) All mechanical equipment associated with lock operation will be installed above water level. (b) A sliding gate automatic system modelled on Bel Marin Keys, California, where there have been no accidents or serious failures, is preferred. (c) The management body will be responsible for letting a period contract for regular inspection and servicing and annual maintenance and refurbishing of the lock.	Lock operation will be incident-free.	DPA/DTW

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
(23) CONT	(d) Bulkheads will be provided for insertion behind gates when required for maintenance or repair work.		
(24) Changes to design over the four year staged construction period could occur and not be subject to environmental assessment.	(a) The proponent will provide CCNT with details of project changes as the development progresses and will willingly participate in CCNT's review of this information.	Adequate environmental protection will be negotiated at all stages of development.	CCNT
(25) Location of sewer rising main underneath the canal lock will present maintenance problems.	(a) The rising main will either be cast into the base slab of the lock or placed in a lidded trench which would be accessible with the lock fully drained.	Maintenance of the sewer will not be a problem.	PAWA
(26) Canals widths not sufficient for clear navigation.	(a) Criteria for navigable widths for canals, channels and marina fairways recommended by CCNT will be incorporated in final design.	Canals will be wide enough for clear navigation of all design vessels.	DPA/CCNT
(27) Heavy metals and pesticide pollutants in muds already on site would be released by disturbing the muds during the dredging and clearing of mangroves.	(a) The developer will undertake marine sediment sampling and a bio-accumulation study of an appropriate marine organism before work on site commences to establish baseline heavy metal and organic pollutant levels.	Heavy metal pollutant concentrations will be tracked in some detail to enable ameliorative measures to be investigated if necessary.	CCNT/DPA/DPIF

**POTENTIAL
IMPACTS****SAFEGUARDS****PREDICTED EFFECTS
AFTER SAFEGUARDS****OVERSEEING
AUTHORITY**

27) CCNT

- (b) A condition of passing the title from developer to management body will be inclusion of continuation of marine sediment and water quality monitoring.
 - (c) Heavy metal concentrations in the canal sediments will be measured following the first year of operation of the lock system.
-

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
-------------------	------------	------------------------------------	----------------------

B. SOCIAL

1) Effect of the development on historical and archaeological sites.	(a) A detailed plan and photographic record of all sites will be compiled before the development interferes with any of the sites. (b) Deleted (c) The developer will liaise with heritage authorities and government on the requirements for records to be kept and sites to be retained. (d) A record of all shell scatters on the site will be compiled prior to construction activity on the site. (e) An archaeological salvage excavation of significant finds will be undertaken prior to construction. (f) Any shell scatters or other archaeological sites encountered during construction will be reported to the NT Museum and work will be terminated in the area until clearance to proceed is negotiated.	The proposed safeguards will ensure that there is no unauthorised adverse effect on any heritage or archaeological site currently known or encountered during construction.	MAGNT/CCNT
2) Danger from crocodiles and box-jellyfish and drowning in the canals and Sadgroves Creek.	(a) The salt water intakes to the canals will be screened both during initial filling and at the water circulation pump intakes. (b) The overflow weirs will also be screened. (c) The management body will provide public education on the dangers and responsibilities of living on a canal estate and will	Accidental drowning, stings or crocodile attack would be a result of personal negligence rather than a consequence of insufficient information and warning provided by the management body.	CCNT

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
2) CONT	(c) provide signs discouraging swimming, particularly in the period October - May. (d) Lifesaving equipment will be provided on jetties, at the marina and at the lock.		
3) Increased vehicular traffic on Tiger Brennan Drive and other approach roads to the canal estate. Requirement for relocation of planned future roundabout.	(a) Two new intersections will be designed and constructed on Tiger Brennan Drive in accordance with DTW requests and guidelines. (b) DTW will be provided with predicted population trends in the canal estate to enable planning of the re-direction or upgrading of nearby traffic. (c) The proponent has undertaken to provide an acceptable future foundation for the new roundabout intersection.	Some additional delays to through traffic will be created by the intersections on Tiger Brennan Drive.	DTW
4) Difficult access for pedestrians and cyclists.	(a) Pedestrian/bicycle access to and from, and within the estate will be planned in conjunction with DTW.	Satisfactory provision of bicycle/pedestrians access.	DTW
5) All normal services and facilities afforded to other ratepayers in the Darwin City region will have to be planned and provided to the residents of the canal estate.	(a) Power, water and fire services will be provided to the estate. (b) Stormwater drainage and sewerage systems will be constructed with overflows into the tidally flushed areas of Sadgroves Creek. (c) Domestic garbage collection and disposal services will be provided by the DCC contractor. (d) Commercial and industrial services are in close proximity at Darwin City, Stuart Park, Parap and Winnellie.	High quality residential suburb.	DTW/DCC

