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Department of Conservation and Land Management, W.A.

## *Benger Swamp Nature Reserve*



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Draft Management Plan  
DECEMBER 1986

## ENTERED ON GIS

**Name:** Wellington Location 1 Lot 1 Sand Excavation Environmental  
Assessment and Management Plan  
**Date:** 28/04/2006  
**Capture Author:** Thomas Leong / Ian Steward

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**Wellington Location 1 Lot 1**

**Sand Excavation**

**Environmental Assessment and**

**Management Plan**

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May 2002

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# 1 Introduction

## 1.1 The Scope of the Report

This report has been prepared by SMEC Australia Pty Ltd (SMEC) on behalf of David Partridge Pty Ltd and Ian Partridge Pty Ltd to address the environmental aspects and effects likely to occur should sand excavation be undertaken on Wellington Location 1 Lot 1 in Wellington Road, Wellesley and the background against which those aspects and effects are derived. A locality plan of the area under consideration is provided at Figure 1.

The report also addresses the environmental management that would be required to maximise the environmental benefit of the project when it is implemented.

The report is concluded with a statement of the expected environmental outcome should the project be implemented.

## 1.2 The Context of the Report

This report has been prepared on the basis that the owners of Lot 1 made application, to establish a sand extraction project at that location in 1997. The report takes into account information that would have been collected in the process of making that application and the relevant environmental legislation, regulations, policies and other controls that applied at that time.

The report investigates the range of significant issues as they were understood in 1997 and does not consider more recent initiatives that would affect the assessment of the environmental effects of the project in 2002.

## 1.3 The Structure of the Report

Following this introduction the report is structured as follows:

- Section 2 – Describes the decision making process associated with an extractive industry;
- Section 3 – Describes the proposal and similar projects in the area;
- Section 4 – Discusses the historic land uses on Lot 1;
- Section 5 – Establishes the existing environmental aspects to be found within the project area and their inter-relationships;

- Section 6 – Predicts the environmental effects that may be expected to occur should sand extraction occur on Lot 1;
- Section 7 – Discusses the management options and makes commitments regarding environmental management to be undertaken should implementation of the projected occur; and
- Section 8 – Provides a conclusion regarding the ability to manage effects on the environment to maximise the positive benefits and minimise any negative outcomes through extraction of sand from Lot 1.

## 2 The Decision Making Process

### 2.1 Extractive Industry Licence

To proceed, the project would require an extractive industry licence, issued by the Shire of Harvey. The requirements of Division 3 of Part IV of the Environmental Protection Act 1986, as amended by the Planning Legislation Amendment Act 1996, would require assessment of the proposal by the Environmental Protection Authority. This legislation was gazetted in 4 August 1996. The assessment is required, as the environmental issues raised by the proposal were not assessed during the assessment of the Region Scheme or the town plan for the Shire of Harvey.

On application for the licence, the Shire of Harvey would refer the licence application to the EPA. The need for assessment would then be determined, based on the expected environmental impacts and the detail in the information provided.

To process the application and provide approval to proceed with an extractive industry the Shire of Harvey would require evidence of approval to proceed with the project from the following agencies:

- Environmental Protection Authority; and
- Commissioner for Soil Conservation.

Advice on the proposal from the Department of Conservation and Land Management (regarding the value of the vegetation on Lot 1 and the likelihood of impact on Declared Rare flora and fauna) and the Water and Rivers Commission (with respect to the effect of the proposal on the Wellesley River and nearby wetlands) would also expedite approval to proceed from the Shire.

### 2.2 Environmental Approval

The project would be referred to the EPA for assessment by the Shire of Harvey, if the proponent had not already done so. The EPA would consider the proposal under Division 3 of Part IV of the Environmental Protection Act 1986 (as amended) if referred by the Shire and under Division 1 of Part IV if it was referred by the proponent. The EPA would then make a judgement on the environmental acceptability of the project, or otherwise. The EPA may consider the proposal warrants formal assessment if the environmental objectives of the

EPA are compromised and it considers the environmental effects of the project require consideration by other agencies and the general public.

The objectives of the EPA with respect to regionally significant vegetation in the rural zone are:

- Ensure the abundance, diversity, geographic distribution and productivity of vegetation communities is maintained;
- Protect Declared Rare Flora and Priority Fauna consistent with the provisions of the Wildlife Conservation Act 1950; and
- Ensure riparian vegetation on substantial streamlines is adequately protected (WAPC, 2000).

The EPA has defined the following objective in relation to wetlands in the rural zone:

- Key ecological factors of these wetlands should be protected and maintained through appropriate planning mechanisms (WAPC, 2000).

Provision of comment on the project by other agencies, with specific focus on these objectives, would lessen the likelihood of formal assessment if that comment indicated the project was considered to have no significant environmental effects.

## 2.3 Notice of Intention to Clear

### 2.3.1 Assessment Process

The Soil and Land Conservation Regulations 1992, that support the Soil and Land Conservation Act 1945, requires that a Notice of Intention to Clear is required to be lodged with the Commissioner for Soil and Land Conservation. That Notice should be lodged if a landholder proposes to clear in excess of one hectare of land, either singularly or cumulatively. When submitting the Notice, the landholder should demonstrate that clearing of the land will not cause land degradation (WADA, 2002).

The Commissioner has two courses of action:

- Object to the clearing where land degradation is likely to occur; or
- Elect not to object to the proposal (possibly subject to conditions) and advise the proponent and other departments accordingly.

The Commissioner has ninety (90) days to respond to a Notice.

In the case where the Commissioner does object, the proponent has the opportunity to appeal the decision to the Minister for Agriculture.

The scope of assessment addressed by the Commissioner is confined to issues of land and soil conservation. Where other environmental concerns arise, both the Commissioner and the Minister may refer the proposal to the EPA or seek advice from the Inter-Agency Working Group.

Under a Memorandum of Understanding between the Commissioner and the EPA established in May 1996, any project, referred to the Commissioner that is considered to compromise the environmental values on private lands is referred to the EPA for assessment. Provision of comment from other agencies who form the Inter-Agency Working Group, including the Department of Conservation and Land Management and the Waters and Rivers Commission, now Department of Water, Catchment and Environmental Protection, assists the Commissioner in his judgement of potential of the project to compromise the environmental values of the land concerned and its environs and cause environmental harm.

### **2.3.2 Involvement of Other Agencies**

The provision of a Notice of Intent to the Commissioner for Soil and Land Conservation is the trigger for the involvement of an Inter-Agency Working group that advises the Commissioner on the environmental values associated with the land area under consideration. Typically this involves the Department of Conservation and Land Management, the Water and Rivers Commission and the Department of Environmental Protection.

These agencies advise the Commissioner of the environmental values associated with the land, specifically in relation to its conservation values and the interests of the individual agencies.

### **2.3.3 Criteria for Evaluation of a Notice of Intent**

Each member of the Inter-Agency Working Party represents a natural resource management department with specific responsibilities that can be defined under the following subject areas:

- Land degradation issues associated with vegetation clearing
- Conservation and heritage values (natural and cultural) of areas to be cleared

- Representativeness of vegetation in the area to be cleared and its function in the landscape; and
- Ecological viability of the vegetation (over a fifty (50) year horizon).

## 2.4 Summary

Three trigger mechanisms for assessment of the environmental effects of the proposal to extract the sand resource on Lot 1 are available. Two of these mechanisms, an application for an extractive industry licence (to the Shire of Harvey) and a Notice of Intention to Clear (through the Commissioner for Soil Conservation) would result in activation of the third mechanism (referral to the EPA) if the predicted environmental effects were considered significant.

## 3 The Proposal

### 3.1 The Scope of the Project

The sand resource on Wellington Location 1 Lot 1 would be extracted using open cut excavation methods and to transport the sand from Lot 1 via Wellington Road and Wellesley Road to markets in the Greater Bunbury Region. The proposed site location is shown at Figure 1 and the area proposed for sand extraction is shown at Figure 2.

The rate of extraction is expected to be about 200,000 cubic metres per annum, but will be dependent on local demand for the type of sand available. At this rate about three (3) hectares of land will be disturbed each year for the purposes of sand extraction.

The overall useable resource is conservatively estimated to be in the order of four (4) million cubic metres of sand. The resource estimate was made using a combination of drill and probe test results and relating those results to the local topography to create polygons. The volume of sand in each polygon was calculated maximising the uncertainties in each calculation. The sum of the polygons was established as the resource of sand available for extraction. This equates to a project life of twenty (20) years at the proposed rate of extraction. The area proposed for excavation is shown on Figure 3.

This estimate includes consideration of the following controls on the excavation:

- The location of a clay layer at depths ranging from four (4) to 11 metres below the natural surface of the site (as established from the Geotech soil logs and Electric Friction-cone Penetrometer logs at Appendix B);
- Provision of a 50 metre vegetated buffer along the south and western boundary around the area proposed for excavation;
- Provision of a 100 metre buffer around the peripheral wetland vegetation;
- Restriction of clearing to between three (3) and five (5) hectares per annum;
- Limitation of working hours for the purpose of excavation to 12 hours per day, six (6) days per week; and
- A final land use to create pasture for cattle grazing and hay production.

The Partridge family, have always been aware of the value of the sand on Lot 1, particularly the sand ridge in the south west corner. This sand resource is the closest sand resource to the South West Highway and would likely to be used as road fill if the highway is upgraded.

The end land use proposed is improved grazing pasture. It is expected the clayey sand that lies beneath the extractable resource will provide a better agricultural soil than the current soil cover when rehabilitated with the topsoil removed. The clayey soil has greater nutrient retention capacity than the overlying sand proposed for removal, a feature that has strongly influenced current land use. That feature resulted in the clearing of the clayey and duplex soils on Lot 1 as the cost of nutrient addition to satisfy requirements of the deep sand areas were prohibitive.

### 3.2 Other Sand Excavation in the Region of the Project

There are three sand extraction operations in the Kemerton region that are currently mined. These areas are located in a range of environments, including remnant vegetation. They occupy sand ridges in the Yoongatillup, Karrakatta and Bassendean Sands.

Two of these operations lie within the Kemerton Buffer Zone, as does the proposed extraction operation on Lot 1. These are the operations undertaken by Edwards and Giacci.

At least three other proposals for sand extraction are known to be under consideration in the Kemerton area. These proposals include land with a similar land use history to that which has occurred on Lot 1.

## 4 Historical Land Use

### 4.1 Land Ownership

The land was purchased by R I E and D W Partridge on July 1 1960. In July 1969 the land ownership was transferred from R I E and D W Partridge to family holding companies, Ian Partridge Pty Ltd and David Partridge Pty Ltd. The land has always been farmed since its purchase by the family business entity, WS Partridge and Sons.

