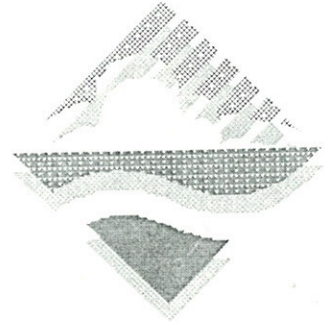


DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Internal memorandum



MEMO TO: Director, Policy Co-ordination Division, Conservation Branch
(Attention: Garry Whisson)

FROM: Director, Evaluation Division, Environmental Audit Branch
(Attention: Kim Martin)

SUBJECT: SHIRE OF MURRAY TPS NO. 4 AMENDMENT NO. 104
(PT GREY) (ASS NO 1084, ST NO 519)

DATE: October 18, 2000

Attached is Report M98209 by BBG on the Point Grey Development Conservation Area Boundaries. The boundaries of the conservation area are proposed in this Report, with Condition 6-1 of Ministerial Statement 519 relating specifically to this matter.

Can you please advise if the proposed boundaries set aside for conservation in this Report are likely to meet the requirements of the EPA.

I would appreciate your comments by **Friday, 10 November 2000**, thank you.

Bronwen . Can you look at this please.
J.

Our Ref: M98209

16 October 2000

Mr Kim Martin
Department of Environmental Protection
141 St Georges Terrace
PERTH WA 6000

DEPARTMENT OF ENVIRONMENTAL PROTECTION

17 OCT 2000

File No 1 A/16095/5 Name K Martin
File No 2 _____ Name _____
File No 3 _____ Name _____

290 Churchill Avenue
Subiaco
Western Australia 6008
PO Box 465 Subiaco
Western Australia 6904
Tel: (618) 9382 4744
Fax: (618) 9382 1177
Email: info@bbg.net.au
Web: www.bbg.net.au

Dear Kim

**Point Grey Development –
Conservation Area Boundaries**

On behalf of our client TS Plunkett Pty Ltd, we enclose a report on proposed conservation boundaries at Point Grey for your consideration. Copies of the report have also been forwarded to the Ministry for Planning, the Peel Inlet Management Authority, the Department of Conservation and Land Management and the Shire of Murray.

This report is submitted in accordance with Conditions 6-1 and 6-2 of the Minister for the Environment's approval of Amendment No. 104 (Point Grey) to the Shire of Murray Town Planning Scheme No. 4.

We look forward to receiving your comments on the proposed boundaries in due course. In the meantime, please do not hesitate to contact the undersigned if you require any clarification or further information.

Yours sincerely

BOWMAN BISHAW GORHAM

PHIL BAYLEY

DIRECTORS

Martin P. Bowman
B.Sc. (Hons), MEIA, MUDIA.

Michael Bishaw
B.Sc.(Hons), MEIA, MAWWA.

Richard A. Gorham
LL.B., B.Sc., M.Sc., MEIA,
MAMSA, MECA.

Stuart A. Smith
B.Env.Sc., MWMAA.

ASSOCIATES

Stephen W. Rolls
B.App.Sc., B.Sc.(Hons), MECA,
MAIBiol.

Phillip Bayley
B.Sc., MECA.

Michael Forde
B.Sc., M.Sc., MAMSA.

Printed By: Gary Whisson 27/11/00 10:02 AM
From: Bronwen Keighery, Bronwen Keighery,
To: Gary Whisson
CC:
BCC:
Priority: Normal

Page: 1

Date sent: 26/11/00 11:19 AM



Time Sheets/Point Grey/Bushplan

Hi Gary

Good luck with Bushplan!

Please find attached my times for November. They are not in the current sheet but all the needed info is there.

Point Grey - This is on the coffee table bench in my office (maybe under something). My comments are essentially that

- the foreshore reserve should ALWAYS be more than 50m (less in places)
- special rural, large blocks in this veg is not compatible with conservation unless in the order of 20ha in size

wetland adjacent to the reserve in the south east corner of the area MUST be protected (contains priority flora and possibly DRF). They have NOT done any extra flora/veg work and do not seem to explain where floristic community type 26a has come from (maps still show limestone area as Banksia)

There are some annotations on the copy in my office.

Cheers Bronwen

RFC822 header

RECEIVED: from SF_Database by POP_Mailbox_-1236885735 ; 26 NOV 00 11:06:01 UT
Received: from ENVIRON.WA.GOV.AU by smtpgw.viron.wa.gov.au
with SMTP (QuickMail Pro Server for MacOS 1.1.2); 26-Nov-2000 11:05:55 +0800
Received: from belgarion.it.net.au ([203.8.116.1]) by epagate.viron.wa.gov.au with ESMTMP id <119042>; Sun, 26 Nov 2000 11:07:32 +0800
Received: from cygnus.uwa.edu.au (root@cygnus.it.net.au [203.8.116.90])
by belgarion.it.net.au (8.9.3/8.9.3/Debian 8.9.3-21) with ESMTMP id LAA06440
for <gary_whisson@environ.wa.gov.au>; Sun, 26 Nov 2000 11:03:52 +0800
Received: from [202.148.94.159] (dial01-159-std.dy.uwa.cygnus.net.au [202.148.94.159])
by cygnus.uwa.edu.au (8.9.3/8.9.3/Debian 8.9.3-21) with ESMTMP id LAA18637
for <gary_whisson@environ.wa.gov.au>; Sun, 26 Nov 2000 11:03:48 +0800
X-Authentication-Warning: cygnus.uwa.edu.au: Host dial01-159-std.dy.uwa.cygnus.net.au [202.148.94.159] claimed to be [202.148.94.159]
Mime-Version: 1.0
Message-Id: <f04310108b6463009fab8@[202.148.94.159]>
Date: Sun, 26 Nov 2000 11:19:43 +0800
To: Gary Whisson <gary_whisson@environ.wa.gov.au>
From: Bronwen Keighery <bjkeighe@cygnus.uwa.edu.au>
Subject: Time Sheets/Point Grey/Bushplan
Content-Type: multipart/mixed;
boundary="=====_-_1236913704==_====="

ENTERED ON GIS

Name: Point Grey Development Conservation Area Boundaries
Date: 01/05/2006
Capture Author: Thomas Leong / Ian Steward

Comments:

Polygon

Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual references, resulting in polygon boundary errors

Attributes

Report Info – Captured without problems

Custodial/Contact – Captured without problems

Content – Captured without problems

BOWMAN BISHAW GORHAM

ENVIRONMENTAL MANAGEMENT CONSULTANTS



POINT GREY DEVELOPMENT
CONSERVATION AREA BOUNDARIES

Prepared for:
TS Plunkett Pty Ltd
84 Colin Street
WEST PERTH WA 6005

Prepared by:
Bowman Bishaw Gorham
290 Churchill Avenue
SUBIACO WA 6008
Telephone: (08) 9382 4744
Facsimile: (08) 9382 1177

Report No: M98209

1998

TABLE OF CONTENTS

	Page No.
PART A: INTRODUCTION	1
PART B: PROPOSED CONSERVATION BOUNDARIES	3
PART C: ENVIRONMENTAL FEATURES OF POINT GREY	4
C.1 Vegetation	4
C.1.1 Vegetation Communities	4
C.1.2 Rare Flora and Fauna	6
C.1.3 Estuarine Seagrasses	6
C.1.4 Saltmarshes	6
C.2 Hydrology	7
C.2.1 Surface Water	7
C.2.2 Groundwater	7
C.3 Topography, Landforms and Soils	9
C.3.1 Topography	9
C.3.2 Landform and Soils	9
C.3.3 Estuarine Sediments	10
C.4 Geology	11
C.5 Foreshore Function	11
C.5.1 Foreshores	11
C.5.2 Mosquito Breeding Habitat	12
C.6 Fauna Habitat	13
C.6.1 Water Birds	13
C.6.2 Terrestrial Fauna	14
C.7 Water Levels	14
C.8 Shoreline Stability	15
C.9 Land Use Pressure	16
C.10 Aboriginal Heritage	17

LIST OF FIGURES

Figure No.

- | | |
|---|---------------------------|
| 1 | Vegetation Classification |
| 2 | Vegetation Condition |
| 3 | Seagrass Distribution |
| 4 | Saltmarsh Distribution |
| 5 | Wetlands |
| 6 | Topography and Soils |

PART A: INTRODUCTION

This report has been prepared to satisfy Conditions 6-1 and 6-2 of the Minister for the Environment's approval of Amendment No. 104 (Point Grey) to the Shire of Murray Town Planning Scheme No. 4.

These conditions state:

- “6.1 Prior to finalisation of the Outline Development Plan required by Condition 1-1, the boundaries of areas to be set aside for conservation shall be determined to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection, the Ministry for Planning, the Peel Inlet Management Authority, the Department of Conservation and Land Management and the Shire of Murray.
- 6.2 An area of remnant vegetation of no less than that which is depicted in the Outline Development Plan contained in the Environmental Review for the Shire of Murray Town Planning Scheme No 4 Amendment No. 104 shall be retained for conservation.

In defining the boundary of the conservation areas, the following biophysical topics shall be taken into consideration:

- 1 vegetation;
- 2 hydrology;
- 3 soil type;
- 4 geology;
- 5 topography;
- 6 foreshore function;
- 7 habitat;
- 8 climatic variability;
- 9 land use pressure; and
- 10 archaeological and ethnographic sites.”

In response to Conditions 6-1 and 6-2 the following actions have been taken to define the conservation boundaries:

- Information on the above factors has been collated and assessed in terms of its relevance to boundary alignments.
- A detailed site survey has been undertaken to ground-truth the above information and to identify and peg a logical alignment for the boundary based on the physical characteristics of the site.
- Conservation area boundaries have been mapped for the site on the basis of the above factors and the ODP.
- Officers of the DEP, MfP, WRC and CALM have been conducted on a tour of the site to inspect the proposed boundary and to discuss issues arising from the proposed alignment (the Shire of Murray was unable to attend the site inspection).
- Two meetings have been held with the above agencies to discuss in detail the basis for selecting the boundaries and particular issues associated with the proposed alignment.
- The proposed boundary has been modified following the above discussions and has been mapped onto aerial photographs of the site. The final boundary defines an area of conservation reserve that is slightly larger than the area originally defined by the ODP.

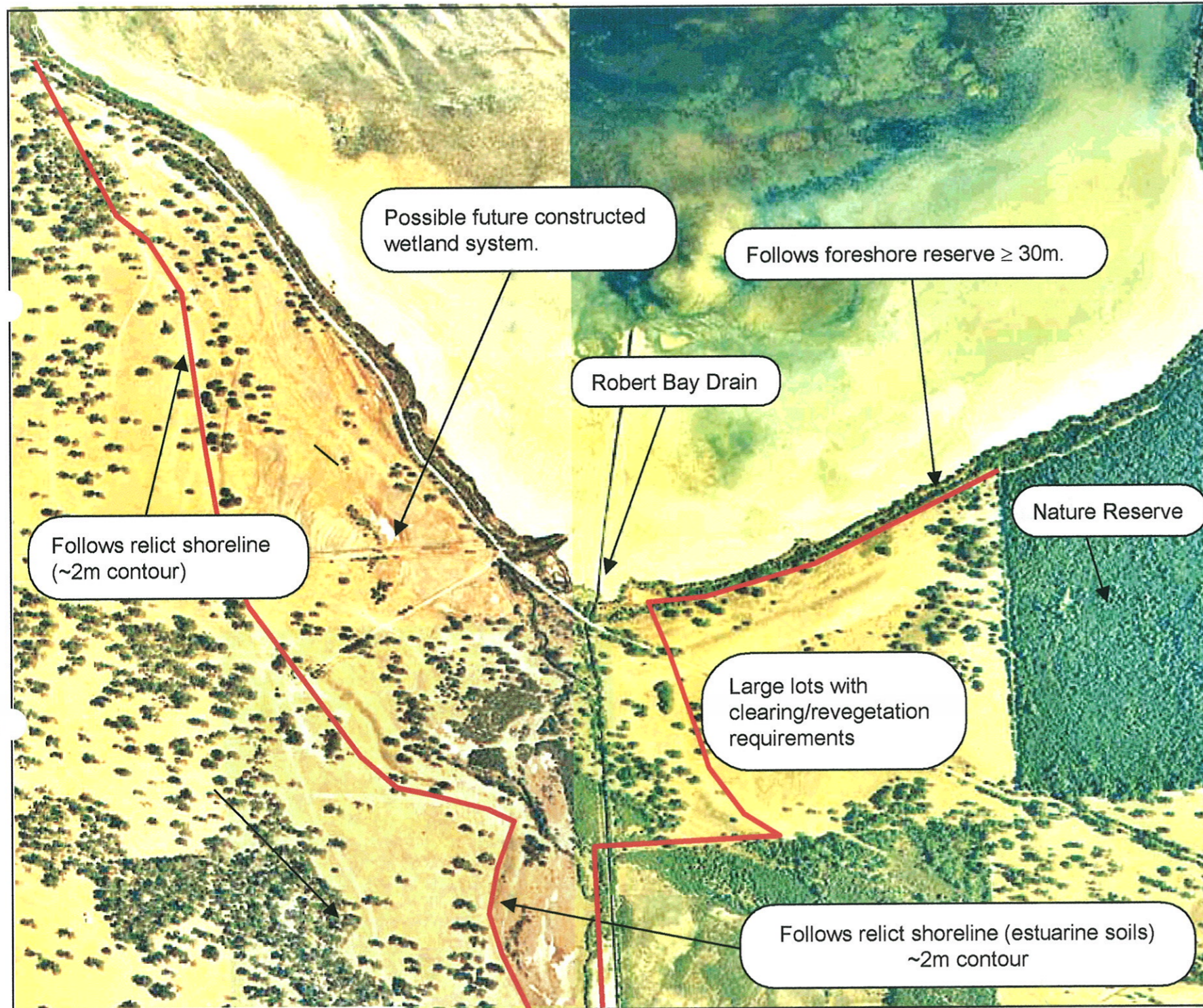
Part B of this report shows the proposed boundaries mapped onto aerial photographs of Point Grey. The site has been broken down into seven sectors that are shown as Plates 1 to 7. Each plate shows the proposed boundary for that sector, the key environmental features influencing the boundary alignment and the means by which those factors have been addressed in the boundary selection.