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
5) CONT	(e) The nearby schools, Stuart Park and Parap Primary; Darwin High and St John's College, can cater for potential student numbers from the proposed estate. (f) Darwin Bus Service could service the estate as an extension to the Stuart Park or Winnellie routes. (g) Passive recreational areas will be available on the estate. Over 11% of the estate land area has been set aside as open space. (h) "Green" streets will be provided as appropriate and if agreed by government.		
6) Boat traffic in the approaches and lower reaches of Sadgroves Creek will be increased.	(a) Navigational aids will be provided in the lower reaches of Sadgroves Creek and the approach channel to the lock. (b) Lay-bys will be installed inside and outside the lock entrance to allow temporary mooring of craft while waiting to use lock.	Possible cumulative impact on Sadgroves Creek.	DTW/DPA
(7) Noise and visual impacts from Tiger Brennan Drive on residents of the estate.	(a) A 25m landscaped buffer strip between the estate and road will be established, in addition to the separation which exists due to the rail and water reserves.	The buffer will reduce visual, but not noise impacts, on the estate.	CCNT
8) Inadequate open space/ community facilities.	(a) Parklands/open space will be increased to 11% of the land area of the estate. (b) Community parks will be equipped with childrens' playground facilities.	Adequate public open space will be available.	CCNT/DCC

POTENTIAL IMPACTS	SAFEGUARDS	PREDICTED EFFECTS AFTER SAFEGUARDS	OVERSEEING AUTHORITY
8) CONT	(c) Linear parks will be designed for cycling, wheelchair and pedestrian use and will be appropriately landscaped.		
9) Visual impacts of non-standard private jetties.	(a) The visual integrity of the canal lots will be maintained through an appropriate development covenant administered by the management body.	Visual impacts of private jetties will be minimised.	CCNT/DPA
10) Inadequate estate management will result in adverse environmental and social impacts.	(a) Special legislation will be introduced by government to allow appropriate management of common property by a management body or Body Corporate. Legislative control over the body will ensure the responsibilities are not neglected. (b) The areas to be managed by the body include the canals, marina, navigation lock, pumping system, water quality and certain open space.	Effective management will minimise environmental effects potentially arising from construction and operation of the estate.	CCNT/DLH

KEY TO OVERSEEING AUTHORITY ABBREVIATIONS

CCNT -	Conservation Commission of the Northern Territory
PAWA -	Power and Water Authority
DPA -	Darwin Port Authority
NTES -	Northern Territory Emergency Services
DTW -	Department of Transport and Works
DCC -	Darwin City Council
DHCS -	Department of Health and Community Services
DPIF -	Department of Primary Industry and Fisheries
MAGNT -	Museums and Art Galleries of the Northern Territory
DLH -	Department of Lands and Housing

**APPENDIX A PORT AND HARBOUR CONSULTANTS - REVIEW OF DRAFT
EIS**

DARWIN

BAYVIEW HAVEN CANAL ESTATE

REVIEW OF DRAFT ENVIRONMENTAL IMPACT STATEMENT

Prepared by

PORT AND HARBOUR CONSULTANTS PTY. LIMITED

NOVEMBER 1991

TABLE OF CONTENTS

<u>Section No.</u>	<u>Heading</u>	<u>Page No.</u>
1.0	INTRODUCTION	1
2.0	THE CANAL ESTATE, CONCEPT AND DESIGN	2
3.0	POTENTIAL IMPACTS ON COASTAL PROCESSES/ LANDFORMS IN TERMS OF WATER AND SEDIMENT MOVEMENTS, EROSION, ETC.	6
4.0	ADEQUACY OF INVESTIGATIONS AND DESIGN RELATING TO THE STABILITY OF STRUCTURES SUCH AS SEAWALLS, REVETMENT AND LOCK STRUCTURES	8
5.0	IMPACTS OF DREDGING AND RECLAMATION IN TERMS OF SETTLEMENT, STABILITY, BEHAVIOUR OF MARINE MUDS, REQUIREMENTS FOR MAINTENANCE DREDGING	10
6.0	LOCK STRUCTURE DESIGN AND OPERATION	12
7.0	PREDICTED WATER QUALITY WITHIN THE CANALS IN TERMS OF MIXING, FLUSHING, POTENTIAL FOR ACCUMULATION OF POLLUTANTS SUCH AS HEAVY METALS	14
8.0	PROPOSED ESTATE MANAGEMENT IN RELATION TO MATTERS ASSOCIATED WITH ENVIRONMENTAL PROTECTION SUCH AS OPERATION OF FLUSHING SYSTEMS AND LOCK, MAINTENANCE DREDGING, EROSION, WATER QUALITY, ETC.	16
9.0	DESIGN OF INTERIOR CHANNELS, FAIRWAYS AND BERTHS WITHIN THE CANAL SYSTEM AND MARINA	18
APPENDIX	ABBREVIATED C.V.'s OF REVIEWERS	20