### 4.2 Agriculture

#### 4.2.1 Clover Production

Prior to its ownership by the family business, the river flats had been cleared and developed for clover production.

In the 1950s the wetland areas were also drained on Lot 1 and property to the west in a joint arrangement by the then owners of the properties and these areas were also developed for clover production. These drains were cleaned out every couple of years during the 1960s and 70s.

#### 4.2.2 Grazing

The property has been used by the family business to graze about 200 head of cattle over the period from June to August each year. Its use as winter grazing avoided the pugging of soil at the nearby family holding, "White Rocks", where the soils have a high clay content and do not withstand movement of cattle on them without distortion of the soil surface.

Lot 1 was a key element of the pasture and soil conservation on the holdings operated by the family business as it allowed cattle to be removed from the moisture sensitive soils at White Rocks during the winter and enabled grazing to be stopped on Lot 1 during the drier spring, summer and autumn months when grazing would have deteriorated the sand soils and their vegetation cover.

#### 4.2.3 Hay Production

The Wellesley river flats within Lot 1 and some adjacent drained wetland areas on Lot 1 have been cut for hay every year. They have been fertilised regularly by the Partridge family and previous owners of Lot 1 initially with superphosphate and potash and, over the last decade, with urea and sulphate of ammonia to increase hay yield.

Hay production until June 1997 was in the order of 300 to 400 round rolls per year.

#### 4.3 Timber Extraction

Timber has been removed commercially from the property on two occasions – at the turn of the century and in the early 1950s – for the purpose of sleeper production. The mill stumps present on the site provide some evidence to the size of the trees felled on each occasion. There was a caveat on the land title regarding the rights to the timber. This caveat has never been exercised or withdrawn.

The property has provided a supply of strainer posts for both this property and White Rocks during the time it has been owned by the Partridges.

#### 4.4 Sand Extraction

A pilot sample of sand, totalling 400 tonnes, was removed in the late 1970's and sent to Japan to test its potential for use in glass making. The presence of ilmenite in the sand (1.5%) precluded its use due to the cost associated with the removal of the ilmenite.

Small portions of sand have also been removed for use in the farming operation.

## 5 Existing Environment

### 5.1 Water

#### 5.1.1 Surface Water Flows

##### 5.1.1.1 Proximity of Wellesley River

The boundary of the sand resource is located within 50 metres of the Wellesley River at its closest point and beyond 500 metres at its furthestmost point. The southern boundary of Lot 1 is within one (1) kilometre of the System 6 area C67 which includes the lower reaches of the Wellesley, Collie and Brunswick Rivers (DCE, 1983)

The banks of the river and its adjacent floodplain within the area of Lot 1 are very degraded. Very little of the vegetation that formed the buffer along the river remains and hence there is little opportunity to filter runoff from adjacent land into the river to remove sediment and nutrient contained in the runoff. This is confirmed by examination of the water condition and the sediment build up on the river bed in December 2001.

The Leschenault Inlet Management Authority and the Water and Rivers Commission have an objective of developing a vegetated 50 metre buffer along the river. It is anticipated that development of the buffer would be a condition applied to the proposal to extract sand as part of the statement of condition to proceed should approval from the EPA be forthcoming.

##### 5.1.1.2 Surface Drainage Structures

Within Lot 1 a number of drainage channels have been constructed to drain cleared wetland areas. Intercepted groundwater and runoff is diverted into the Wellesley River by these drains. The drains are located as shown in Figure 2.

##### 5.1.1.3 Surface Runoff

Very little surface runoff is generated by the sand ridges on the site. Surface indicators suggest rainfall infiltrates into the sand except under extreme rainfall events.

The cleared wetland areas and the Wellesley River floodplain generate runoff, where surface or near surface soils tend to be non-cohesive materials.

## 5.1.2 Groundwater

### 5.1.2.1 Regional Groundwater

Within the Kemerton area the regional ground water flow tends to be east to west. The superficial groundwater aquifer is the layer of interest to this project as it is the layer most likely to be intercepted or influenced by the proposed sand extraction.

The superficial aquifer tends to be fresh water with a salinity of less than 1000 milligrams per litre. It is used for farm, domestic, stock and irrigation supply in the Greater Bunbury Region (WAPC, 2000).

### 5.1.2.2 Local Groundwater Characteristics

Very little specific data is available for the groundwater flows and levels within the proposed sand excavation area. However, following visual observations made of surface conditions on the site, the following conditions are anticipated.

The groundwater under the sand ridge is expected to mound due to the storage capacity of the sand. This expectation is based on the elevated location of some small wetland areas and the presence of "wetland" plants at locations within the sand ridge.

The groundwater "leaks" from the sand ridge along its eastern margin. This leakage is expressed as a band of rushes and paperbark trees along that zone at a level some three (3) to five (5) metres above the normal flow level in the Wellesley River. Thus there is an indication that the local groundwater flow is west to east at the boundary of the Bassendean Sands System with the fluvial deposits of Cannington land system. The Cannington land system is characterised by poorly drained yellow duplex soils with medium textured sandy clay features.

The wetlands around the south and west boundaries of the property reflect the groundwater level at those locations.

The presence of "green" vegetation in channels draining wetlands suggests groundwater is close to the invert level of the channel.

### 5.1.2.3 Groundwater Expression

As described above, the groundwater level is expressed on and around Lot 1 by wetlands and "wetland" type vegetation at a number of locations abutting the area proposed for sand extraction. In the absence of detailed groundwater data, these expressions indicate the groundwater flows from Lot 1 across a cohesive soil layer that underlies the sand ridge.

The presence of "wetland" type vegetation at points above the level of the Wellesley River floodplain on the sand ridge suggests that the groundwater "mounds" within the sand ridge. The mounding may be reflecting changes in the depth of sand across the site.

### 5.1.3 Wetlands

#### 5.1.3.1 Historical Background

The value of wetlands for conservation was recognised and has been actively pursued by conservation interests since the 1960's and early 1970's. During the deliberations of the Conservation Through Reserves Committee it was reported in 1976 that a number of 'wetlands' should be reserved to protect the environmental and cultural values that were recognised by the community at large in these areas. The Department of Conservation and Environment (now the Department of Water, Catchment and Environmental Protection (DEWCAP)) addressed these recommendations in its reports on the natural land systems within Western Australia. The report covering the subject area of this report, System 6, was released in 1983 and recommended the setting aside of Mialla Lagoon, west of Lot 1, as a reserve for the protection of its wetland values.

In 1986 the DCE released Bulletin 227 which provided draft guidelines for wetland conservation in the Perth metropolitan area (DCE, 1986). The Environmental Protection Authority (EPA) then released a guide to wetland management in Perth in the form of Bulletin 374 (EPA, 1990).

Further community pressure, public protests regarding the loss of wetlands to development and research into the environmental and social values of wetlands resulted in the Environmental Protection Authority establishing an Environmental Protection Policy to protect wetlands on the Swan Coastal Plain (EPP, 1992). The Policy was endorsed by the Government of the day. To address the requirements of the extension of the scope of the policy into the entire Swan Coastal Plain, the EPA produced Bulletin 686 (EPA, 1993). This document provided guidelines for management of wetlands in Perth and the Swan Coastal Plain.

In parallel with the policy development that was occurring, the Water Authority (now within DEWCAP described above) commenced mapping the wetlands of the Perth metropolitan area and near the metropolitan area. It is understood mapping within the Bunbury region was not undertaken until 1998.

#### 5.1.4 Wetlands Likely to be Influenced

There are three wetland areas of conservation significance that impinge on Lot 1. These wetlands are categorised into one of three categories, described in EPA Bulletin 686 (EPA, 1993).<sup>1</sup>

One of the wetlands to be considered is located on the southern boundary of Lot 1 (as shown in Figure 3). The wetland is bisected by the boundary fence. It is a "Conservation" category wetland. That is, it is a wetland that supports a high level of natural attributes and functions (EPA, 1993). The management objective for this wetland would be to preserve the wetland functions and attributes through reservation in national parks, crown reserves, state owned land and protection under environmental protection policies. The wetland is a deep depression surrounded by a sand dune (the source of sand identified on Lot 1) and its water level is likely to be an expression of the local groundwater.

Two other "Conservation" wetlands are bisected by the western boundary fence. One of these is a wetland described under the EPP.

Another wetland on the western boundary is classed as a "Resource Enhancement" wetland. This category of wetland has lost some of its natural attributes and functions. Such wetlands are expected to be managed in such a manner that the wetlands are restored through maintenance and enhancement of wetland functions and attributes by protection in Crown reserves, State or local government owned lands and by environmental protection policies, or in private property by sustainable management.

Other wetlands within Lot 1 are classed as "Multiple Use" wetlands (not identified in Figure 3) whose use, development and management should be considered in the context of water, town and environmental planning through Landcare.

These wetlands are shown on the aerial photograph at Figure 3.

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#### <sup>1</sup> Wetland Classifications

Conservation: a wetland that supports a high level of natural attributes and functions

Resource Enhancement: a wetland has lost some of its natural attributes and functions

Multiple Use: a wetland whose use, development and management should be considered in the context of water, town and environmental planning through Landcare

## 5.2 Soil

The surface soil on the site varies from the sandy clay of the Wellesley floodplain and the wetland areas within Lot 1 to the coarse sandy soils of the sand ridge.

A number of bore holes have been drilled across the site. These have been located adjacent to the Wellesley River, through a cross-section of shallow sand and alluvial clay zones on the eastern side of the property and along the western boundary through a range of shallow sand and wetland associated soils. The logs of these boreholes are not available. A second set of boreholes was established to define the size of the sand resource. These boreholes radiated from the south western corner of Lot 1 and traversed the sand ridge proposed for excavation. The holes were established using a RAB (rotary air blast) drill. The borehole logs have been assessed and the following findings are made. An additional ten (10) probes were undertaken using an electric cone penetrometer.

The surface sands are white, medium grained, single sized sand with minimal silt and clay fines. As a result, their void ratio is high and they are highly permeable.

The sands vary in depth from four (4) to eleven (11) metres as shown in drill logs and electric cone penetrometer test probes at Appendix B.

A zone of grey sandy clay and clay underlies the surface sands. This layer is considered to be relatively impermeable in comparison to the sands that overly it. It is likely to present a barrier to the downward flow of water from rainfall infiltrating the surface.

The clay sand would tend to encourage lateral flow of this material types. This layer tends to follow the local topography. Consequently water tends to accumulate in areas where the clay sand layer is depressed. Where it is exposed or covered by a thin layer of sand, its expression is likely to create the wetlands evident at the boundaries of the project area.