Part C provides background technical information on the environmental characteristics of Point Grey.

PART B: PROPOSED CONSERVATION BOUNDARIES



INDEX TO ENLARGEMENTS



Sector 1

Vegetation

- Cleared except for Foreshore Community and narrow fringe.
- Conservation area incorporates all valuable remnants.

Hydrology

- Local groundwater recharge and discharge into Robert Bay.
- Robert Bay drain traverses.
- Winter waterlogging in low-lying areas.
- Areas subject to seasonal waterlogging are within conservation area.

Soil Type

- Vasse estuarine and lagoonal deposits.
- Soils associated with former foreshore vegetation are mostly in conservation area.

Topography

- Low-lying, flat, apparent relict shoreline at 2m AHD.
- Conservation area boundary mostly follows 2m contour.

Foreshore Function

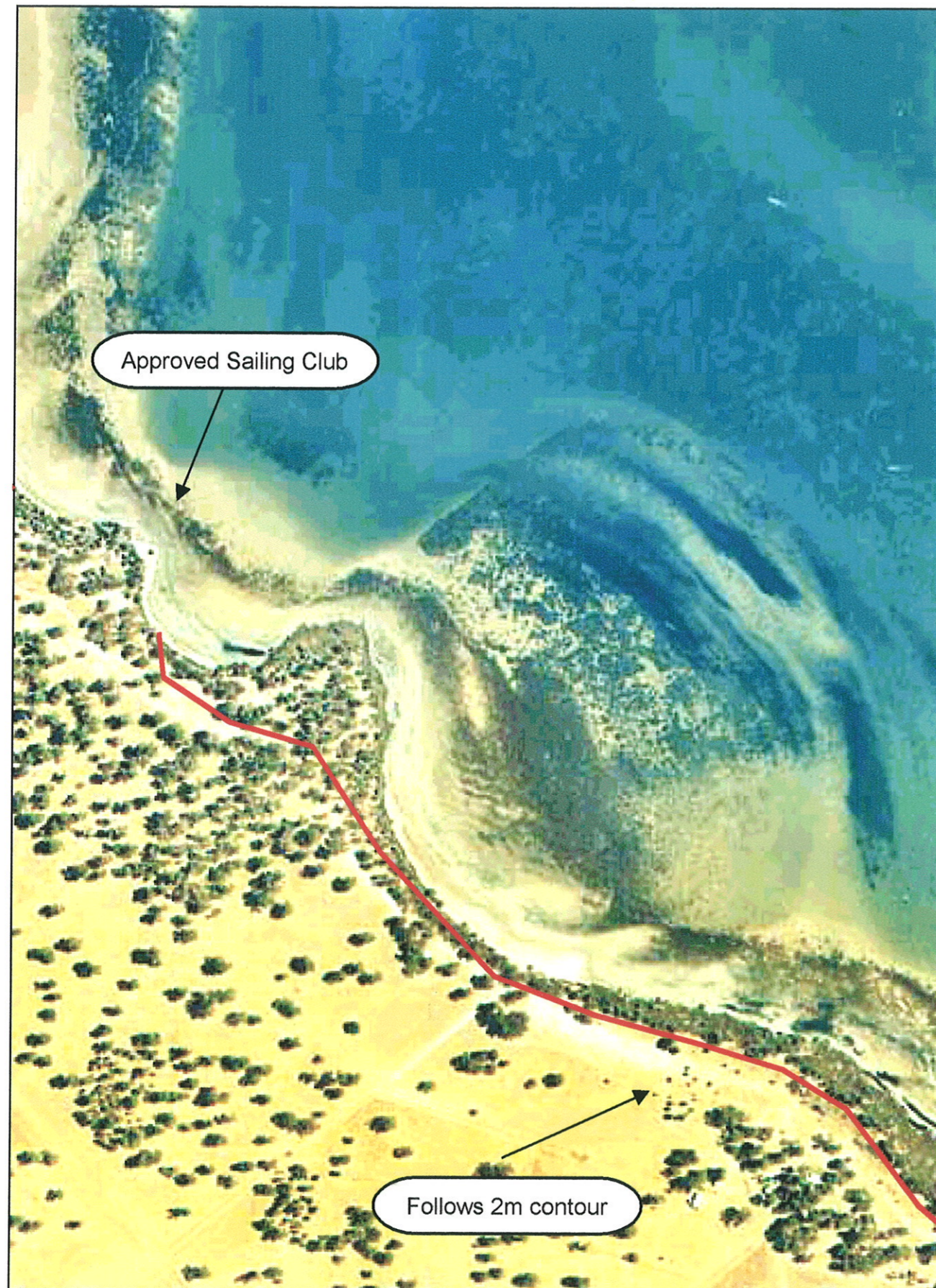
- Broad intertidal zone.
- Shoreline stabilisation.
- Major recreational crabbing destination.
- Important functions preserved and potential for rehabilitation incorporated.

Habitats

- Adjoins major intertidal area.
- Estuarine fringing vegetation.
- Robert Bay drain, ephemeral wetlands and saltmarsh.
- Sedgeland and low woodlands.
- All important habitats are in conservation area.

CONSERVATION BOUNDARY

SECTOR 1



Sector 2

Vegetation

- Foreshore community.
- Eucalyptus rudis woodlands.
- Agricultural impacts.
- Upland fully or parkland cleared.
- All fringing vegetation is in conservation area.
- Boundary follows and includes dryland vegetation.
-

Hydrology

- Shallow groundwater in nearshore zone.
- Upland areas well drained.
- Areas with shallow water table are in conservation area.
-

Soil Type

- Spearwood sand with narrow or absent estuarine fringe.
- Estuarine soil types and transition to Spearwood contained within conservation area
-

Topography

- Gentle north-east slope from 2m AHD contour to estuary.
- Conservation boundary lies at or above 2m contour.
-

Foreshore Function

- Adjoins moderately wide intertidal zone.
- Limited roosting habitat for waterbirds.
- Perching habitat for land birds.
- Sailing Club in defined area with full rehab program.
-

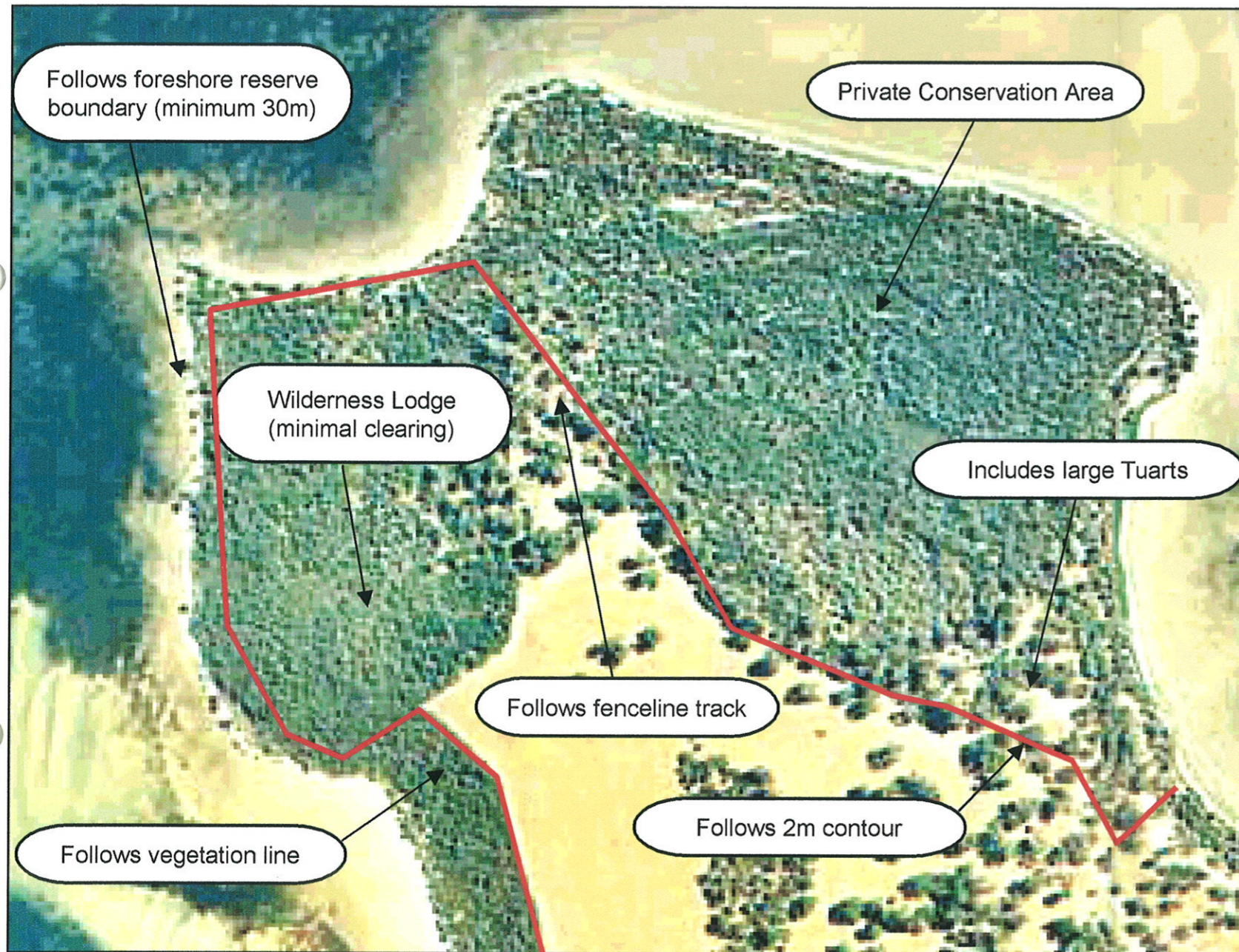
Habitats

- Adjacent to intertidal zone.
- Narrow sedgeland and fringing woodland.
- Fully or parkland cleared upland.
- Remnant mature eucalypts.
- All remnant foreshore and fringing vegetation and transition to upland vegetation are retained.

CONSERVATION BOUNDARY

SECTOR 2

Sector 3



CONSERVATION BOUNDARY

SECTOR 3

Vegetation

- Major wetland with largely intact vegetation extending from upland to foreshore community.
- Limestone ridge upland with R.E.(?) *← what is this?*
- Remnant parkland cleared Tuart.
- Narrow remnant foreshore community with fringing woodland.
- Hinterland fully or parkland cleared.
- All remnant foreshore vegetation and significant upland vegetation are in conservation area.
- Approved Wilderness Lodge will incorporate vegetation protection.
- Conservation reserve boundary adjacent to Wilderness Lodge set at existing foreshore reserve or 30m from foreshore, whichever is greater.

Hydrology

- Shallow groundwater and seasonal inundation in wetland.
- Shallow groundwater in nearshore zone.
- Low groundwater flows.
- All shallow groundwater areas and discharge zones are within conservation area.

Soil Type

- Spearwood sands on upland with shallow limestone
- Broad area of Vasse estuarine and lagoonal deposits in north-east half.
- Most estuarine soils are conservation area.