1.0 INTRODUCTION

1.1 In response to the commission by the Environment Protection Unit of the Conservation Commission of the Northern Territory, Port and Harbour Consultants Pty. Limited have undertaken a review of the Draft Environmental Impact Statement for the proposed Bayview Haven Canal Estate.

1.2 Terms of Reference are that the Conservation Commission is seeking independent expert advice and review of the following aspects of the project:

- (i) The canal estate, concept and design.
- (ii) Potential impacts on coastal processes/landforms in terms of water and sediment movements, erosion, etc.
- (iii) Adequacy of investigations and design relating to stability of structures such as seawalls, breakwaters and revetment.
- (iv) Impacts of dredging and reclamation in terms of settlement, stability, behaviour of marine muds, requirements for maintenance dredging.
- (v) Lock structure design and operation.
- (vi) Predicted water quality within the canals in terms of mixing, flushing, potential for accumulation of pollutants such as heavy metals.
- (vii) Proposed estate management in relation to matters associated with environmental protection such as operation of flushing systems and lock, maintenance dredging, erosion, water quality, etc.

1.3 Port and Harbour Consultants staff who were engaged in this review were:

- (i) Alan G. Smith - Principal
- (ii) John P.A. Schepis - Associate/Senior Coastal Engineer
- (iii) Haddin A.W. Barr - Senior Design Engineer

Brief C.V.'s of these reviewers are attached as an appendix to this report.

THE CANAL ESTATE, CONCEPT AND DESIGN

2.1 Introduction

The proposal is to develop a high quality residential canal estate along the northern shore of the middle reaches of Sadgroves Creek, Darwin Harbour. The estate will include a mix of detached residential dwellings, cluster dwellings, high density residential dwellings and commercial property around a canal system and marina.

125 house lots will have canal frontage and the marina will provide space for 60 berths which will be available to residents without canal frontage or other users from outside the canal estate. The development will help satisfy a demand for safe moorings for boats within the Darwin area.

2.2 General Comments

- (a) The concept is for a fully enclosed canal system and marina with water level maintained at about R.L. 3.2 m above A.H.D. A lock is to be used for the passage of boats to and from a dredged entrance channel into Sadgroves Creek. Flushing of the canal system and marina is to be achieved by pumping in seawater from Sadgroves Creek near the lock and discharging via weirs at the canal extremities back into Sadgroves Creek.
- (b) The perimeter seawall and outer end of the lock have top levels set at a minimum of R.L. 6.5 A.H.D. following comments by the Bureau of Meteorology in its review of the Preliminary Environmental Report. This gives a freeboard of 300 mm on the current prediction for the 1000 year cyclonic surge level.
- (c) Canal frontage housing allotments have their minimum ground surface level set at R.L. 5.0 A.H.D. This level corresponds with the 100 year cyclonic surge level as predicted in the "Greater Darwin Storm Surge Study". (This criterion agrees with the recommendation for minimum building floor levels in canal estates contained in the W.A. Government publication "Recommendations for the Development of Canal Estates".) There is therefore an outside chance that a failure of the seawall or lock gates could "lead to" flooding of private property within allotments with canal frontage.

2.2

General Comments

(c)

cont'd

Litigation against the owners of the failed structure could follow as a result. Design and construction of the seawall and lock gates and their respective foundations must therefore be vigorously checked and supervised. Thorough geotechnical investigations of the site are essential.

(d)

Approximately one third of the development involves reclamation over low lying areas of mudflats and mangroves. Because of the settlement problems associated with reclaiming over saturated marine mud it is proposed that where reclamation is planned, all the marine mud will be physically removed, solar dried, then placed back in its original position as a consolidated engineering fill material. When used as an engineering fill material, the solar dried marine mud will be restricted to a maximum total thickness of 1.5 metres. Over this will be placed a terrestrial fill material of not less than 2.5 metres thickness. By using this method and by properly consolidating the solar dried marine mud fill, it is anticipated that long term settlement will not occur. This method is also designed to prevent escape from the marine mud of toxic salts into the groundwater. Reclamation over marine mud areas will be limited to where the existing thickness does not exceed 3.0 metres. This limitation is based on stability problems at the edge of the fill zone, but more importantly is based on the need to limit the initial consolidation period and minimise long term differential settlements.