## 5.3 Flora

### 5.3.1 Historical Background

A number of flora surveys had been carried out in the Kemerton Region associated with specific industry proposals prior to 1997 (for example, see Matiske (1993) and Dames and Moore (1989)).

Muir (1999) provides a more detailed biological survey of the Kemerton area, including the area proposed for inclusion in the Kemerton Industrial Area.

### 5.3.2 Site Specific Information

To date no survey provides specific details on the flora associated with the area proposed for extraction of sand.

A number of key species to enable classification of the vegetation site types were identified during an inspection of the site. These included *Eucalyptus marginata*, *Banksia attenuata*, *Kunzea ericifolia*, *Agonis flexuosa*, *Hibbertia hypericoides*, *Conostylis aculeata*, *Macrozamia reidleyi* and *Bossiaea eriocarpa*.

A search of the CALM database revealed that no Declared Rare or Priority listed flora have been identified in the project area. The information on flora developed as a result of the survey of the Kemerton Industrial Area conducted by Muir (1999) did not reveal any presence of Declared Rare Flora on Lot 1.

## 5.4 Vegetation

The vegetation cover on Lot 1 is variable but reflects the different soil types on the land. The heavier soils have been cleared and used for pasture and hay production. The sandy soils are essentially uncleared or regenerated and have a cover of native vegetation.

The vegetation covering the sandy soils is a Jarrah – Banksias woodland association, termed by Gibson et al (1994) as Community 21a – Central *Banksia attenuata* – *Eucalyptus marginata* woodlands. The association is considered to be well reserved and have a low risk conservation status. The vegetation is considered to be in good condition<sup>2</sup>. There is evidence of the occurrence of the dieback fungus in patches throughout the vegetated areas. The lack of spread of the fungus is likely to be due to the lack of runoff on sandy ridge.

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#### <sup>2</sup> Classifications of vegetation condition:

- Excellent – Diversity similar to that observed in land reserved for nature conservation purposes with the same vegetation association.
- Good – Diversity including 50% of species expected to occur on land reserved for nature conservation, limited cover (<25%) of cover with exotic weed species and limited disturbance by human activities, such as grazing.
- Poor – Minimal presence of ground cover and lower storey species, significant weed invasion or ongoing disturbance by human activities.

Traditionally it has been lightly grazed, yet it retains a wide diversity of flora and shows little evidence of the weed invasion normally associated with medium to heavy grazing.

On the edge of the sand ridge, where it descends onto the banks of the Wellesley River, the vegetation includes *Agonis flexuosa* which appears to proliferate in response to earlier disturbance of the area and the changing soil profile.

In other disturbed areas on the sand ridge *Kunzea ericifolia* thickets are evident. The response of this plant to the disturbance may suggest that the plant is a disturbance opportunist and warrants consideration as a key element in any future site rehabilitation works.

The vegetation in the wetlands surrounding the sandy vegetation varies but its condition is consistent with the wetland classifications provided above. The vegetation is generally a *Melaleuca* shrubland.

Vegetation in the Bassendean Vegetation Complex is reasonably well represented regionally. In the Greater Bunbury Region, 11.8% of the total area of this vegetation complex is currently reserved. Gibson et al (1994) considered the Community 21a – Central *Banksia attenuata* – *Eucalyptus marginata* woodlands to be well reserved and have a low risk conservation status.

A search of the database of Threatened Ecological Communities identified by CALM suggests that no such communities exist within Lot 1 (English and Blyth, 1997)

## 5.5 Fauna

No formal fauna survey is available for the project area. No endangered fauna species are listed in the CALM database of Priority Fauna as being tied specifically to the area in which this project would be implemented.

The habitat in the project area is part of a larger block of vegetation that extends to the west, north and south. To the east it is truncated by the Wellesley River and the cleared agricultural land east of the river. The habitat types found in the project area are also found in the adjoining areas of the Bassendean Vegetation Complex.

The Wellesley River contained cobbles, marron and water mussels in abundance prior to the clearing and straightening of the river by the Public Works Department (PWD) in the 1960's. It is now a drain sterile of any aquatic fauna of significance. The action of the PWD was stopped as a result of landowner protests (D. Partridge, pers. comm.).

## 5.6 Aboriginal Heritage

There are no sites of significance to aboriginal people listed as occurring on Lot 1.

## 6 Potential Impacts From Sand Excavation

### 6.1 Wellesley River

#### 6.1.1 Historical Background

A number of land drains enter the Wellesley River from the west. These drains cross the project area and drain wetlands within and around Lot 1. They were installed by the then land managers during the period from 1945 to 1965 (David Partridge pers. comm.) and have been draining those areas since that time.

With the completion of the System 6 study and the release of its report, a section of the Wellesley River was recommended for conservation, Recommendation C67 (DCE, 1983). This section of the river is downstream of Lot 1. It is limited to the section of the river downstream of Wellesley Road.

#### 6.1.2 Potential Impacts

The Wellesley River is between 50 and 200 metres from the edge of the sand ridge. There is minimal streamline vegetation along the river in the project area. The vegetation loss is the result of the river being "trained" and used as a surrogate land drain to service the adjacent irrigated farmland.

The drains are grassed and have substantial reed beds sporadically along their length, particularly where they encounter the clay zone in the duplex soils. Thus they have the capacity to trap sediments and utilise nutrients that may occur in the runoff. They also provide a sink for other possible contaminants.

Very little surface runoff is generated by the sand ridges on the site. Surface indicators suggest rainfall infiltrates into the sand except under extreme rainfall events.

The sand extraction operation has the potential to modify the local landform and reduction of the depth of sand over the clay layer. As a result, the local drainage patterns may be modified and change the flow pattern and the absorptive capacity of the drain. As any new drains develop their vegetation component their absorptive capacity will be re-established. In the interim a physical structure would be required to provide the detention time necessary to ensure the quality of water released into the Wellesley River is maintained.

## 6.2 Local Groundwater/Wetland Interaction

The wetlands around the south and west boundaries of the property reflect the groundwater level at those locations.

The presence of "green" vegetation in channels draining wetlands suggests groundwater is close to the invert level of the channel.

As described above, the groundwater level is expressed on and around Lot 1 by wetlands and "wetland" type vegetation at a number of locations. In the absence of detailed groundwater data, these expressions indicate the groundwater flows from Lot 1 across a cohesive soil layer that underlies the sand ridge. The vegetation also occurs in the area proposed for sand extraction.

The presence of "wetland" type vegetation at points high on the sand ridge also suggests that the groundwater perches within the sand ridge. As a result, a water management system would be required to enable groundwater to be managed when it was encountered.

Interruption of local groundwater flow during the process of sand extraction would be predicted to have potential to affect water levels in the adjacent wetlands if a suitable management regime was not created.

## 6.3 Wetland Protection

At present there is no physical barrier to protect wetlands from the agricultural activities that occur on Lot 1. The wetlands remain unfenced and are subject to the effects of grazing stock.

Unmanaged sand extraction could also lead to deterioration of the wetlands and the vegetation on its margins. Controls to prevent this occurring could be established to minimise the potential to alter the attributes of these wetlands with characteristics worthy of retention.

## 6.4 Vegetation Clearing

When viewed from a regional perspective, that is within the Shire of Harvey, the clearing of vegetation from Lot 1 to extract sand is unlikely to have a significant impact on the conservation of flora or vegetation. The vegetation/land system types are widespread across the Swan Coastal Plain and this vegetation type is not considered threatened (Gibson et al, 1994).

The site lies within the Shire of Harvey, where more than 20% of the original vegetation remains in the main agricultural area. It is likely the Inter-agency Working Group would consider the effect of clearing the section of Lot 1 required for sand extraction and judge its acceptability against the following criteria:

- No deterioration in surface or groundwater catchments leading to increased salinity or eutrophication;
- No contribution to soil erosion, waterlogging and flooding;
- The land does not provide a corridor or important stepping stone between conservation areas and is not an inlier to conservation areas;
- The land has no physiographic, landscape or heritage values;
- The land has no high ecological values (rare or threatened flora and fauna, biological diversity, significant wetlands, representation of reserves, habitats, viability of existing bushland, pests and weeds)

(WAPC, 2000).

Locally, the clearing of the vegetation will be completed progressively over a number of years. Considerable areas of the same vegetation type are available for conservation and some are likely to be more representative of their type than the vegetation on Lot 1 as they may not have been grazed as extensively as the vegetation on Lot 1. For example, areas containing these vegetation types can be found on the eastern margin of the State Forest west of Harvey and Waroona,

The clearing of the vegetation is not expected to degrade the land as the proposed rehabilitation will ensure stability of the soil and maintenance of the current land use in a sustainable manner.

It is proposed to retain a 50 metre buffer of vegetation along the southern and western boundary of the project area. This buffer would retain existing vegetation in that zone. In addition a 100 metre buffer width would be retained around any wetland areas that border the proposed excavation.

## 6.5 Declared Rare Flora

It is known that Declared Rare Flora (DRF) and Priority Listed Flora (PLF) occur within one (1) kilometre of the site. It is understood that Lot 1 has not been surveyed to establish the detail of its flora and if the nearby species are located within the site.

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Prior to commencement of excavation it is proposed to conduct a flora survey of the site. Should any DRF or PLF be identified the management of these flora would be discussed with the Department of Conservation and Land Management to identify methods to conserve the flora while the sand excavation was undertaken.

## 6.6 Dieback

The dieback fungus (*Phytophthora cinnamomi*) is present as patch infections throughout the proposed excavation zone. It is possible that the dieback fungus has spread laterally within the sand source at depth, in response to groundwater movement, as it is transported by water movement in the soil.

The presence of the fungus is an issue if the excavated sand is to be placed into areas that are currently dieback free. Without a full knowledge of the market for the sand, it is difficult to predict if dieback will be an issue. For example, sand used as residential or industrial site fill is unlikely to be affected by the presence of the dieback fungus in the sand. If the sand was used for road construction, it could be placed in areas where the road reserve was dieback infected or the roadside vegetation was in poor condition (or totally absent). Much of South West Highway south of Harvey would be classified to have this status.

## 6.7 Fauna Protection

The retention of vegetation buffers and improvement of those buffers by vegetation establishment in currently cleared areas around the boundary of the excavated area will provide fauna with a corridor to move around the area being excavated.

The rate of clearing of the vegetation within the excavation zone will be limited to about three (3) hectares per year. This rate of clearing will allow for the progressive movement of fauna away from the project area and lessen the potential for loss of fauna through the clearing operations. Timing of clearing to avoid breeding seasons will also reduce losses of juvenile fauna.