Topography

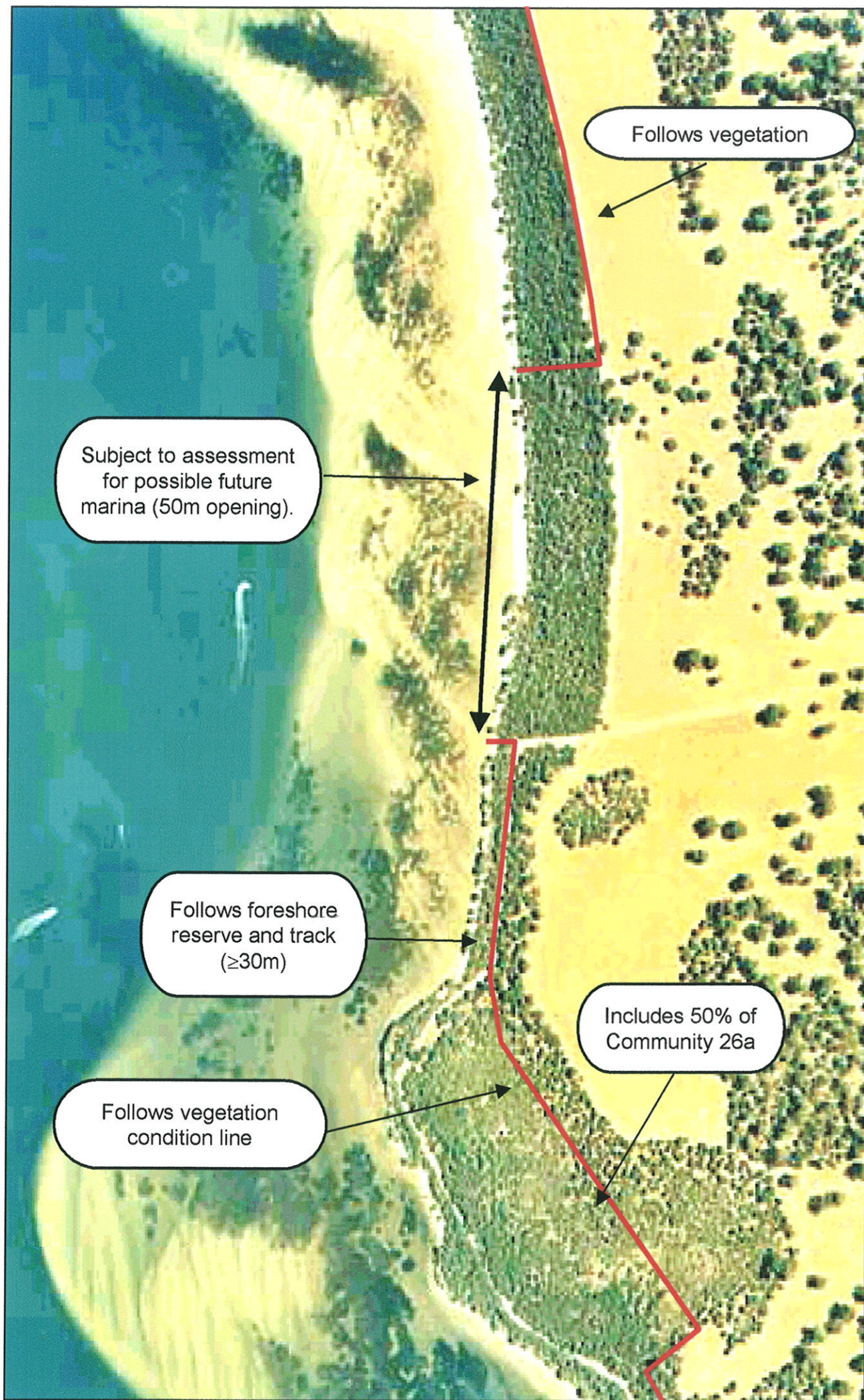
- Gently undulating sand plain.
- Apparent relict shoreline at 2m AHD on eastern shore.
- Limestone knoll to 10m AHD.
- Conservation boundary lies at or above 2m contour.

Foreshore Function

- Transect and air photo analysis by Murdoch University (Kobryn et al., 2000) found no evidence of shoreline or vegetation changes resulting from Dawesville Channel.
- Locally broad intertidal zone.
- Part of intact sequence from foreshore to upland.
- Low-key passive recreation.
- Occasional boat landing point.
- Most of foreshore retained as part of major private conservation area.
- Remainder of foreshore retained to at least 30m from shoreline.

Habitats

- Major unbroken sequence, incorporating intertidal zone, foreshore, fringing woodland, wetland, sandplain and upland, retained in conservation area.
- Habitat functions preserved in Wilderness Lodge precinct.



Sector 4

Vegetation

- >100m wide shoreline band, including foreshore, fringing and upland vegetation, fenced from stock access.
- Degraded Floristic Community Type 26a (*Melaleuca huegelii* – *M. acerosa* shrubland) on limestone rise with shallow soil.
- Banksia woodland and Tuart on uplands.
- Casuarina woodland on lower slopes.
- Foreshore and fringing vegetation in good condition, upland vegetation degraded.
- Area near centre is subject to further assessment for possible 50m marina opening.
- Balance of development and retention of significant vegetation.

not indicated in veg map. Fig 2.4

Hydrology

- Shallow groundwater in and near foreshore zone.
- All area well drained.
- All shallow groundwater areas (except marina study area) are in conservation area.

Soil Type

- Spearwood sands with estuarine deposits corresponding to vegetated area in north-west.
- Shallow sand over limestone in south supports Community type 26a.
- All estuarine soils are in conservation area.

Topography

- Low-lying, gently sloping sandplain to limestone ridge.
- Possible future marina is located at low point.

Foreshore Function

- No evidence observed by Murdoch University study (Kobryn et al., 2000) of shoreline erosion resulting from Dawesville Channel tidal influence.
- Adjacent to narrow intertidal and broad subtidal zone.
- Fringing estuarine habitat.
- Low-key passive recreation, boat landing and crabbing.
- Possible site for future marina entrance (subject to further investigation and EPA assessment).
- Conservation boundary allows for any future shoreline erosion.

Habitats

- Partial sequence from foreshore through fringing zone to sandplain.
- Transition from foreshore zone to limestone ridge.
- Restricted habitat in *Melaleuca huegelii* - *M. acerosa* shrubland.
- Low limestone cliffs on relict shoreline.
- Foreshore to sandplain sequence, limestone cliffs and foreshore-ridge transition are conserved.

CONSERVATION BOUNDARY

SECTOR 4

BOWMAN BISHAW GORHAM



Sector 5

Vegetation

- Government Reserve preserves sequence from foreshore to wooded upland.
- Broad (>100m) band of remnant vegetation along southern shoreline.
- Cleared hinterland.
- Government Reserve and all good quality fringing vegetation are conserved.

Hydrology

- Shallow groundwater at foreshore.
- All areas well drained.
- Shallow groundwater areas are conserved.

Soil Type

- Spearwood sand with partial shoreline fringe of Vasse estuarine deposits.
- All estuarine soils are conserved.

Topography

- Narrow estuarine fringe sloping to upland plain.
- Locally steep slopes in south-east.
- Not a determining factor.

Foreshore Function

- Intact sequence from estuary to upland conserved.
- All foreshore functions retained.

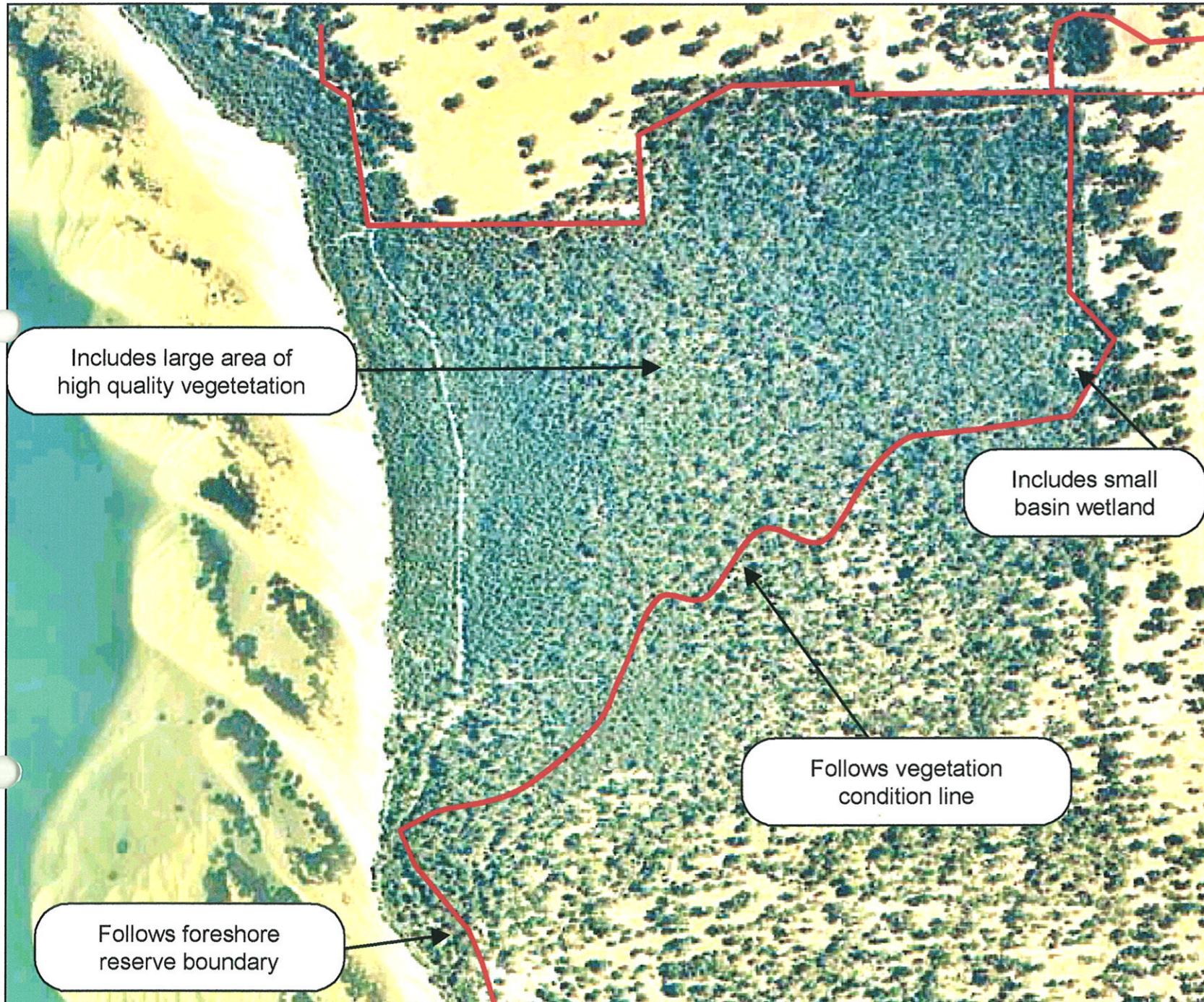
Habitats

- Broad subtidal and narrow intertidal zones.
- Limited waterbird usage.
- Habitat sequence from estuary to upland is preserved.

CONSERVATION BOUNDARY

SECTOR 5

Boundary diverts north to include small basin wetland and buffer



Includes large area of high quality vegetation

Includes small basin wetland

Follows vegetation condition line

Follows foreshore reserve boundary

Sector 6

Vegetation

- Large (>100ha) block of upland Tuart forest and foreshore vegetation.
- Major sequence from foreshore to upland.
- 100ha block of Tuart forest retained in conservation area.
- Southern boundary of conservation area is generally defined by vegetation condition.

Hydrology

- Shallow groundwater in foreshore zone.
- Small basin wetland on eastern boundary.
- Wetland and shallow groundwater areas are reserved.

Soil Type

- Spearwood sands with fringing Vasse estuarine deposits.
- All estuarine soils are in conservation area.

Topography

- Topographic sequence from estuary across limestone ridge to inland plain is preserved.