2.3

Recommendations

(a)

As the Bayview Haven Canal Estate involves creating a system of canals with water surface level maintained at approximately 3.2 metres above mean sea level, the seawall will in effect be acting as an earth dam holding back the waters of the canal system. At extreme high tides the seawall holds back the sea. It is conceivable that seepage through the earthfill and seawall could pose operational problems in maintaining the design water surface level within the canals in addition to causing other problems such as loss of fines and instability within the seawall. Therefore thorough and detailed engineering investigations and assessment of geotechnical

Recommendations

- (a) cont'd
- conditions, seawall integrity, lock structure in addition to other aspects of the design of the canals will be required. Recommendations on these and other issues are given in this review.
- (b) The EIS contains a report on a two dimensional water circulation analysis of the canal system. The report identifies the best option of a number of inflow/outflow arrangements investigated by means of the "Wessie" computer model. This model was developed by the CSIRO to study two dimensional circulation patterns and sedimentation within lakes, canals and other water bodies and is an appropriate tool to use in this project. The model being two dimensional does not calculate vertical variation of low velocity. However, the identifying of "dead" areas of very low water circulation in the two dimensional model is very useful and sufficient to identify both the best inflow/outflow arrangement and to identify the potential "dead" areas. These "dead" areas are locations at which stormwater (possibly containing pollutants) should not be allowed to discharge. It is therefore recommended that stormwater drain outfalls not be permitted along the western section of the southern shoreline of the western canal or along the northern side and eastern side of the marina. It is also recommended that clarification be given on the implication for pump cycle times of closing the outfall weirs during tides above R.L. 3.2 A.H.D.
- (c) Details of the dredged entrance channel should be included in the EIS. Information needs to be provided on the intended minimum navigable waterway width within the entrance channel; the proposed channel side slopes given the presence of transverse and longitudinal current velocities; and the possible beneficial role of the mangroves in aiding the stabilisation of the channel profile. The provision of a silt trap to entrap sediments moving downstream in Sadgroves Creek and those exiting from the Canal Estate is an option to be considered. The above factors will determine the volume of excavation required for an entrance channel which is safe to navigate and requires the least frequent maintenance dredging.

2.3

Recommendations

(c) cont'd

Those factors also have implications for the impact of the project on the natural environment within Sadgroves Creek and Darwin Harbour.

(d) Following (c), details should also be provided on designated spoil areas for development and maintenance dredging of the entrance channel.

(e) Consideration should be given to the provision of entrance breakwaters and channel entrance navigation aids to provide safe passage within the entrance channel.

(f) The design of the seawall and lock gates should allow for two sets of extreme water level events namely:

(i) 100 year cyclonic surge level + 0.3 m allowance for Greenhouse Effect + allowance for wave and wind setup.

(ii) 1000 year cyclonic surge level.

A 0.3 m freeboard to the extreme level should be provided in each case.

ADEQUACY OF INVESTIGATIONS AND DESIGN RELATING TO THE STABILITY OF STRUCTURES SUCH AS SEAWALLS, REVETMENT AND LOCK STRUCTURE

4.1

General Comments

- (a) As mentioned previously in Section 1.0 of this review, thorough and detailed engineering investigations and assessment of geotechnical conditions which affect the seawall integrity, lock structure and its foundation design will be required. Though the final embankment/seawall is a relatively broad and low structure which at first impression appears to present no stability problems, it must be realised that the greater proportion of the width will be bulk fill material of a permeable to highly permeable nature. Consequently the initial bund wall within the embankment/seawall should be able to withstand the full hydrostatic head of the canals relative to external intertidal mudflat ground level and provide the necessary impermeability to seepage flow.
- (b) Externally, the seawall (and initial bund wall) should be designed as a breakwater seaward face with properly controlled armour stone size and underlying filter layer. The armour stone size should be selected to resist the maximum wave climate appropriate to the design life of the structure, current velocities arising through tidal influences and boat wash. It is suggested that the 100 year return cyclone including an allowance for Greenhouse Effect be accepted as the design criteria.
- (c) The seawall itself will be founded on undisturbed marine mud and therefore subject to settlement over an extended period of time. The impermeable core should be such that it remains intact notwithstanding the settlement of the seawall.
- (d) The design of the lock structure is multi-disciplined. Geotechnical, hydraulic, structural, mechanical and electrical engineering are involved to varying degrees. The geotechnical aspects of the design will possibly present the biggest challenge.