## 6.8 Dust

It is unlikely that dust will be an issue in the sand extraction process. Tracks and work areas on the site will be kept moist to provide a good operating surface for trucks and loaders.

The public roads used to access the site are principally sealed surfaces. A short section of Wellington Road is unsealed. However any dust generated is not likely to affect environmental or public health qualities in the area. No houses front this section of Wellington Road.

## 6.9 Noise

The nearest residence to the proposed operations is at least 2 km away from the proposed excavation. Operations at the face being excavated will be behind the operating work face with respect to this residence and will present a barrier to any noise generated.

## 6.10 Hazardous Materials

It is unlikely any hazardous good will be stored on site. All fuel and lubricant requirements, for machines retained at the site, will be transported to the site on a daily basis as part of the daily maintenance requirements of the machine.

## 6.11 Aesthetics

The work area of the excavation will be bordered by retained vegetation, which will provide a visual screen around the operation.

In areas where excavation is complete, landforming will be undertaken and pasture established, to limit and potential for wind erosion of the sand surface and to progress the development of the end land use of the site. It is expected the visual presentation of the site will be similar to that that currently exists within five (5) years of the commencement of the excavation.

## 7 Management of Impacts

### 7.1 Surface Water Flow Controls

The Leschenault Inlet Management Authority and the Water and Rivers Commission have an objective of developing a vegetated 50 metre buffer along the river (WAPC, 2000). It is anticipated that development of the buffer would be a condition applied to the proposal to extract sand as part of the statement of condition to proceed should approval from the EPA be forthcoming. The proponents would be prepared to establish a 50 metre vegetated buffer adjacent to the Wellesley River to meet the objectives of the regulatory authorities.

It is proposed to leave a section of the sand ridge 50 metres wide as a buffer between the Wellesley River and the proposed excavation works. This buffer will provide a filter for water encountered and also allow the reed beds and paperbark thickets that exist along the boundary of the sand and cohesive floodplain soils to be maintained. The buffer will also provide an opportunity to maintain the quality of water entering the Wellesley River.

The ridge will also contain any water that comes to the surface as a result of the excavation and enable easy management of that water. The connection of the in-pit drainage with the local land drainage system will ensure the maintenance of water quality and prevent undue waterlogging within the operating sand excavation.

### 7.2 Groundwater Hydrology

To ensure the groundwater is not intercepted during excavation it is proposed to undertake an extensive drilling program to establish the groundwater contours over the site. It is proposed the drilling would occur in August/September when the local groundwater levels are expected to peak on an annual basis. The drilling program would also provide detailed information on the local groundwater hydrology and enable the relationship between groundwater level, soil type and topography to be better understood.

Based on the findings of the groundwater study, the proponent would plan excavation of the sand such that it would be limited to a depth one (1) metre above the groundwater level.

Water monitoring bores would be located around the periphery of the proposed excavation zone to check that the sand extraction activities were not affecting groundwater levels beyond the zone of direct disturbance. These levels would be monitored monthly.

However, it is expected the controls proposed will ensure that no alteration of the local groundwater hydrology will occur. Hence the hydrological regime of the surrounding

wetlands will not be affected and the groundwater catchment of the wetlands will remain unchanged with respect to water quality.

### 7.3 Wetland Protection

The sand excavation process would be conducted in such a manner that a 100 metre (or one (1) metre elevation) primary buffer between the wetlands and the sand extraction works. This is consistent with WRC guidelines (WRC, 2001). The buffer will be fenced to ensure stock and machinery are excluded from the wetland buffer. The location of the buffer around each wetland is shown at Figure 3.

The water monitoring described above would also allow any influence on local groundwater levels to be detected.

In addition, the proponents would seek to establish wetland vegetation in any areas that showed indications of suitable soil/moisture regimes within the buffer that are currently cleared.

Thus it is predicted the ecological values associated with the wetlands surrounding the proposed area for excavation.

### 7.4 Vegetation Clearing and Replacement

The area proposed for excavation would have been progressively cleared at a rate of three (3) to five (5) hectares per annum, depending on the depth of sand available and the expected market demand. The area to be cleared will be clearly marked to ensure any vegetation to be retained is not disturbed.

The clearing of the area required for sand excavation will retain some of the vegetation currently existing on Lot 1. Removal of the remaining vegetation will not sever any vegetation corridors, stepping stones between conservation areas and is not an inlier block of vegetation. Hence it should not create an unacceptable condition within the criteria considered by the Inter-Agency Working Group.

Topsoil to a depth of 100 mm will be removed and stockpiled in windrows less than one (1) metre in height. Where possible, the topsoil removed will be immediately placed on areas under rehabilitation to ensure the quality of the topsoil is maintained.

The vegetation cleared will then be stacked for chipping. The wood chip produced will be used to protect the completed batters of the excavation prior to the establishment of pasture on those slopes.

The progressive landforming and establishment of pasture following sand excavation will ensure no soil erosion, waterlogging or local flooding will occur as a result of the land clearing and sand excavation.

## 7.5 Dieback Management

In the event that the dieback was an issue during placement of the sand as fill, the client to whom the sand was supplied would be made aware of the status of the sand source.

Within the workings, any dust suppression would be conducted using a dilute phosphoric acid produced for control of the dieback fungus (Phosjet), in addition to the water to limit the potential for spread of the dieback fungus within the excavation works.

## 7.6 Operational Controls

It is proposed the excavation operations would work up to 12 hours per day from 0600 hrs to 1800hrs, depending on demand, from Monday to Saturday.

All machinery used on the site would be fitted with suitable noise suppression devices.

All machinery servicing would be undertaken in a manner that ensured no contamination of the soil occurred through spillage of fuel or lubricant.

Use of fires for disposal of vegetation or waste would not be permitted. All waste generated on the site would be recycled (oils, filters, cardboard etc) or disposed of at the nearest designated waste disposal site.

## 7.7 Landforming

During and following excavation, the affected area will be reshaped to allow for establishment of pasture on the area disturbed by excavation. The shape of the land following landforming would be gently undulating, in a manner similar to the flood plain area adjacent to the Wellesley River, as the base of the excavation would follow the undulations in the clay layer below the sand to be excavated. The final shape of the land would be flatter than the current land surface as the depth of the sand resource increases in elevated portions of the existing land surface.

All slopes established in the landforming process will be sufficiently flat to allow farming operations to occur on them.

The landforming will maintain the vegetation buffer around and within the excavation.

The reshaping is expected to result in a slight ridge being formed to follow the topography of the clayey sand that underlies the sand to be excavated. A narrow ridge will be retained between the excavated zone and clayey soils of the Wellesley River flood plain.

The existing land drainage system will be retained and the vegetation in the drains re-established to provide the filtering qualities that are currently evident.

## 7.8 Final Land Use

The proposed final land use for the area is grazing of cattle. To that end the vegetation cover proposed is a blend of clover and grasses that will stabilise the soil and provide an economic benefit to the land owner.

Some vegetation will be retained around the edges of the area disturbed by the excavation. This vegetation will be fenced to prevent degradation by stock. In addition, it is proposed to include patches of bush across the area excavated to provide shelter for the stock. These patches will be fenced to enable them to mature without loss due to grazing and trampling.

It is proposed to develop the 50 metre vegetation buffer along the Wellesley River and fence it off from stock. This vegetation will contain representative flora consistent with the original vegetation. Similar protection of the significant wetlands within Lot 1 would also protect the sensitive flora and vegetation communities around the wetlands.

## 8 Conclusion

The proposal to establish a sand extraction operation on Wellington Location 1 Lot 1 can be undertaken with minimal impact on the key environmental aspects within and around Lot 1 with appropriate management.

The key issues in the management of the sand excavation are:

- The relationship between the groundwater and the wetlands surrounding the proposed works;
- Protection of wetlands on the boundaries of Lot 1;
- Known presence of Declared Rare Flora within one (1) kilometre of the site;
- The perceived environmental value of the remnant vegetation on Lot 1; and
- The end land use of the excavated area.

We believe all of these issues can be adequately managed using recognised and widely used excavation controls and site management.

The site does not represent any physiographic, landscape or heritage values that may be considered significant in the assessment of the acceptability of this project.

The end land use will be for grazing pasture, consistent with the current land use, with the area subject to excavation being covered with clover and pasture grasses.

In the assessment of this project, criteria agreed by the Inter-agency Working Group have been considered. From the assessment undertaken, it is predicted that none of the issues included in the criteria used by the Working Group would be considered unacceptable with respect to this project.