Foreshore Function

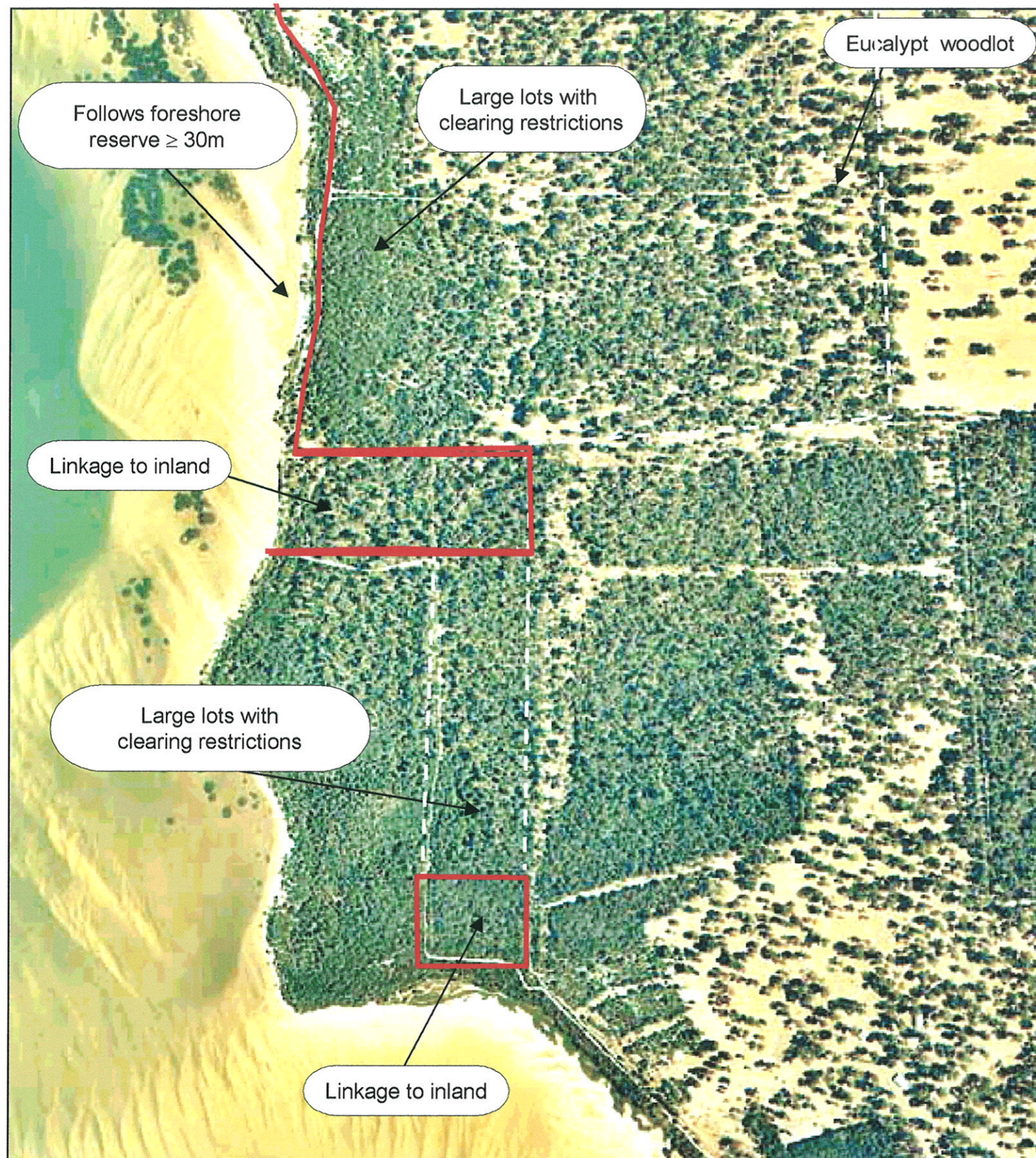
- Narrow intertidal and broad subtidal zones.
- Foreshore functions including transition to inland sequence retained.

Habitats

- Major area of high quality upland vegetation (forest) retained.
- Basin wetland and buffer on eastern boundary retained.
- All foreshore habitat retained.

CONSERVATION BOUNDARY

SECTOR 6



Sector 7

Vegetation

- Mostly narrow foreshore band grading to large area of parkland cleared upland.
- Part of upland protected within large Special Rural lots with restricted clearing.
- Vegetation links from foreshore to inland preserved at south.

Hydrology

- Shallow groundwater in narrow foreshore zone.
- All site well drained.
- All shallow groundwater areas reserved.

Soil Type

- Deep Spearwood sands with narrow Vasse estuarine band in north-west and south.
- Not a determining factor.

Topography

- Topographic sequence from foreshore to upland is preserved.

Foreshore Function

- Narrow intertidal and broad subtidal zones.
- Low waterbird usage.
- Passive recreation.
- All foreshore functions are retained.

Habitats

- Disturbed sequence from shoreline to upland.
- Linkages from foreshore to inland are retained in reserve and Special Rural lots.

CONSERVATION BOUNDARY

SECTOR 7

PART C: ENVIRONMENTAL FEATURES OF POINT GREY

C.1 Vegetation

C.1.1 Vegetation Communities

The majority of the site has previously been cleared for grazing. Some parts of the site, predominantly the fringing estuarine vegetation but also a large area of upland vegetation, remain uncleared.

The site was surveyed in 1996 by specialist botanical consultants to provide information on floristic composition, vegetation types and conservation values for the Point Grey Environmental Review (Goble-Garratt, 1996).

Ten vegetation types are recognised from the property. These are shown on Figure 1 and are listed below in descending order of the size of remnant stands within the site. The vegetation condition across the site is shown on Figure 2.

- i. **Eucalypt/Banksia Woodland:** A mixed canopy of Jarrah (*Eucalyptus marginata*) and Marri (*E. calophylla*), with Sheoak (*Allocasuarina fraseriana*) and *Banksia* species forming a second stratum. A dense and diverse understorey of shrubs under a metre in height and a range of sedge and rush species are also present in this unit. A major remnant of this unit occurs across the centre and at the southern extension of the site.
- ii. **Tuart Woodland:** Open woodland with dominant Tuart (*E. gomphocephala*) canopy. The understorey is low and, even where not grazed, tends to be open in structure. Prior to agricultural development this would have been the dominant vegetation type but is now restricted to small remnants throughout the site. These remnants are generally in fair to poor condition and there is no regeneration in grazed areas.
- iii. **Spearwood Thickets:** These occur quite extensively just inland of the Shoreline Communities along much of the western edge of the site and are dominated by Spearwood (*Kunzea ericifolia*). Sheoak, Candle Banksia, Swamp Banksia and wattle (*Acacia saligna*) may occur as individuals. Due to its impenetrable nature, this vegetation is generally undisturbed.

-
- iv. **Beach Ridge Mosaic:** This is a shrubland of varying density and height, with species distribution associated with variations in topography caused by the old beach ridges. The unit occurs at the northern extent of the site and also in the southwestern margin. The unit is a diverse mix of shrubs, sedges as occasional low trees, including *Jacksonia furcellata*, *Acacia saligna*, *Regelia ciliata* and Spearwood. This vegetation unit is in good condition and generally weed free, with the exception of areas close to access tracks to the water at both the Point and the southern boundary of the site.
- v. **Flooded Gum Woodland:** This vegetation type occurs on low lying sites where fresh water is close to the ground surface. It is predominantly located immediately inland of the Shoreline Communities on the eastern side of the point and on the sandy terraces and estuarine alluvium at the north-east margin. The open woodland structure is dominated by flooded gum (*E. rudis*) although Swamp Banksia (*B. littoralis*) and Swamp Paperbark (*Melaleuca raphiophylla*) are sometimes present. Small stands in good condition occur within the site although generally the unit is in fair to poor condition.
- vi. **Banksia Woodland:** A woodland/low woodland formation of varying density with an open understorey that occurs on the crest and upper slopes of the site. Candle Banksia (*B. attenuata*) is dominant but occasional stunted eucalypts also occur. The unit is generally in good condition.
- vii. **Shoreline Communities:** Salt tolerant communities, mainly consisting of dense beds of reeds or low shrubs, occurring in a narrow band along the entire shoreline. Dense beds of *Juncus kraussii* are the dominant species with occasional individuals or clumps of trees. The unit is generally in good condition, with the heaviest disturbance occurring in areas used for crabbing and fishing.
- viii. **Melaleuca Thicket:** Dense stands of *Melaleuca viminea*, *M. uncinata* and *M. raphiophylla* create an almost closed canopy to about 4m in height with few if any understorey species, on the seasonally wet flats at the north east of the site and around a small seasonal wetland along the eastern boundary. Most of this vegetation type has been extensively altered by complete clearing or pasture and weed invasion.
- ix. **Acacia Thicket:** One limited stand of thicket dominated by *Acacia rostellifera* occupies the south eastern toe and lower slopes of the rise at the northern extent
-

of the site. Apart from the presence of rabbits the vegetation appears undisturbed.

- x. **Paperbark Swamp:** Several basin swamps on the Point and near the eastern edge of the site support woodlands of Paperbarks. *M. preissiana* and *M. rhapsiophylla* are the dominant species, although species composition is governed by inundation regimes. Major occurrences of this vegetation unit on the site exhibit some disturbance due to grazing.

C.1.2 Rare Flora and Fauna

During the 1996 survey, the site was also examined for declared rare flora and priority species. The CALM rare flora database was consulted as part of the survey.

No Declared Rare or Threatened flora species were encountered during the surveys, nor during previous surveys conducted over the site.

C.1.3 Estuarine Seagrasses

The major species of seagrass near the west coast of Point Grey is *Halophila ovalis*, which forms dense meadows on the shallow sand banks. Smaller meadows of *Zostera mucronata* and *Ruppia megacarpa* are interspersed with the *H. ovalis* meadows. *Heterozostera* and *Lepilaena cylindrocarpa* have also been reported in other parts of the Peel-Harvey (Lavery *et al.*, 1995).

On Point Grey's east coast and in Robert Bay, seagrasses are limited to patches of *Halophila ovalis* and *Ruppia megacarpa*. *R. megacarpa* meadows generally occur only in the shallows closest to shore. Epiphyte (attached algae) growth on seagrasses in this area is often heavy, but is decreasing with the improving nutrient status of the Estuary.

Figure 3 shows the distribution of seagrasses in the vicinity of Point Grey.

C.1.4 Saltmarshes

Figure 4 shows the distribution of saltmarshes surrounding the Peel-Harvey Estuary. In the vicinity of Point Grey there is a large saltmarsh at the mouth of Robert Bay Drain, dominated by *Halosarcia* spp. Only minor areas of samphire occur along the western shore, the largest being along the southern edge of Stony Point.

The total area of saltmarsh vegetation surrounding the Peel-Harvey Estuary declined by 17% in the 37 years to 1994 (McComb *et al.*, 1995). The Robert Bay saltmarsh declined by 48%, from 155ha in 1957 to 81ha in 1994. This area was identified by the Waterways Commission (1992) as being ecologically significant and was recommended for retention, conservation and management.

C.2 Hydrology

C.2.1 Surface Water

There is little naturally occurring surface water at Point Grey. The vast majority of the site is elevated, gently undulating sandy terrain that has no effective runoff and therefore does not create any significant surface drainage.

The Robert Bay drain, which exports surface water and shallow groundwater from low lying Bassendean dunes and alluvial plains to the east and south of the site, passes through the site near its eastern boundary. There are remnants of former natural drainage channels that have been modified by drainage to the Robert Bay drain on the site

Limited areas of low-lying Vasse landform areas adjacent to Robert Bay exhibit periodic ponding of surface water during the wetter months.

There are small seasonal groundwater wetlands along the eastern margin of the Spearwood landform. These are dry during summer and flooded but shallow during winter.

The hydrology of the site is shown on Figure 5.

C.2.2 Groundwater

Unconfined Aquifer System

An unconfined aquifer has developed in the sand and Tamala limestone that make up the superficial formations at Point Grey.

The Superficial aquifer is recharged directly by rainfall and also by upward leakage from the underlying Leederville Formation where the confining Osborne Formation clays are

absent. Groundwater flow in the superficial aquifer is generally radial outwards from the central ridge to the Estuary, along the length of the peninsula.

Within the low-lying nearshore fringe, the water table is almost flat and very shallow, at about the same level as the Estuary. Tidal movements and storm surges would produce regular small variations in the water table level close to the shore. A saline “wedge” is likely to exist close to the shore beneath the overlying fresh groundwater.

Confined Aquifer System

The Leederville Formation subcrops beneath clay and sand of the Guildford Formation and Jandakot Beds to the east of the Peel Inlet and Harvey Estuary, and dips westwards beneath the Peel Inlet and Harvey Estuary towards the ocean. The thickness of the aquifer beneath the project area ranges from approximately 180m to 220m.

In the west, including part of the Point Grey peninsula, the confining Osborne Formation overlies the Leederville Formation.

The Leederville aquifer is recharged by downward infiltration of groundwater from the superficial aquifer in an area to the south-east of Point Grey. The reverse occurs in the area between the Osborne Formation and the western boundary of the recharge area where an upward hydraulic gradient causes upward leakage of water from the Leederville to the superficial aquifer. Water balance calculations indicate a net downward leakage from the superficial aquifer to the Leederville aquifer of about 4,500kL/day. Where the Osborne Formation underlies the superficial aquifer, including most of Point Grey, there is effectively no leakage between the two.

Groundwater flow in the Leederville aquifer is westwards. Discharge is inferred to occur offshore as well as to the superficial aquifer.

C.3 Topography, Landforms and Soils

The topography, landforms and soils of the Point Grey peninsula are shown on Figure 6.

C.3.1 Topography

A limestone ridge rising from narrow low-lying coastal fringes at 1-5m AHD to 25-38m AHD on the ridge crests forms the Point Grey peninsula. The central parts of the site comprise gently undulating valleys and sandy ridge crests with some limestone outcrops.

C.3.2 Landform and Soils

There are three different landform-soil associations on the site. These are described below.