4.2

Recommendations

- (a) As the seawall in effect becomes an earthfill dam, comprehensive geotechnical testing and reporting on foundation conditions is required. All embankment structures which are to retain a differential water level head are to be designed in accordance with established procedures for earthfill dam design. Scour of embankment toes is to be examined.
- (b) The geotechnical investigations will also account for the presence of the marine mud which may lead to long term settlement of the seawall (and entrance breakwaters if built). Due allowance for settlement is to be made in design and the performance of the structures should be monitored during the construction period and at regular intervals thereafter. Any requirement for staging embankment construction is to be considered and a construction programme should be submitted.

5.0

IMPACTS OF DREDGING AND RECLAMATION IN TERMS OF SETTLEMENT, STABILITY, BEHAVIOUR OF MARINE MUDS, REQUIREMENTS FOR MAINTENANCE DREDGING

5.1

General Comments

- (a) As previously stated in this review about one third of the area of the development will include reclamation over intertidal mangrove mudflat areas and the prior physical removal, solar drying and the replacement as a consolidated fill of the marine mud itself. The full depth of the marine mud will be removed for solar drying and recompaction. However, depth of excavation will not exceed 3.0 metres as marine mud sediments of greater thickness than this are excluded from the planned areas of reclamation. The reclamation areas should therefore be free of long term settlement problems providing the drying and consolidation process is properly engineered and monitored.
- (b) The seawalls will be built on undisturbed, hence unpreconsolidated marine mud and therefore subject to long term settlement. The seawall is in effect being constructed in two stages, the first stage being as the initial bund wall construction to a height of R.L. 4.5 A.H.D. As stated in paragraph 3.2(b) the structure should be monitored during the construction phase and thereafter.
- (c) Dredging of the entrance channel will involve a cut of two to three metres depth through marine mud sediments in the intertidal mangrove mudflat area. Stability of the marine mud will depend on the design slope adopted for the channel side slopes and the degree to which the mangrove root systems hold the soil. The mangroves also assist by impeding water flow at the mud surface. The continued presence of healthy mangroves adjacent to the dredged entrance channel side slopes is therefore important.
- (d) As stated previously, the dredging programme should be arranged to coincide with predicted low tides to maximise the amount of excavation carried out in the "dry".

5.1 General Comments cont'd

- (e) Ongoing maintenance dredging will probably be required in the entrance channel not because of sediment brought down from the development but because of sediment movement within Sadgroves Creek during periods of high run-off and also from occasional slumping within the entrance channel itself. The latter will tend to become less with the passage of time as the side slopes gradually achieve a stabile profile.

5.2 Recommendations

- (a) Regular monitoring of the initial bund wall construction and subsequently the seawall construction for settlement should be set in place to check for potential problems regarding integrity of the bund wall and its impermeable core.
- (b) The solar drying and consolidation of the marine mud subsequently must be carried out strictly in accordance with an approved soils engineering procedure. Certification of reclaimed areas as being suitable for development should be obtained from an independent approved soils testing laboratory.
- (c) A design for the entrance channel including protective breakwaters and silt trap if investigations into these prove their necessity, should be submitted as part of this review process.

LOCK STRUCTURE DESIGN AND OPERATION

6.1 General Comments

- (a) The lock structure will be located where marine mud sediments presently exist. Excavation of the marine mud down to solid strata, as in the reclamation areas, would appear to be necessary to provide a proper foundation for this structure given its need for zero settlement to occur in either the short or the long term under a variety of loading conditions. The potential also exists for uplift and hydrostatic pressure problems associated with the different water levels either side of and within the lock. A thorough investigation into geotechnical and ground seepage factors is required.
- (b) The selection of the most trouble free type of lock gate type is important. The following comments are made in the light of discussions held with the Darwin Port Authority on the development and operation of the lock gates at Frances Bay.
 - (i) The horizontal sliding gates have proven to be expensive to maintain, particularly because of underwater mechanical components. It would be preferable to use outward opening gates and to ensure that all mechanical equipment is installed above water level.
 - (ii) Malfunction or jamming of the gates by debris can occur. Provision should be made for a third gate to be manually inserted in an emergency and as a further safeguard during cyclones.
 - (iii) Operation of lock gates in a high tidal range is a specialist task, requiring experienced personnel who can react to unusual situations such as jamming of gates or violent movement of vessels in the lock. A number of potentially critical situations at Frances Bay have been averted by the quick reaction of experienced Port Authority staff. Lock gates at Bayview Haven Canal Estate will require operation by a lock master and trained personnel.