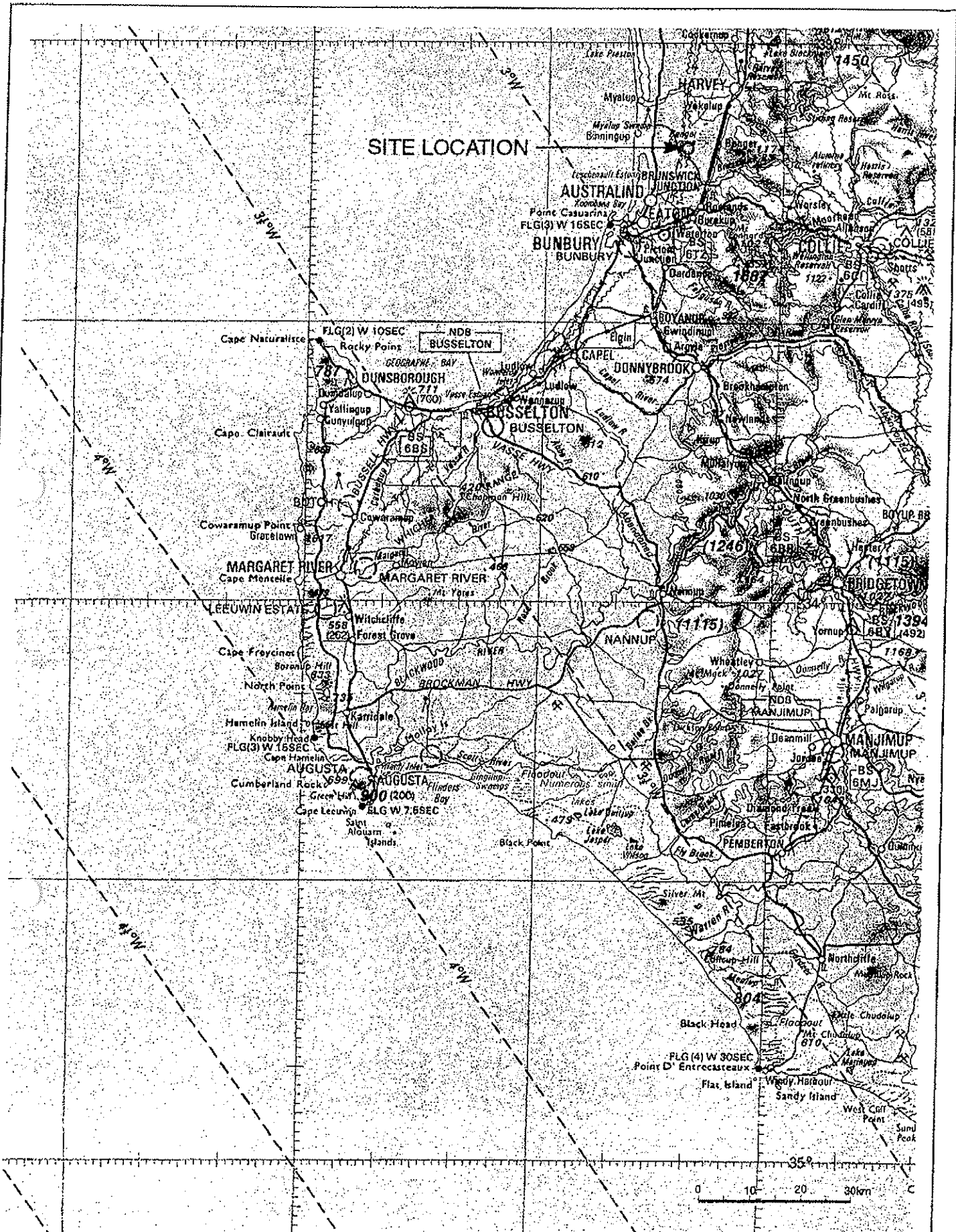
## 9 References

- Dames and Moore (1989); *Kemerton Aluminium Smelter Public Environmental Report*. Prepared for Kemerton Aluminium Limited.
- Department of Conservation and Environment (1983); *Conservation Reserves for Western Australia. The Darling System – System 6. Part I; General Principles and Recommendations and Part II: Recommendations for Specific Localities*. Report 13. DCE, Perth, Western Australia.
- Department of Conservation and Environment (1986); *Draft Guidelines for Wetland Conservation in the Perth Metropolitan Area*. Bulletin 227. DCE, Perth, Western Australia.
- Department of Mines (1991); *Environmental Management of Quarries – Development, Operation and Rehabilitation Guidelines*. Department of Mines, Perth Western Australia.
- English V J and Blyth J (1997); *Identifying and identifying Threatened Ecological Communities in the South West Botanical Province*. Final report in Project Number N702 to Environment Australia by CALM, Perth, Western Australia.
- Environmental Protection Authority (1990); *A guide to wetland management in Perth*. Bulletin 374. EPA, Perth Western Australia.
- Environmental Protection Authority (1993); *A guide to wetland management in Perth and the near Perth Swan Coastal Plain – An update of EPA Bulletin 374*. Bulletin 686. EPA, Perth Western Australia.
- Gibson N, Keighery B J, Keighery G J, Burbidge A H and Lyons M N (1994); *A Floristic Survey of the Swan Coastal Plain*. Unpublished report prepared for the Australian Heritage Commission by the Western Australian Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc).
- Government of Western Australia (1992); *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*. Government Gazette, Perth, Western Australia, 18 December 1992, pp. 100 – 102.
- Flora and Vegetation, Kemerton Sand Project, Gwalia Matiskke (1993)
- Water and Rivers Commission (2001); *Position Statement: Wetlands*. WRC, Perth, Western Australia.

Western Australian Department of Agriculture (2002); *Application and Assessment Procedures for the Clearing of native Vegetation in Western Australia*, WADA, South Perth, Western Australia.

Western Australian Planning Commission (2000); *Greater Bunbury Region Scheme Environmental Review*. Western Australian Planning Commission, Perth Western Australia.

## Appendix A - Figures

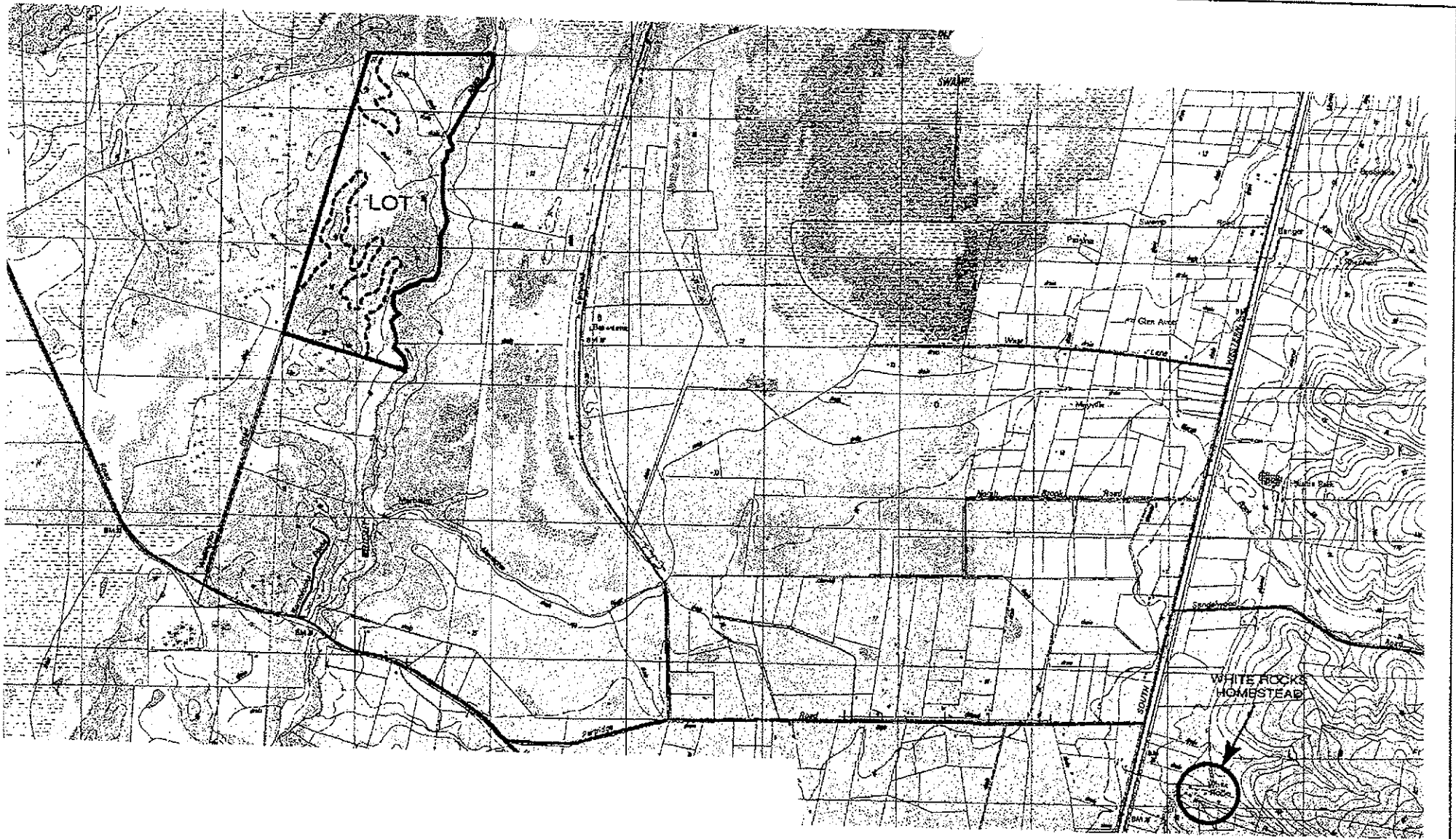


ACN 065 475 149  
Level 5, 12 St Georges Terrace

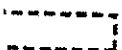
### LOCALITY PLAN

Project Number:  
**36206.018**

Drawing Number:  
**FIGURE 1**



**LEGEND:**

 POTENTIAL ZONE FOR SAND EXTRACTION

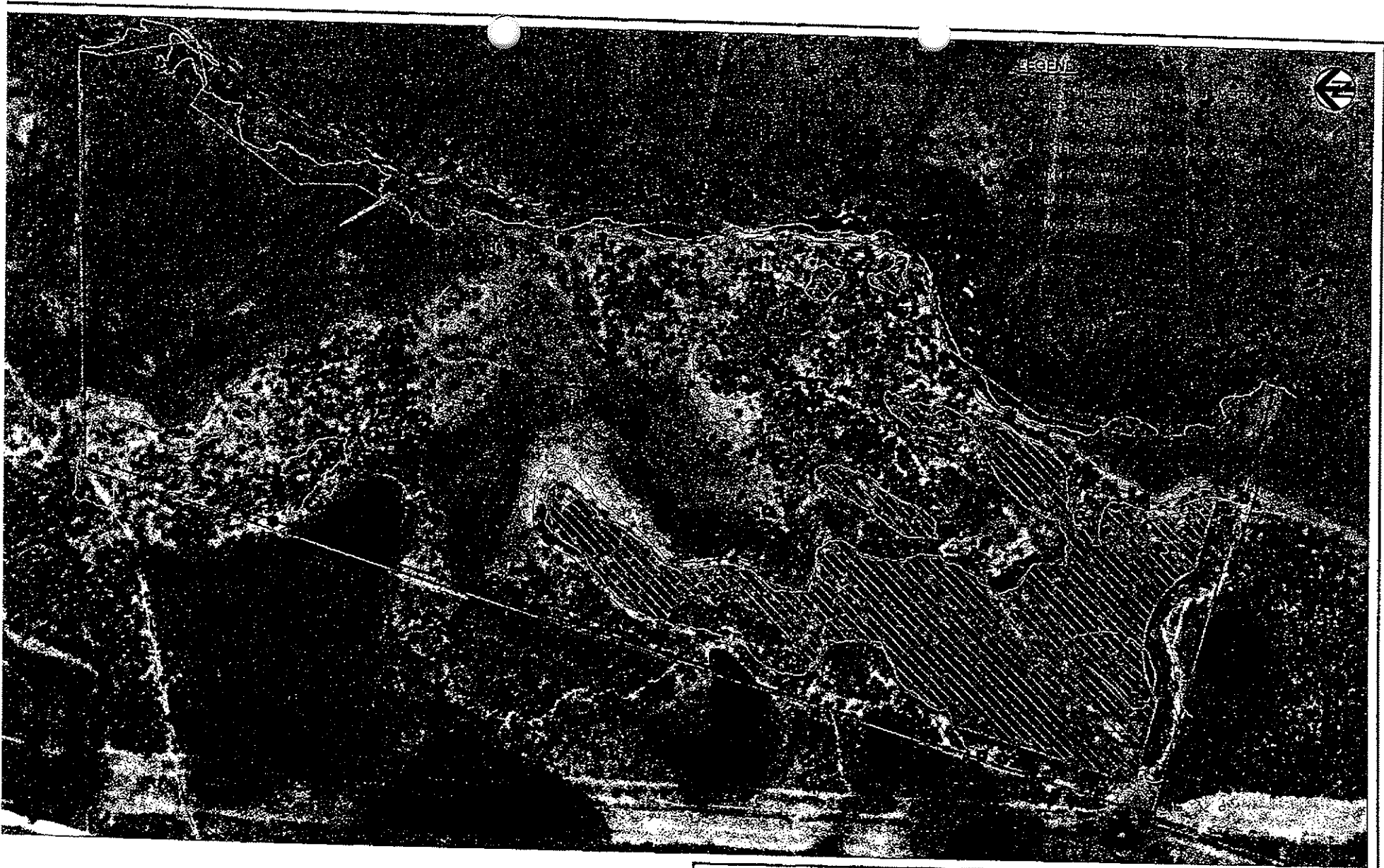


ACN:065 475 149  
 Level 5, 12 St Georges Terrace  
 PERTH WA 6000  
 Tel: (08) 9221 5900 Fax: (08) 9221 5901