(i) Spearwood Dune Landform System

This landform/soil system consists of gently to moderately inclined low hills and gently undulating plain located west of the Bassendean System and associated with Pleistocene Tamala Limestone. Hills consist of a core of aeolianite, capped by secondary calcite and overlain by variable depths of rapidly drained siliceous yellow brown sands.

The soils of this unit that occur at Point Grey are:

- **S1:** Gently to moderately inclined dune ridges with shallow to deep siliceous yellow brown sands. Limestone outcrops may occur.
- **S2:** Level or moderately inclined lower slopes of dune ridges with shallow to deep siliceous yellow brown sands. Limestone outcrops may occur.
- **S4:** Flat to gently undulating sand plain with pale bleached sands and yellow brown subsoils.

(ii) Vasse Estuarine and Lagoonal System

Low lying poorly drained terraces, flats and beach ridges fringing Peel Inlet and Harvey Estuary. Soils are extremely variable, being formed on unconsolidated Holocene estuarine alluvium and lagoonal deposits, and are often highly saline and subject to periodic inundation.

Soils of this unit occurring at Point Grey are:

- **V6:** Upper level sandy terraces and gently undulating beach ridges with deep grey sands.
- **V6a:** Gently undulating beach ridges with deep, grey acidic siliceous sands overlying an iron-organic hardpan.

(iii) Bassendean Dune and Plain System

Very low relief, leached grey siliceous Pleistocene sand dunes with intervening sandy and clayey swamps and gently undulating plains; occurring generally east of the Spearwood Dune System.

The soil type of this unit occurring at Point Grey is:

- **B4:** Broad, poorly drained plain with deep grey siliceous sands and bleached sands with an iron-organic hardpan, underlain at depths generally not greater than 1.5m by a mottled grey clay layer supporting a perched water table.

C.3.3 Estuarine Sediments

Extensive intertidal and shallow subtidal sand and mud flats border the shorelines of Point Grey. The shallow subtidal and intertidal shelf adjacent to the beach is 200-1,000m wide.

Sediment in the Peel-Harvey Estuary ranges from clean, oxygenated sand to anoxic black ooze in deeper water and under the macroalgal mats in shallow areas such as Robert Bay. The sediments are both a sink and source for nutrients, depending on their oxygen content.

Sediments along the western shoreline of Point Grey are generally oxic to a depth of about 0.5 - 2.5cm (Rose, 1994), with the depth of the layer varying with season. In Robert Bay on the eastern shoreline the oxic layer is very shallow and even absent in some places.

Indications are that the increased flow of highly oxygenated seawater through the Dawesville Channel has significantly improved the oxygen status of the bottom

sediments on the western coast of Point Grey. The sediments on the eastern side of Point Grey (in Robert Bay) appear to be less affected and remain less oxygenated than those on the western side, although improvement is evident.

C.4 Geology

Tamala limestone forms the core of the ridge and extends from at or near surface level on the higher ridges to about 10m below surface level on the lower slopes. Leached sands derived from Tamala limestone (Spearwood Sands) with an average depth of 7m form the surface sediments.

C.5 Foreshore Function

C.5.1 Foreshores

The site's foreshores have values for landscape, vegetation, habitat and as water quality buffers for water draining to the Estuary at the surface or as shallow groundwater.

The site's foreshores vary in both their natural characteristics and their current condition. They include:

- Shoreline vegetation communities, backed by a narrow band of Flooded Gum, Paperbark and Sheoak, then a band of parkland cleared land supporting pasture, with gentle grades between the intertidal and the fringing plain and an abrupt change in grade at the transition to limestone dune terrain.
- Shoreline communities backed by thickets and rising steadily into either Banksia woodland, Tuart woodland or pasture.
- Shoreline communities and thickets backed by a steep limestone scarp with either Spearwood thicket or Banksia woodland.
- Shoreline communities and thickets backed by broad expanses of parkland-cleared Tuart woodland and Banksia woodland.

The existing impacts of agriculture and recreational uses (particularly crabbing) at and near the foreshore are greatest on the eastern shores of the site.

In general terms, the shoreline vegetation communities remain uncleared, the fringing tree vegetation is present with pasture understorey, and the upland vegetation has been completely or parkland cleared.

Where limestone outcrops occur very close to the foreshore, the natural vegetation tends to remain in place as these areas have little agricultural value and have not previously been cleared, although the effect of stock on understorey vegetation is evident throughout the site.

C.5.2 Mosquito Breeding Habitat

Twenty two species of mosquito breed in the region, with two biting species (*Aedes camptorhyncus* and *Aedes vigilax*) causing the greatest nuisance. *Aedes vigilax* breeds in saltmarshes, with breeding limited by low temperatures and confined to the period November to April. *Aedes camptorhyncus* breeds all year round in saline, brackish or fresh water.

Both species are major vectors of epidemic polyarthritis (Ross River Virus). Both species lay desiccation-resistant eggs in dry saltmarsh wetlands that can lie dormant for indefinite periods until temporary stagnant pools are formed by tidal inundation. The eggs hatch within one to two days after inundation and larval development commences.

One of the critical conditions for mosquito development is the presence of shallow stagnant pools that persist for longer than 7-10 days in summer and from three to four weeks in winter. The area of mosquito breeding grounds within the Estuary has increased markedly since the construction of the Dawesville Channel, as a result of the increased tidal range. Development in accordance with the ODP will not result in the creation of any additional breeding habitat.

No regular surveying or spraying of mosquito breeding sites is known to occur in the area of Point Grey at present, however surveys should be considered as the population of the area increases.

C.6 Fauna Habitat

C.6.1 Water Birds

Peel Inlet is listed as the fourth most important area in Western Australia in terms of the number of shorebird species for which it is internationally and nationally important (Watkins, 1993), and is recognised as the most important habitat in south-western Australia for waterbirds. It has Ramsar Convention listing as a wetland of international significance, and a number of reserves are located around its edge.

The Peel-Harvey Estuary normally supports more than 20,000 waterbirds, including 27 species cited in Japan/Australia (JAMBA) and China/Australia (CAMBA) Migratory Birds Agreements (Ninox, 1996).

These waterfowl predominantly utilise the shallows of the eastern and southern shores of Peel Inlet and southern Harvey Estuary. Wading birds use these areas and the shallows of the northern shore of the Estuary as feeding grounds.

Most, if not all, of the 84 waterbird species recorded to date in the Peel-Harvey Estuary are expected to occur at Point Grey (Ninox, 1996). However, because of the narrowness of the foreshore and intertidal zone and the comparatively small area of habitat available, the abundance of species around the peninsula is low. By far the most important waterfowl habitat in the vicinity of the site is located at the extreme southern limit of Robert Bay where extensive intertidal flats provide feeding and loafing habitats. Most trans-equatorial migratory waterbird flocks congregate in this area. These intertidal flats are outside of the Point Grey Project area.

The lowest waterbird activity was recorded on the western edge of Point Grey, where waterbird numbers were estimated as being one third that of the eastern shoreline.

The intertidal habitat at the peninsula's eastern shoreline is much narrower than around Robert Bay, and waterfowl congregation is principally associated with rocky points and areas where low limestone rocks emerge in shallow water, and where the shoreline supports tree vegetation with dead limbs suitable for opportunistic perching. Common cormorant species and pelicans dominate these areas and migratory species are poorly represented.

Remnant fringing vegetation and a seasonal wetland in the vicinity of the lower reaches of Robert Bay drain support large numbers of ducks and swans in winter and are likely to provide protected refuge during high winds. This area has no value as a summer drought refuge.

C.6.2 Terrestrial Fauna

At certain locations near the shoreline within the coastal reserve on the western shore there are low limestone ridges and cliffs with numerous small caves that might provide refuge for the rare Carpet Python. No sightings or other evidence of the species' existence were identified during the survey. These limestone cliffs are contained within the conservation area.

A large tract of woodland vegetation is located in the southern part of the site, and is flanked to the south by parkland-cleared agricultural land. This tract of land contains good examples of the woodland understorey habitat that has been lost from the remainder of the site and provides habitat for a wide range of bushland birds, mammals and reptiles.

Remnant fringing habitat along the eastern shoreline provides mature tree habitats in parkland cleared condition, including Tuart, Flooded Gum, Marri and Paperbarks, with increasing degradation towards the south where recreational activities have been more intense.

No gazetted rare fauna or any evidence of their recent presence was found during field surveys of the site. However, the distribution and habitat of some gazetted rare fauna occur on the site and therefore these species may occur at Point Grey even though none were sighted during surveys.

C.7 **Water Levels**

Extreme high water levels in the Peel-Harvey Estuary are governed by astronomical and meteorological tides, wind set-up, storm surge and flooding. The effect of extreme water levels on on-shore structures can be exacerbated by wave run-up.

The Dawesville Channel has influenced water levels in the estuary by increasing the astronomical tidal range and reducing the effect of river flooding. In the future, the

Greenhouse Effect is predicted to raise average sea levels in the region by about 0.2m by 2050 (Wigley & Raper, 1992).

The predicted effects of the above factors and the resulting design water levels adopted for the Point Grey Project are shown in Table 1.

Table 1
Design Water Levels

	High Water Level (mAHD) due to:					Design Building Level (mAHD)
	Astronomical & Meteorological Tides	1-in-100 yr Flood	Storm Surge	Wind Set-up	Greenhouse	
Peel Inlet (east)	0.64	1.12	1.15	0.6	0.22	2.3
Harvey Estuary (west)	0.65	1.00	1.15	<0.6	0.22	2.0

The design building levels adopted for the Point Grey Project are mostly well outside the conservation area boundary, which generally falls at or above the 2mAHD contour. Where private lots extend below 2mAHD, such as in some areas in the south-west and far east, building covenants can be used to restrict building to above 2mAHD.

C.8 Shoreline Stability

Aerial photographs taken between 1965 and 1996 indicate that the shorelines on both sides of Point Grey are stable and have no significant movement of sediment along the shore.

Field inspection of the Point Grey shoreline similarly found no indication of significant shoreline erosion or accretion, with the exception of a small section of beach on the central west coast, where localised erosion had exposed the fringing *Melaleuca* roots. This erosion is likely to have resulted from the faster tidal currents associated with the opening of the Dawesville Channel, combined with the effects of wind waves in south-west wind events. It is believed to represent an adjustment to the altered tidal and current regime following the opening of the channel, rather than an indication of ongoing littoral movement.

Calculations based on the measured current velocities and sediment grain sizes that occur in the area also strongly suggest that there would be insignificant sediment resuspension and transport (Halpern Glick Maunsell, 1996). This is supported by the observations of Department of Transport and PIMA personnel since the opening of the Dawesville Channel, who have described the loss of fine organic sludge from the sediments in subtidal shallows along the Point Grey west coast but have otherwise found the region to remain physically stable.

Tidal currents along the east coast of Point Grey experience a reduction in velocity, causing fine sediment to accumulate in this area.

A pilot study on the degree of erosion within the Peel Harvey Estuary (including Point Grey) and the lower reaches of the Serpentine, Harvey and Murray Rivers has recently been completed (Kobryn *et al.*, 2000). The extent of erosion within the system was assessed during spring 1999 and compared to historical data from 1957 to date. The data sets were at approximately ten year intervals. The extent of shoreline erosion was also mapped using aerial photography and an airborne video system in conjunction with ground transects.

Analysis of historical photography shows that there appears to have been very little change at Point Grey over time. Beach ratios, which give an indication of erosion, were determined between Point Grey and Mealup Point. The beach ratio of this transect was approximately 25% of the total shore length in 1977 and approximately 23% in 1999, showing that the shoreline was stable at this location.

C.9 Land Use Pressure

Currently, land use pressure on the shoreline is concentrated in the east, where recreational crabbing activity occurs.

Following development, human usage of the shoreline will inevitably increase in some areas but this increase will be accompanied by an increase in management (such as construction of boardwalks, car parking areas and restriction of access in sensitive areas), so that the impacts of the increased usage will be minimised. In particular, the effects of destructive activities such as off-road driving and lighting of fires will be much reduced.