6.2

Recommendations

- (a) Geotechnical investigations are required for design of the lock structure foundations and to determine whether long term differential settlement between the lock and embankment could lead to sealing and keying problems.
- (b) The Developer should obtain advice from the Darwin Port Authority on construction, operation and maintenance aspects of the proposed lock. The limitations of operating lock gates in strong tidal currents and a high tide range should be carefully examined. Provision should be made for emergency sealing of the lock with a third gate.
- (c) The agreement for maintenance of the Canal Estate should specify that a full time lock master and staff are employed by the Body Corporate for operation and maintenance of the lock.

7.0

PREDICTED WATER QUALITY WITHIN THE CANALS IN TERMS OF MIXING, FLUSHING, POTENTIAL FOR ACCUMULATION OF POLLUTANTS SUCH AS HEAVY METALS

7.1 General Comments

- (a) Investigations into the design of the circulation system carried out by the Proponents consultants were discussed in Section 1.0 of this review. Recommendations regarding the prohibiting of stormwater drain outfalls in identified deadwater zones were made.
- (b) Although operation of the canal flushing pumps at the optimum positions indicated by the computer model shows reasonably good circulation with a minimum of deadwater areas, the fact remains that the model is only two dimensional and does not reveal flow velocity variation with depth through the water body. Potential zones of deadwater in the three dimensional canal system will also occur at the base of the overflow weirs for instance. Periodic flushing of bottom waters by means of strategically placed outfall pipes in identified deadwater zones is desirable.
- (c) Monitoring of pollutant concentrations should be carried out on a regular basis to ensure good water quality is maintained. Concentrations should also be checked after high rainfall activity when pollutants arrive in the canals from the canal catchment area. The monitoring will determine whether pump cycle times need to be increased to achieve the desirable flushing of pollutants from the canal system.

7.2 Recommendations

- (a) It is recommended that the arrangement of pumping and outfall positions identified in the computer modelling study be accepted but that bottom draining outfall pipes of adequate size be considered at the following locations:
 - (i) midway along the western most "straight" of the western canal southern shoreline,

7.2 Recommendations

- (a) cont'd
 - (ii) at the intersection of the northern and eastern marina basin toe lines, and
 - (iii) at the weir locations.

These pipes would require a gate valve for normal operation to control bottom water flow velocity and an emergency shut-off valve.

The pump capacity should be such that the pump cycle times for normal operation allow adequate margin for increase in the event that pollutant levels within the canal system rise. Adequate allowance must also be made for high spring tides when determining cycle times. It is recommended that normal cycle times be such that a doubling of cycle time is possible to deal with an emergency situation.

PROPOSED ESTATE MANAGEMENT IN RELATION TO MATTERS ASSOCIATED WITH ENVIRONMENTAL PROTECTION SUCH AS OPERATION OF FLUSHING SYSTEMS AND LOCK, MAINTENANCE DREDGING, EROSION, WATER QUALITY, ETC.

8.1 General Comments

- (a) As stated in Section 6.0, pollutant concentrations should be monitored on a regular basis to determine whether pump cycle times are adequate. It is stated in the EIS that the possible target period for retention will be 4 days. This retention period, if achieved with 2 cycles of 4 hour operation per day, would probably allow for increasing cycle times up to double the normal to deal with an unexpected increase in pollutant concentration.
- (b) Outfall weir structures must include gates which close during high tides greater than R.L. 3.2 A.H.D. The operation of these gates must be integrated with the operation of the pumps, both obviously being limited to the tidal "window" when tide levels are below R.L. 3.2 A.H.D.
- (c) Water quality and bed sediment monitoring and management conditions need to be set by the Conservation Commission. It is suggested that the Australia and New Zealand Environmental Council, National Water Quality Guidelines (Draft), October 1990 be used as the standard. Beneficial uses of the canal and marina water body which should apply include occasional contact recreation besides boating. Because of the high standard of housing to be developed in the Canal Estate, residents will expect a pristine water quality appearance, free from oils, greases and litter.
- (d) Lock operation is not directly involved in the flushing or circulation operations although it must be allowed for in the determination of pump flow required to achieve the desired retention time. On average, the loss of water from the canal system from a single use of the lock will be about 300 cubic metres which will cause a fall in water surface level throughout the canal system of approximately 4 mm.