**SITE PLAN**

Project Number:  
**36206.018**

Drawing Number:  
**FIGURE 2**



0 100 200 300 400 500m



**SMEC**

ACN: 045 478 140  
Level 5, 12 St Georges Terrace  
PERTH WA 6000  
Tel: (08) 9221 5900 Fax: (08) 9221 5901

AERIAL PHOTOGRAPH

Project Number:

Drawing Number:

36206.018

FIGURE 3

## Appendix B – Soil Data Sheets

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Geotech Soil & Aggregate Laboratory

Independent Materials Testing.

NATA Accredited Laboratory No. 5029

Unit 3/ 28 Major Street

Bunbury Western Australia 6230

Phone: (08) 9725 6525 Fax: (08) 9725 6262

## SAND INVESTIGATION REPORT

WELLINGTON LOCATION 1  
LOT 1, KEMERTON.

Submitted to:

David Partridge

"White Rocks"

Brunswick Junction

Western Australia 6224

GEOTECH SOIL & AGGREGATE LABORATORY  
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1. Summary of test results.
2. NATA endorsed test certificates, Particle Size Distribution and Clay & Fine Silt tests.
3. Appendix 1. Soil profile of bore holes.
4. Appendix 2. Test pit / bore hole site locations.

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Unit 3/28 Major Street, Bunbury Western Australia 6230

Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## Summary of Test Results

<b>CLIENT:</b> David Partridge	<b>JOB No:</b> 9939
<b>PROJECT:</b> Sand Investigation	<b>Lab No's:</b> 0101-0501
<b>LOCATION:</b> Wellington Location 1, Lot 1.	0102-0502
<b>Sample ID:</b> Sample location No's 1 - 5	<b>Date Sampled:</b> 04-06-99
<b>Description:</b> Silica Sand	

Sample No:	1	2	3	4	5
Lab No:	0101	0201	0301	0401	0501
	0102	0202	0302	0402	0502

### Particle Size Distribution (AS 1289 3.6.1)

Sieve	1	2	3	4	5
150.0	100	100	100	100	100
75.0	100	100	100	100	100
37.5	100	100	100	100	100
19.0	100	100	100	100	100
9.5	100	100	100	100	100
4.75	100	100	100	100	100
2.36	100	100	100	100	100
1.18	100	100	100	100	100
0.600	95	94	94	93	88
0.425	75	75	61	57	52
0.300	37	38	19	17	19
0.150	5	5	3	2	3
0.075	2	1	1	1	1

### Clay & Fine Silt - Settling Method (AS 1141.33)

	3	2	4	3	4
--	---	---	---	---	---

### Sampling

Test Pit Depth (m):	1.4	1.4	1.2	1.2	1.2
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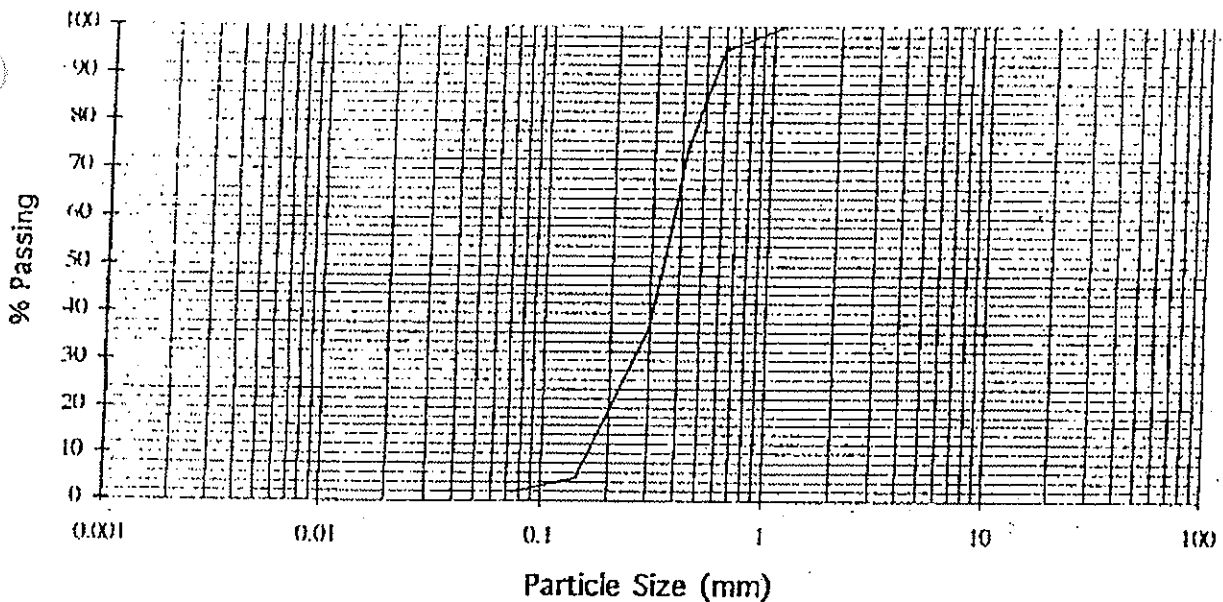
Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE

### PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0101  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 04/05-06-99  
Sample Id: Sample location No 1  
Sample Description: Pale grey white silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	95
0.425	75
0.300	37
0.150	5
0.075	2

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Approved Signatory

(G. Barten) Date: 16/6/99

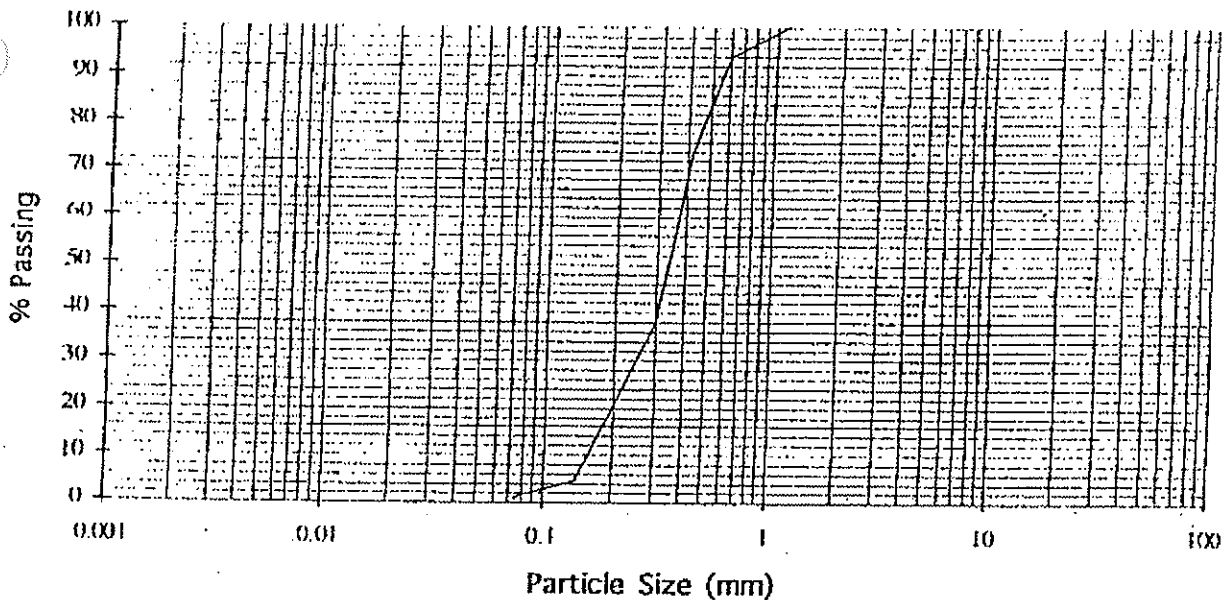
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## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge JOB No: 9939  
PROJECT: Sand Investigation Lab No: 0201  
LOCATION: Wellington Location 1, Lot 1. Date Tested: 04/05-06-99  
Sample Id: Sample location No 2  
Sample Description: Pale yellow grey silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	94
0.425	75
0.300	38
0.150	5
0.075	1