Under the ODP, the greatest concentrations of human use of the foreshore and other conservation areas are expected to be in:

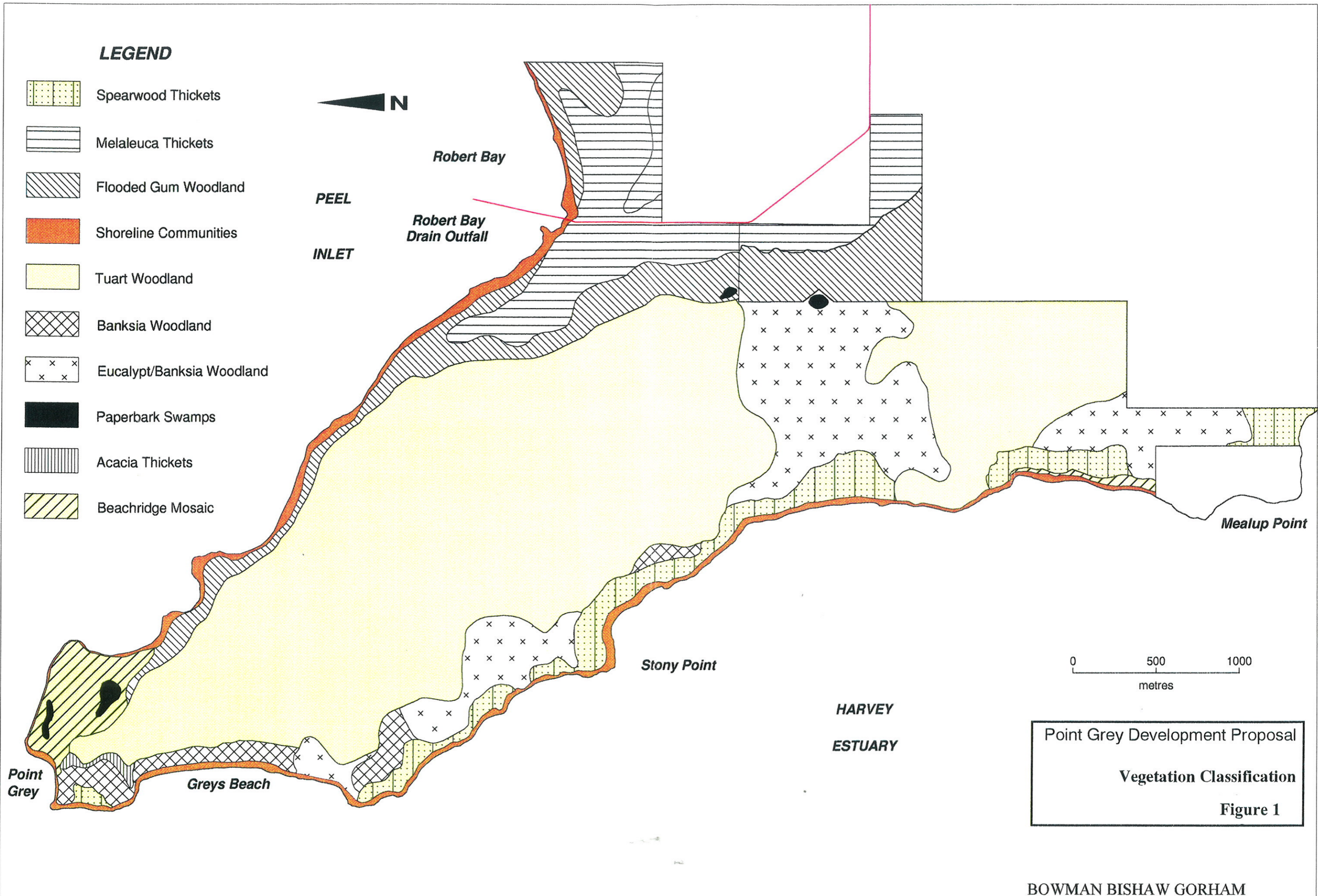
- the sailing club and, if constructed, the marina;
- traditional crabbing areas in the east; and
- areas close to the main accommodations including the Harbourside Tourist Village, the Traditional Neighbourhood Village, the Mealup Point Village and the Wilderness Lodge.

These usage patterns have been accounted for in the delineation of conservation areas. Prior to development in these areas, detailed conservation area management plans detailing such matters as access and land use controls will be prepared in accordance with the Minster's Conditions 6-5 and 6-6.

C.10 Aboriginal Heritage


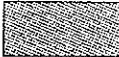




An Aboriginal heritage survey was undertaken by McDonald Hales and Associates during May and June 1996. The survey included archaeological and ethnographic studies. No stone artefacts were located within the study area by the archaeological survey. One scarred tree was noted in the vicinity of the proposed residential village. If practicable, this tree will be included in public open space during the development of the residential village. No artefacts or other heritage sites were found in the vicinity of the foreshore or other conservation areas.

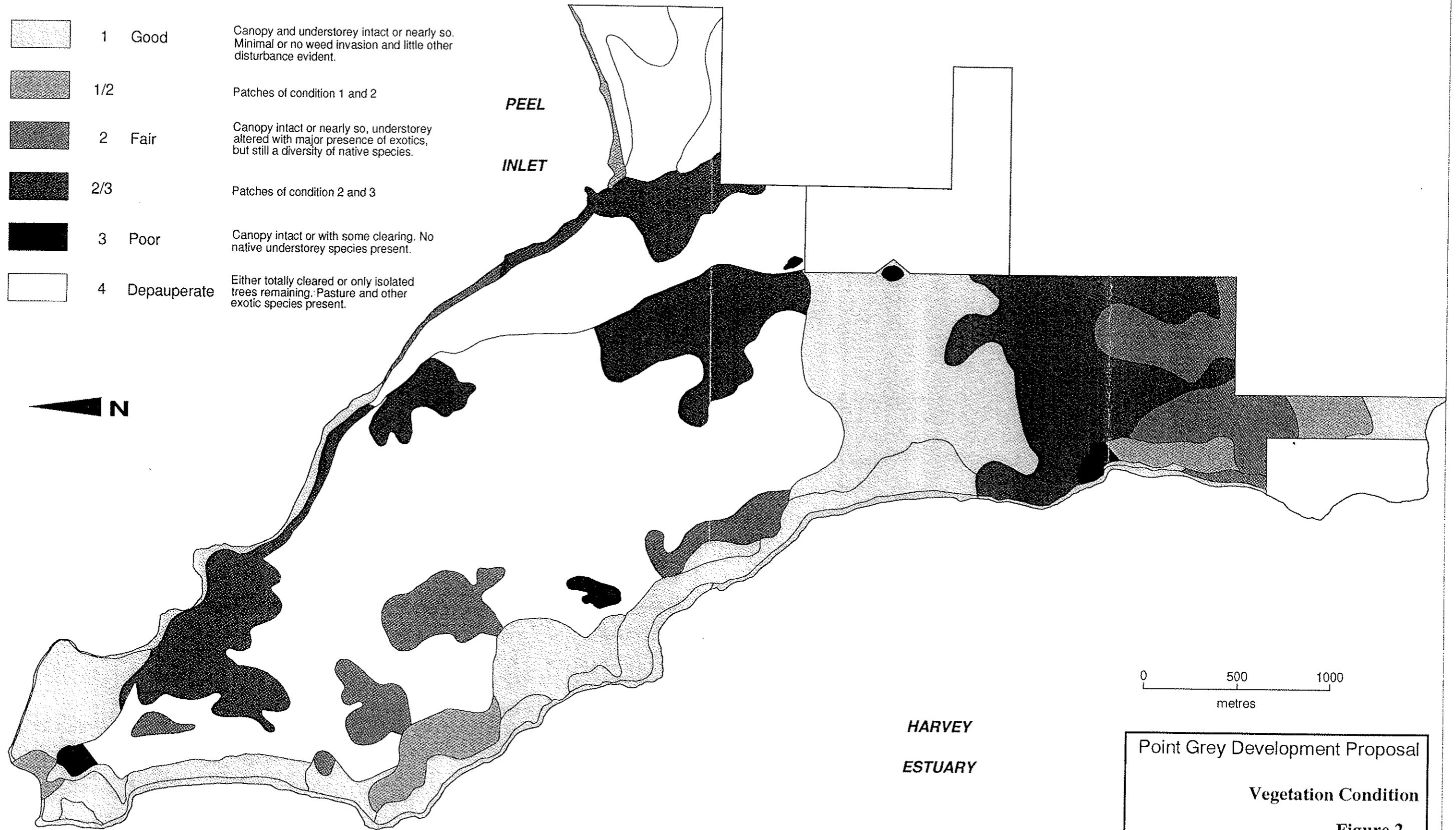
FIGURES



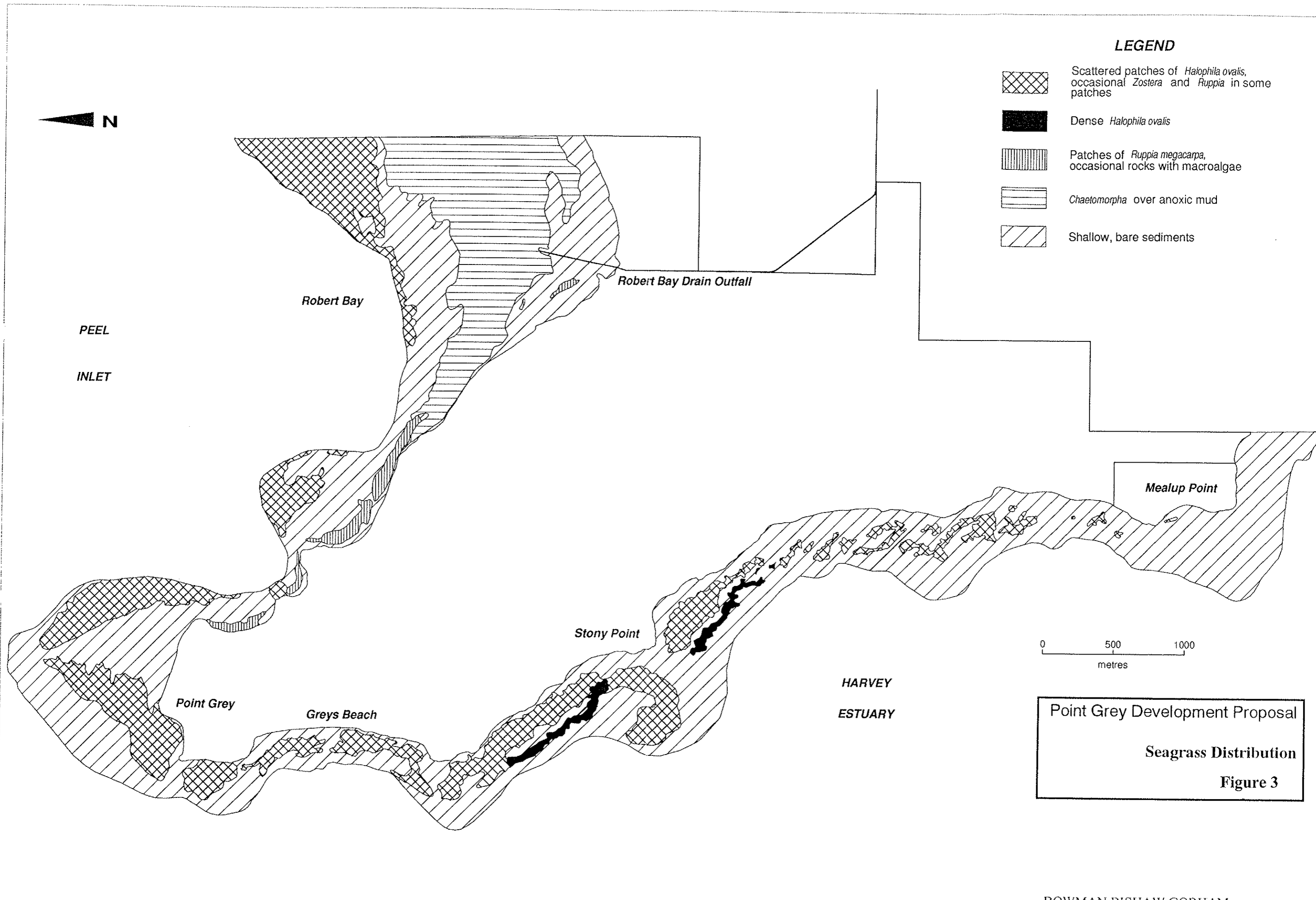
Point Grey Development Proposal
 Vegetation Classification
 Figure 1

LEGEND




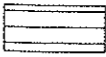
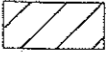
- | | | | |
|---|-----|-------------|--|
|  | 1 | Good | Canopy and understorey intact or nearly so. Minimal or no weed invasion and little other disturbance evident. |
|  | 1/2 | | Patches of condition 1 and 2 |
|  | 2 | Fair | Canopy intact or nearly so, understorey altered with major presence of exotics, but still a diversity of native species. |
|  | 2/3 | | Patches of condition 2 and 3 |
|  | 3 | Poor | Canopy intact or with some clearing. No native understorey species present. |
|  | 4 | Depauperate | Either totally cleared or only isolated trees remaining. Pasture and other exotic species present. |



Point Grey Development Proposal
Vegetation Condition
Figure 2



LEGEND

-  Scattered patches of *Halophila ovalis*, occasional *Zostera* and *Ruppia* in some patches
-  Dense *Halophila ovalis*
-  Patches of *Ruppia megacarpa*, occasional rocks with macroalgae
-  *Chaetomorpha* over anoxic mud
-  Shallow, bare sediments