8.1 General Comments cont'd

- (e) Erosion during construction and building activity is to be controlled by placement of silt fences, sediment trenches, etc. around building sites and embankments or initial bund walling around each stage of development.
- (f) Maintenance dredging as discussed previously in this review will be an ongoing requirement in view of the conditions prevailing in Sadgroves Creek.

8.2 Recommendations

- (a) The Developer should carry out regular monitoring of water quality within the canal system and marina to determine the minimum pump cycle times required to maintain the water quality standards to be set by the Conservation Commission.
- (b) It should be made obligatory for the Developer to put in place the stated measures required to adequately control movement of sediment during construction and building activities.
- (c) A management strategy should be prepared which outlines minimum requirements for the operation of bottom flushing pipe outlets. The total allowable water level variation inside the canal system will need to be considered.
- (d) A study of the dredged entrance channel design in conjunction with tidal current flows and sediment movements in Sadgroves Creek should be carried out to determine the amount of maintenance dredging that is likely to be required.
- (e) The Conservation Commission should set the standards to which water quality and sediment monitoring and management are to be carried out. These standards should be included in the agreement prepared for maintenance of the Canal Estate by the Body Corporate.

DESIGN OF INTERIOR CHANNELS, FAIRWAYS AND BERTHS WITHIN THE CANAL SYSTEM AND MARINA

9.1

General Comments

- (a) No information has been provided in the EIS on anticipated mix of boat sizes, whether the boats are expected to be predominantly yachts or power boats, whether provision for multi-hulled vessels should be included and the frequency of boat usage anticipated. It is noted that berthing parallel to the canal shoreline is intended so as to minimise encroachment of berths into the Canals and that approximately 3.0 m water depth will be available for boating. Before the adequacy of the proposed channel widths can be assessed, the above information must be known.

9.2

Recommendations

- (a) It is recommended that the Proponent supply information on the anticipated mix of boat sizes including the proportion of each size in the mix. The Proponent should also supply information on the types of boat anticipated.
- (b) Anticipated frequency of boat usage should be established and this information supplied as it provides a check on aspects of the proposed lock operation etc.
- (c) The Proponent should also determine the berthing space required for each allotment with frontage onto the canals. Available clear navigation width within the canal, i.e. the interior channel width should be not less than 20 metres nor 1.5 times the design boat length and preferably 25 metres wide or 1.75 times the design boat length whichever is the greater.
- (d) Within the Marina, the criteria in (c) above apply to interior channel width only. Between rows of pens (fairways) the width required is 1.5 times design boat length minimum and 1.75 times design boat length preferred.

- (e) All jetties within the canals should be of a standard type of uniform appearance. This simplifies the jetty licensing approval process and is preferable aesthetically.
- (f) It may be desirable for a berthing structure to be provided outside of the lock entrance, to allow boats to wait in safety until tides are suitable for operation of the lock. This should be considered by the Proponent.

**APPENDIX B SUMMARY OF ADVISORY BODY COMMENTS ON THE FINAL
EIS**

APPENDIX B

SUMMARY OF ADVISORY BODY COMMENTS

BAYVIEW HAVEN CANAL ESTATE FINAL EIS

CONSERVATION COMMISSION

- The request for further detailed information on the dredged entrance channel from Sadgroves Creek has not been met.
- The recommendation that a manually operated rather than an automatic lock gate be used has not been taken up by the proponent. The proponent intends to make a final decision on lock type in the later design stages. This should be subject to further government review.
- The responsibility for maintenance of the proposed gross pollutant traps to be constructed on stormwater outlets draining into the canals is not specified. If incorporated into the final design some definite arrangement for their maintenance needs to be established such as with Council, Transport and Works or the Management Body.
- The proposed regular washdown of the boat maintenance area by the marina operator and the disposal of residue off-site is problematic. While hull maintenance is not permitted it is not clear what other boat maintenance will occur, what the chemical characteristics of the washdown water or residues might be or where the washdown water will run to. Some specific management and characterisation of this aspect will be required.
- The proposed retention of heritage sites 11 and 12 in preference to sites 5 and 6 is not acceptable to the Commission as sites 11 and 12 are ruins and do not have the heritage value of sites 5 and 6 in terms of both condition and uniqueness of design and construction. The Commission strongly recommends the retention of site 6 at the minimum, and preferably sites 5 and 6.