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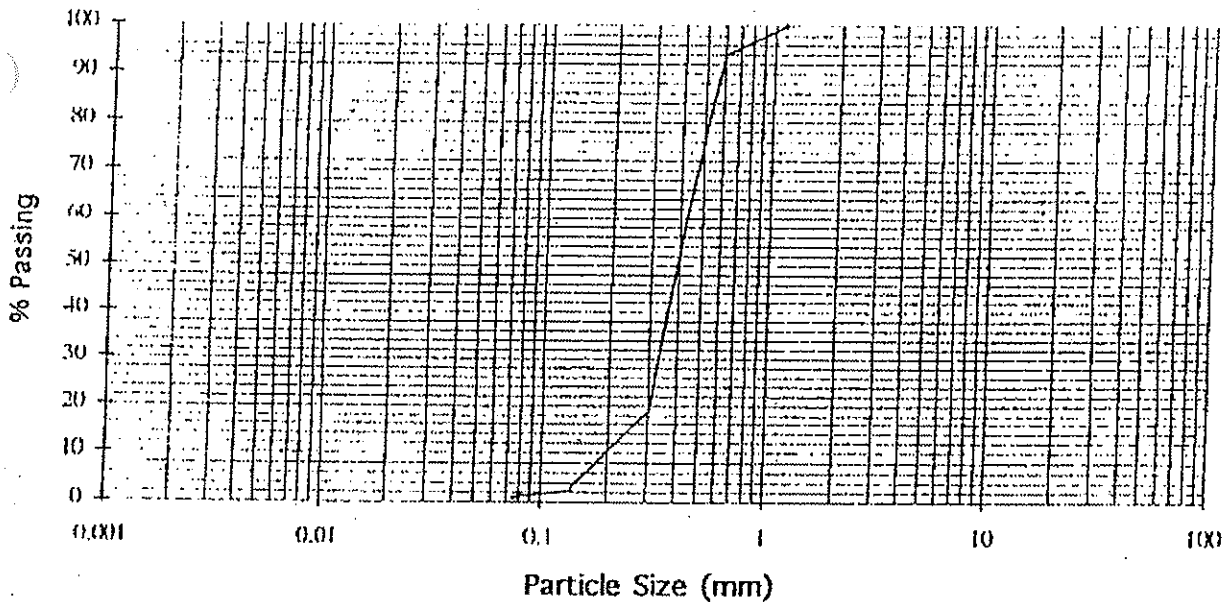
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## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0301  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 04/05-06-99  
Sample Id: Sample location No 3  
Sample Description: Pale grey silica Sand




Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	94
0.425	61
0.300	19
0.150	3
0.075	1

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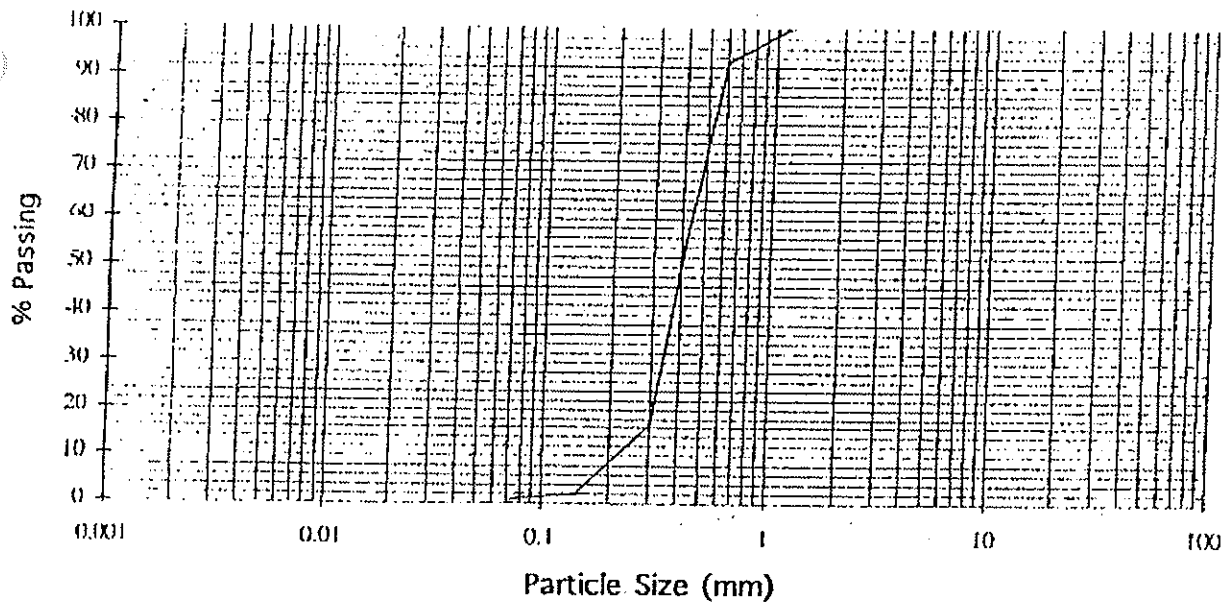
Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE

### PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0401  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 04/05-06-99  
Sample Id: Sample location No 4  
Sample Description: Pale grey white silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	93
0.425	57
0.300	17
0.150	2
0.075	1

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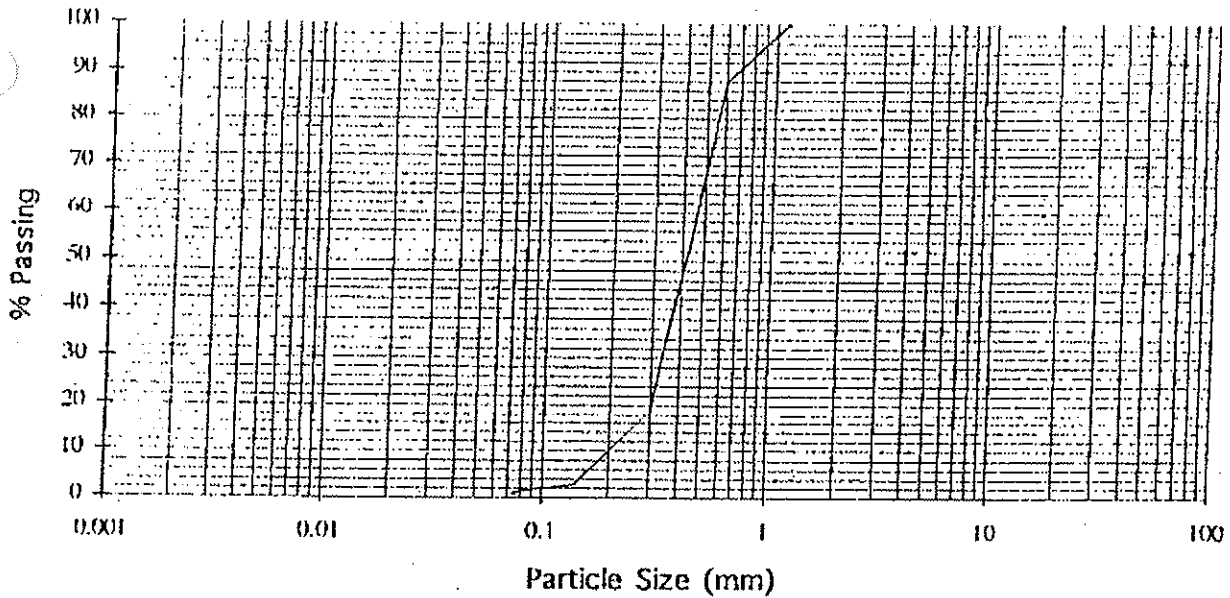
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Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0501  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 04/05-06-99  
Sample Id: Sample location No 5  
Sample Description: Pale grey white silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	88
0.425	52
0.300	19
0.150	3
0.075	1

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# GEOTECH

Karemmi Pty Ltd trading as Geotech Soil & Aggregate Laboratory

NATA Accreditation No 5029 ACN No 078 149 425

Unit 3/28 Major Street, Bunbury Western Australia 6230

Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge

JOB No: 9939

PROJECT: Sand Investigation

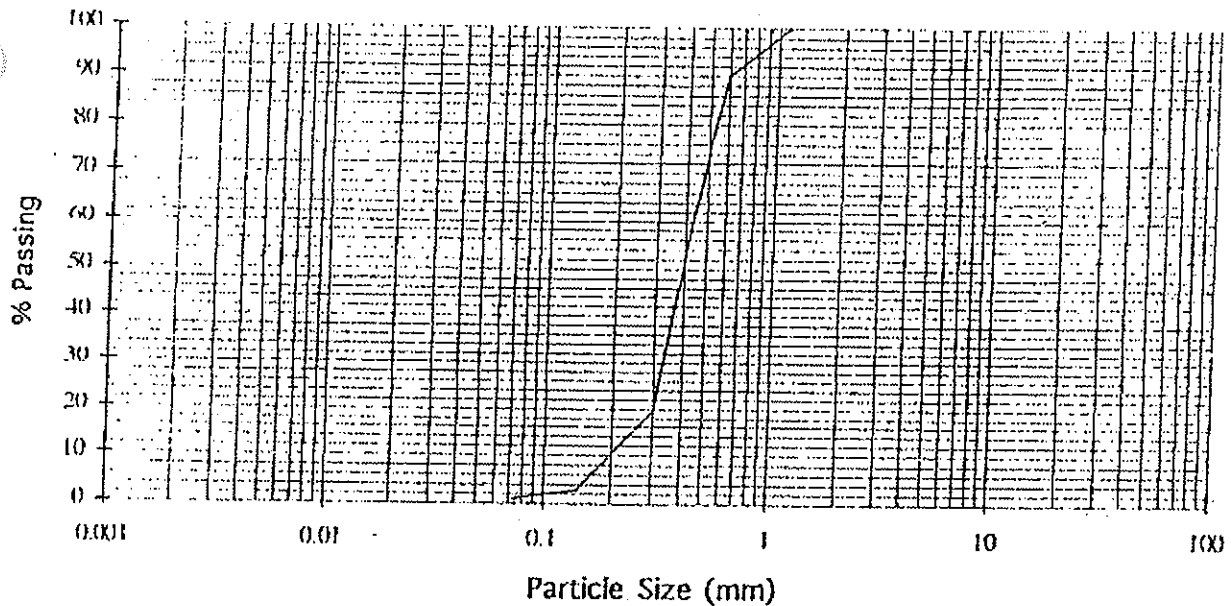
Lab No: 0601

LOCATION: Wellington Location 1, Lot 1.

Date Tested: 08/09-06-99

Sample Id: Sample location No 6

Sample Description: Pale grey white silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	90
0.425	58
0.300	20
0.150	3
0.075	1

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NOTE: Sampled by GEOTECH.