PEEL
INLET

Robert Bay

Robert Bay Drain Outfall

Mealup Point

Stony Point

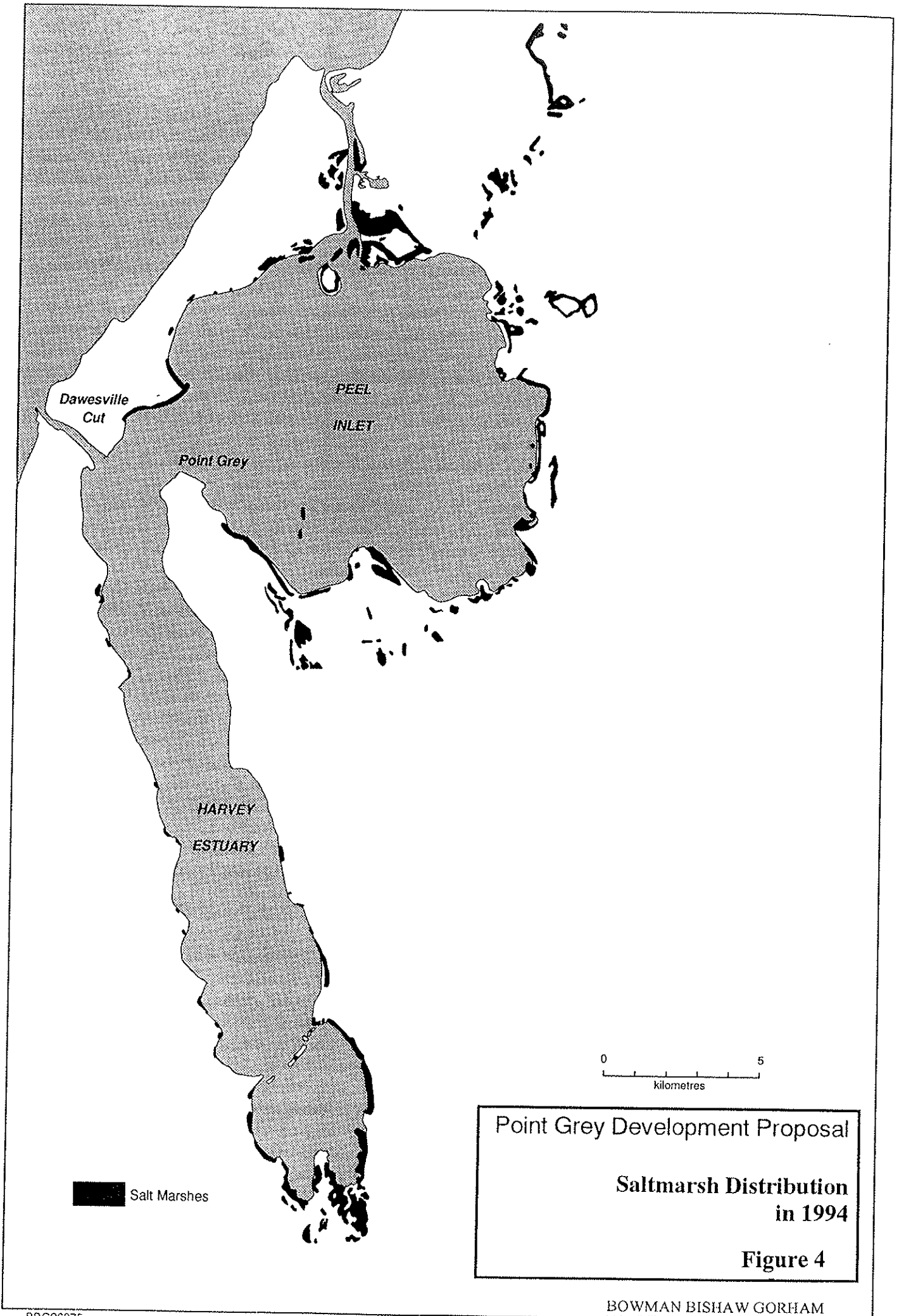
0 500 1000
metres

Point Grey



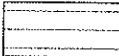

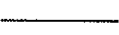
Greys Beach

HARVEY
ESTUARY

Point Grey Development Proposal
Seagrass Distribution
Figure 3



LEGEND

-  Sumpland
-  Dampland
-  Flood Plain
-  Estuarine Wetland
-  Robert Bay Drain

PEEL

INLET

Robert Bay
Drain Outfall

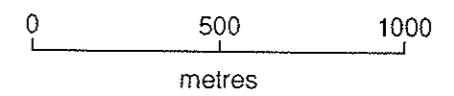


Mealup Point

Stony Point

HARVEY

ESTUARY




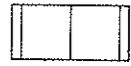
Point Grey


Greys Beach

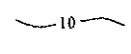
Point Grey Development Proposal
Wetlands
Figure 5

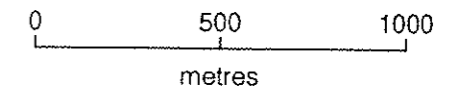
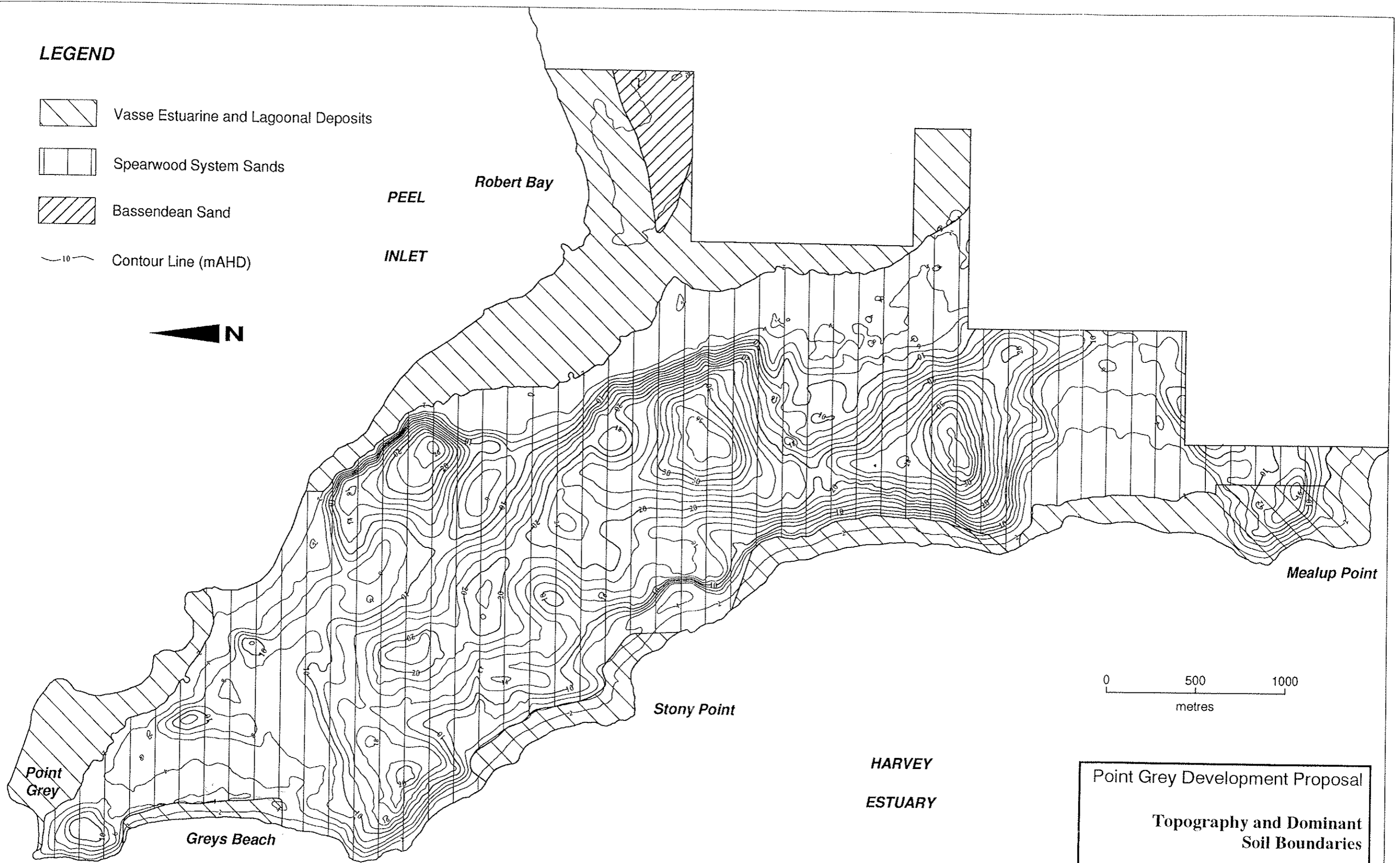
LEGEND

 Vasse Estuarine and Lagoonal Deposits

 Spearwood System Sands

 Bassendean Sand

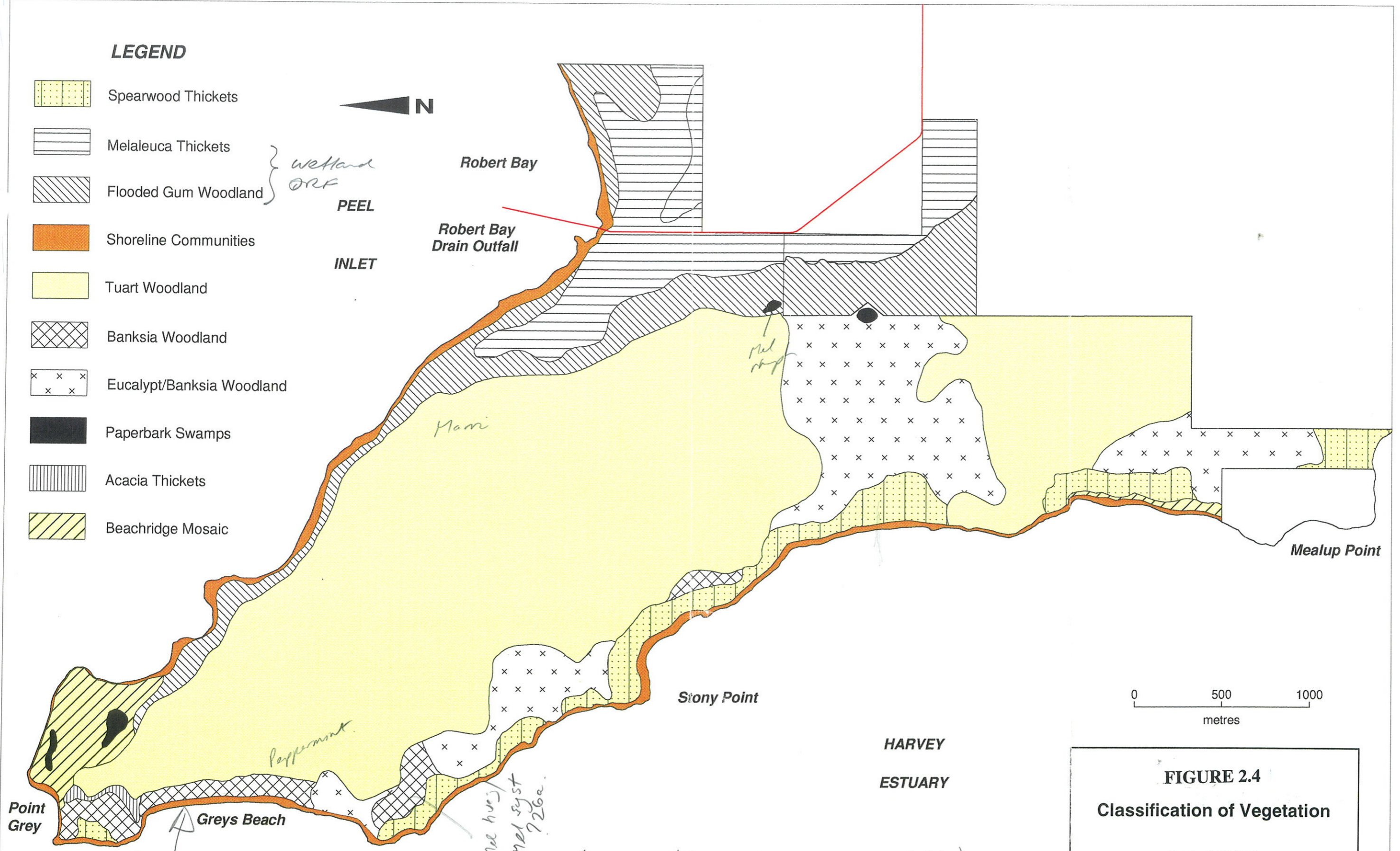
 Contour Line (mAHD)



Point Grey Development Proposal
Topography and Dominant
Soil Boundaries
Figure 6

LEGEND

-  Spearwood Thickets
-  Melaleuca Thickets
-  Flooded Gum Woodland
-  Shoreline Communities
-  Tuart Woodland
-  Banksia Woodland
-  Eucalypt/Banksia Woodland
-  Paperbark Swamps
-  Acacia Thickets
-  Beachridge Mosaic



Wetland ORF

PEEL

INLET

Marr

Peppermint

*Med hwy
Med syst
726a*

*Issues - wae/PIWA
Loss - ? replacement*

*local (this just as valid)
regional value - where else does
continuity of habitat foreshore reserve*

High area protected = higher value with Duneside changes

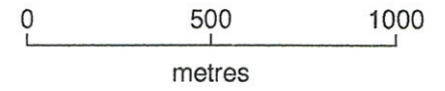


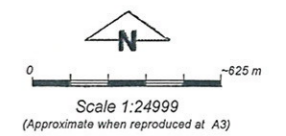
FIGURE 2.4
Classification of Vegetation
Scale: 1:20,000

1998 report based on
BOWMAN BISHAW GORHAM Goble-Garrett
ENVIRONMENTAL MANAGEMENT CONSULTANTS 1996

Point Grey



- LEGEND**
Peel Regional Scheme - DPI 16/08/05
- Industrial
 - Other Regional Roads
 - Primary Regional Roads
 - Private Recreation
 - Public Purposes (High School)
 - Public Purposes (Hospital)
 - Public Purposes (Public Utilities)
 - Public Purposes (Special Uses)
 - Public Purposes (University)
 - Railways
 - Regional Centre
 - Regional Open Space
 - Rural
 - State Forests
 - Urban
 - Urban Deferred
 - Waterways
- Swan Coastal Plain South 20cm
Orthomosaic - DL106



Geocentric Datum Australia 1994
Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.
Prepared by: GlenM
Prepared for:
Date: 29/05/2007 11:19:42 AM

Information derived from this map should be confirmed with the data custodian acknowledged by the agency acronym in the legend.