POWER AND WATER AUTHORITY/ DEPARTMENT OF TRANSPORT AND WORKS

- The developer should confer with the Authority's Water Resources Division with regard to detailed requirements and amendments to the water quality monitoring programme.
- The *Control of Waters Act* is still the current legislation relating to pollution control of waters.
- Errors of detail in the EIS relating to water monitoring include:
 - 85mg/L TSS (p24) from PAWA report has been shown to be incorrect.

Water quality analyses were performed on unfiltered samples (p27, Table S5)

Values for heavy metals should be in micrograms/litre not parts per million which equate to milligrams/litre (p24, Table S5)

- Wet season loadings on the existing sewerage system are of concern and will require resolution.
- Relocation of the 66kv powerline will require further negotiation to finalise location and acquisition of easements.
- Cycle paths will be to AUSTROADS standards and location between the estate and Stuart Park will be determined in consultation with DTW.
- No approval for the second road access to Tiger Brennan Drive has been given. If permitted specific conditions would apply as determined by DTW.
- Street lighting shall be to Australian standards.
- The issue of fill and compaction of the roundabout intersection should be dealt with as part of the development and as agreed to by the developer's consultant's Willing and Partners.
- A number of residual issues (above) remain which require further investigation before approval of the subdivision is finalised.

OFFICE OF LOCAL GOVERNMENT

- The recommendation that public toilets be provided adjacent to the public marina and commercial area has not been taken up. This matter needs to be resolved between the developer and Darwin City Council.

DEPARTMENT OF PRIMARY INDUSTRY AND FISHERIES

- There remains concern that water quality within the canals will deteriorate over time, particularly with leaching of antifoulants from boat hulls. The proposal to discourage the harvesting of marine life from canals indicates that a deterioration is anticipated. Harvesting of marine life should be banned.
- There is insufficient baseline data available to provide a basis for monitoring the effects of development and it is suggested that several years monitoring prior to development would be required to obtain adequate data.
- The monitoring programme proposed is considered inadequate in terms of sampling frequency and sampling type. The following amendments to the monitoring programme are recommended:

Sampling to take into account the effects of tides and include vertical profiling for chemical and physico-chemical parameters.

More than one organism should be tested for bio-accumulation. Water column, benthic surface and bed sediment organisms should be represented.

Advice on the selection of organisms to be tested should be sought from DPIF, and/or specialists from the NT Museum.

Increased funding may need to be committed to the monitoring programme.

- The potential for disturbance to recreational fishing in Sadgroves Creek as a result of construction and operation of the proposal have not been addressed.
- Regular use of pesticides to control biting midges, even in well-controlled circumstances, still presents a threat to the marine food chain.
- Any requirement to dump muds from dredging at sea will require a permit under the *Fisheries Act* in addition to any other approvals which may be required.
- Enforcement of boat speed limits by the Management Body is considered impractical
- The statement in the FEIS that the development will contribute "no more and possibly less to Darwin Harbour pollution than residential developments elsewhere in Darwin" is considered to indicate that appropriate technology to maintain pollution within the assimilative capacity of the environment has not been fully investigated or utilised in this development.

DEPARTMENT OF LANDS AND HOUSING

- The storm surge heights adopted in the design of the estate are based on assumption rather than factual analysis. More rigorous analysis of storm surge heights in this area would be required if the development is not to be required to have embankment heights similar to those adopted for the Cullen Bay Marina proposal. The 6.5AHD height for secondary storm surge does not allow for any freeboard for sea level rise associated with Greenhouse Effect without altering the existing secondary storm surge recurrence interval.
- A more detailed examination of the design and operation of the lock, entrance channel and overflow weirs will be required before final approval of the subdivision will be given.
- The potential effects of the rail corridor on the adjacent residential properties are a matter of planning concern.
- There is concern regarding the practicality of limiting building height by covenant rather than planning controls.
- Issues to be addressed during the development approval and final design process include; economic feasibility, performance guarantees, contribution to costs of road access, responsibility for channel maintenance, inclusion of warnings about biting insect problems in sales and other promotional material.
- The proponent is advised to contact Mr Fabio Finocchiaro of the Planning Branch (89 6109) to obtain further clarification on planning issues.

DEPARTMENT OF INDUSTRIES AND DEVELOPMENT

- The final EIS does not adequately address the issues raised by the department in response to the draft EIS. The issues relate to the staging of construction, access onto Tiger Brennan Drive and therefore to the Central Business District, and cost estimates for management of the estate. The department recognises, however, that the marketability of the estate will be

dependent on the adequate consideration of these issues before the commencement of development.