WA Crown Copyright 2002

Point Grey



LEGEND

Swan Coastal Plain South 20cm
Orthomosaic - DL10



Scale 1:24999
(Approximate when reproduced at A3)

Geocentric Datum Australia 1994

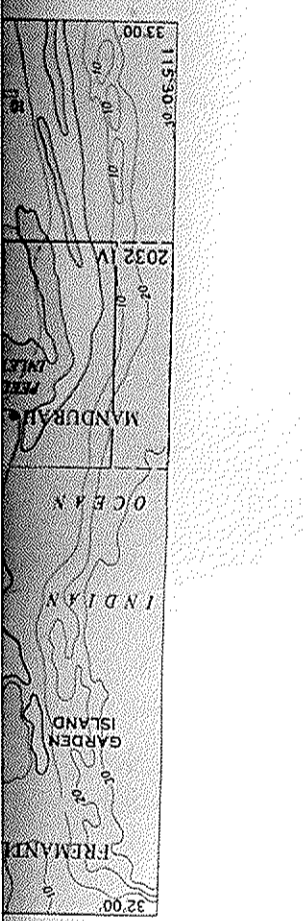
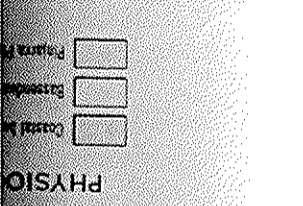
Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

Prepared by: GlenM
Prepared for:
Date: 29/05/2007 11:20:04 AM

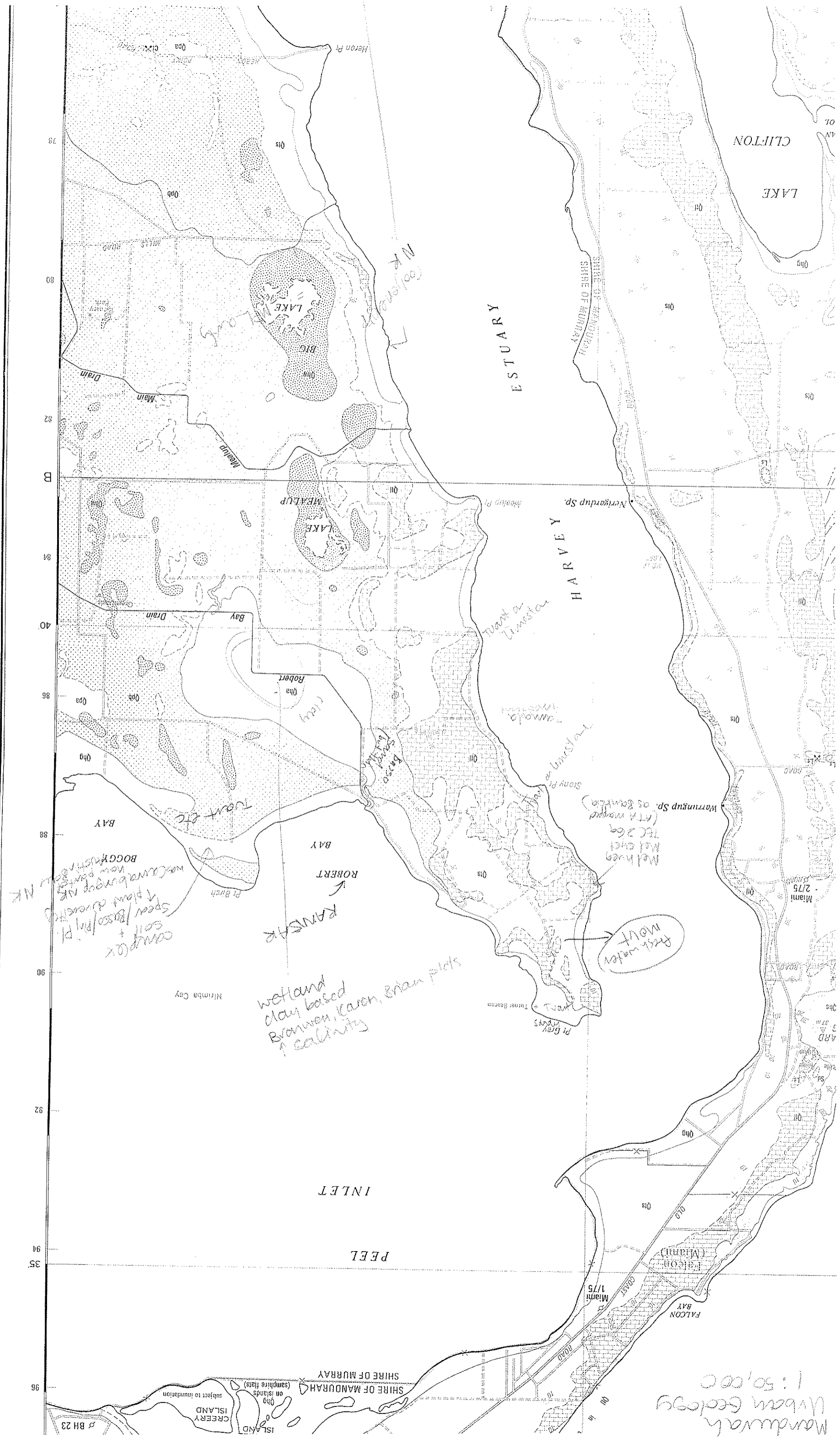
Information derived from this map should be confirmed with the data custodian acknowledged by the agency acronym in the legend.



EARLY CRETACEOUS	WARHRO GROUP	AGE	FORMATION
UPPER PART	LEDEYVILLE FORMATION	QUARTER-NARY	SAFETY BAY SAND
MIDDLE PART			
LOWER PART			
SAGE SANDSTONE		TERTIARY	ROCKINGHAM SAND
MEMBER			



The representation on
 Bathymetric contour
 Benchmark, height as
 Horizontal control, m
 Homestead
 Powerline
 Townsite boundary
 Local authority bound
 Track
 Minor road
 Major road
 Spring
 Drain
 Watercourse
 Contour in metres
 Sand
 Limestone
 Clay
 Mineral occurrence
 Quarry or pit
 Deep borehole (wa
 Fossil strand line
 Dune crest (Decer
 Transitional
 Accurate
 Geographical bound



complex soil + Speer/Basso/Pring Pl. now part of Boggy Creek

wetland clay based Brownian, Carbon, Brian, Brian

Fresh water

Mandurah Urban Geology 1:50,000

ENTERED ON GIS

Name: Point Grey Development Project – Environmental Review and Management Programme
Date: 01/05/2006
Capture Author: Thomas Leong / Ian Steward

Comments:

Polygon

Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual references, resulting in polygon boundary errors

Attributes

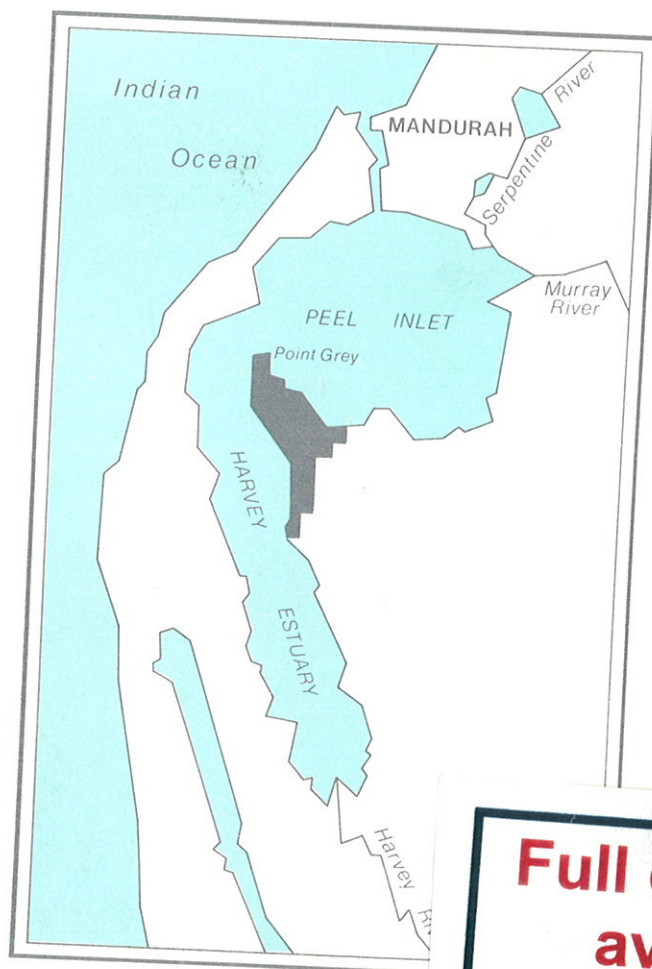
Report Info – Captured without problems

Custodial/Contact – Captured without problems

Content – Captured without problems

POINT GREY DEVELOPMENT PROJECT

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME



**Full document
available
on request**

ENTERED ON GIS

Name: Point Grey Development Project – Environmental Review and Management Programme Appendices
Date: 01/05/2006
Capture Author: Thomas Leong / Ian Steward

Comments:

Polygon

Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual references, resulting in polygon boundary errors

Attributes

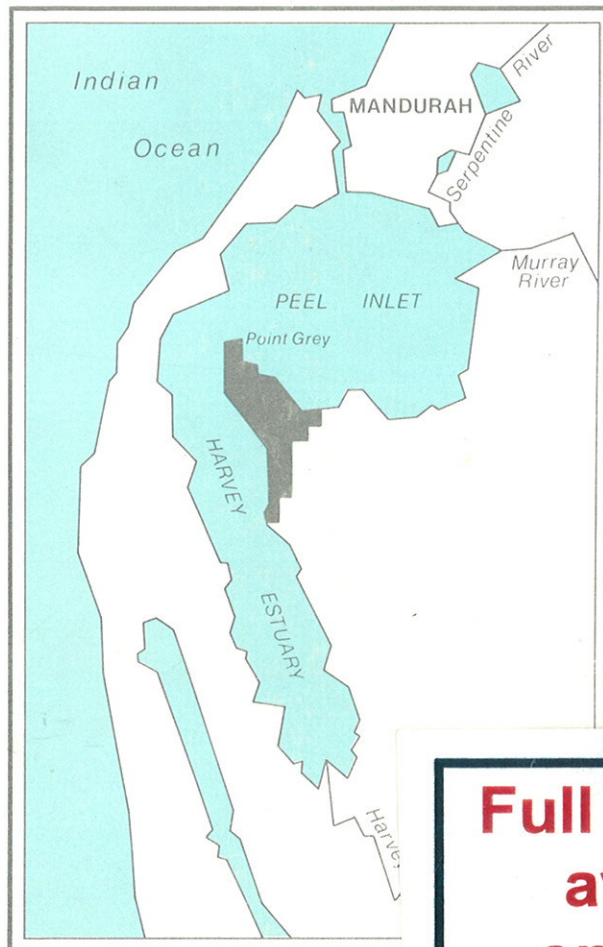
Report Info – Captured without problems

Custodial/Contact – Captured without problems

Content – Captured without problems

POINT GREY DEVELOPMENT PROJECT

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME



**Full document
available
on request**