Approved Signatory

(G. Barten) Date: 16/6/99

NATA ENDORSED DOCUMENT

# GEOTECH

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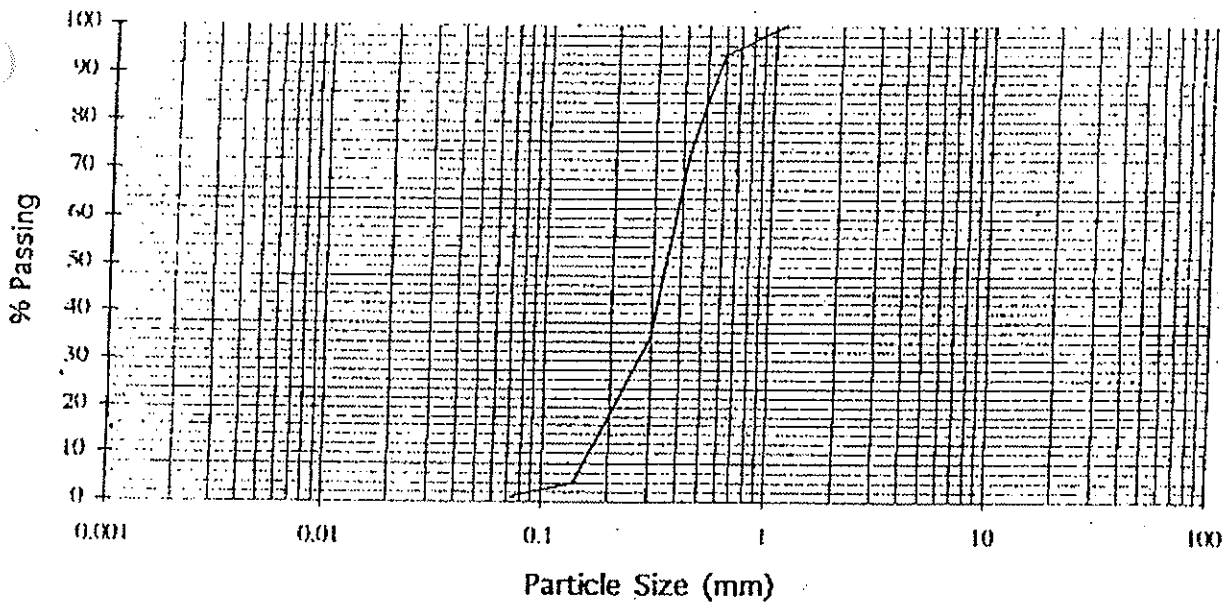
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Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0701  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 08/09-06-99  
Sample Id: Sample location No 7  
Sample Description: White silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	94
0.425	74
0.300	35
0.150	4
0.075	1

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Approved Signatory

(G. Barten) Date: 16/6/99

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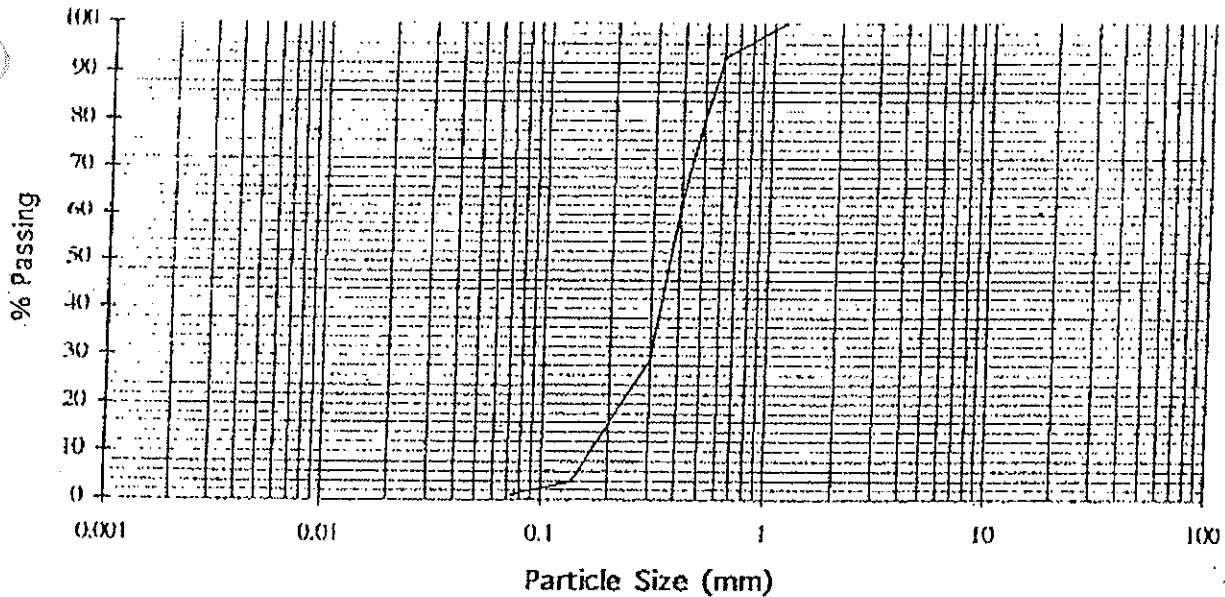
NATA Accreditation No 5029 ACN No 078 149 425

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## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1


CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                  Lab No: 0801  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 08/09-06-99  
Sample Id: Sample location No 8  
Sample Description: Pale grey silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	93
0.425	69
0.300	29
0.150	4
0.075	1

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Approved Signatory 

(G. Barten) Date: 16/6/99



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## TEST CERTIFICATE

### PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1

CLIENT: David Partridge

JOB No: 9939

PROJECT: Sand Investigation

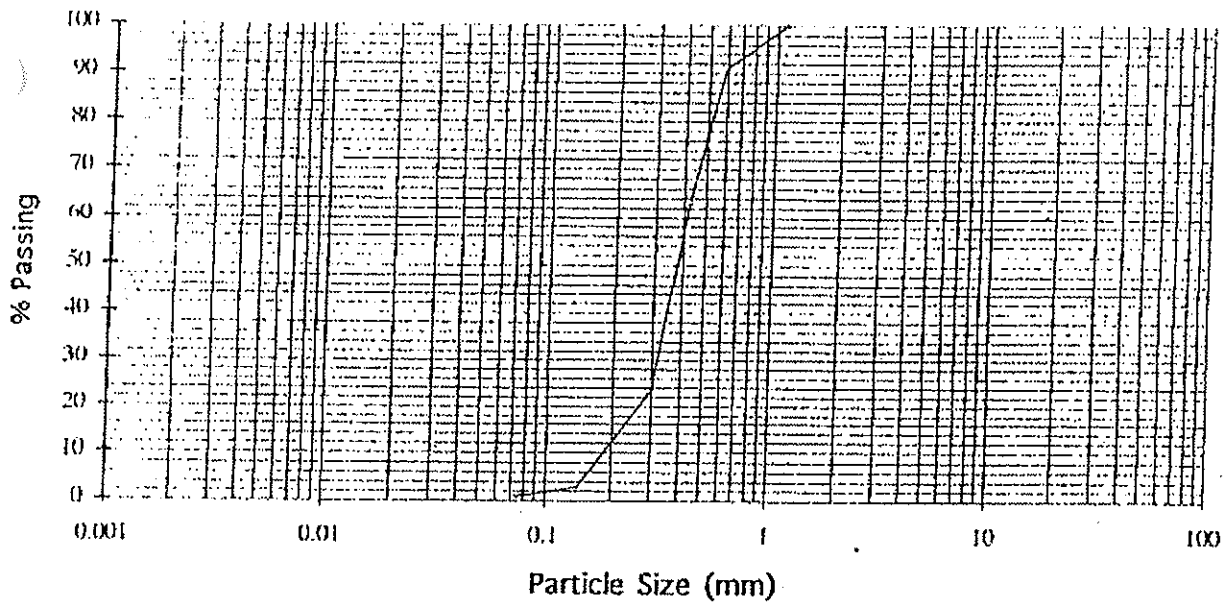
Lab No: 0901

LOCATION: Wellington Location 1, Lot 1.

Date Tested: 08/09-06-99

Sample Id: Sample location No 9

Sample Description: Pale grey white silica Sand



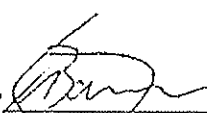
Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	91
0.425	63
0.300	24
0.150	3
0.075	1

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DATE 28/6/99 No. C.....



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Approved Signatory  (G. Barten) Date: 16/6/99

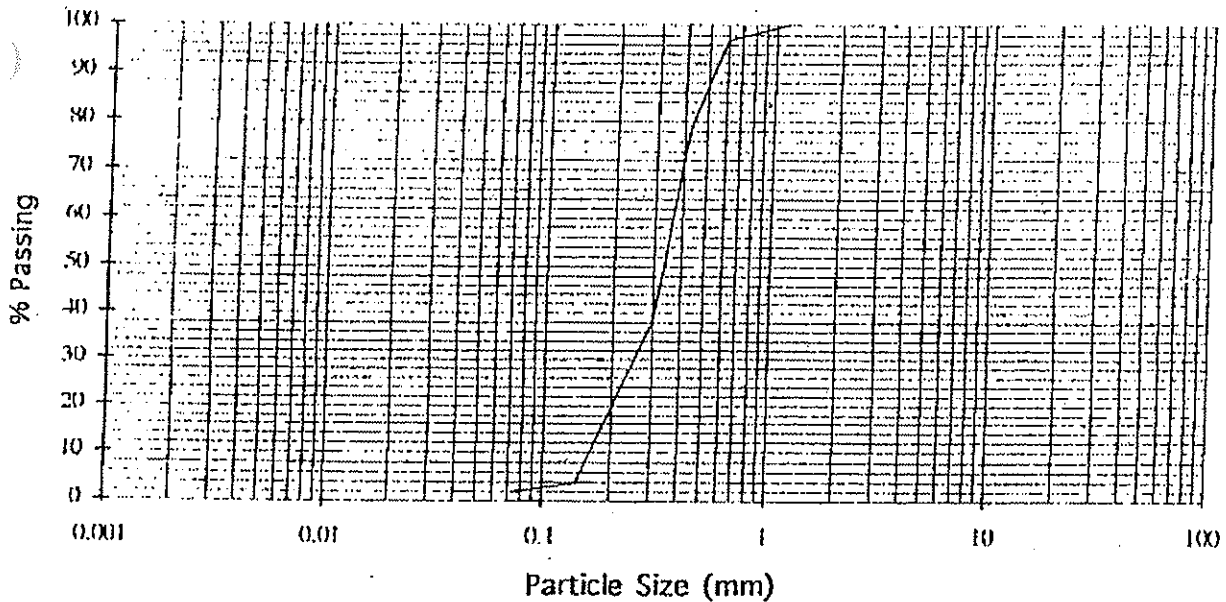
NATA ENDORSED DOCUMENT

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## TEST CERTIFICATE PARTICLE SIZE DISTRIBUTION AS 1289 3.6.1

CLIENT: David Partridge      JOB No: 9939  
PROJECT: Sand Investigation      Lab No: 1001  
LOCATION: Wellington Location 1, Lot 1.      Date Tested: 08/09-06-99  
Sample Id: Sample location No 10  
Sample Description: Pale grey white silica Sand



Sieve Size (mm)	% Passing
150	100
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	97
0.425	79
0.300	38
0.150	4
0.075	2

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(G. Barten) Date: 16/6/99



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## TEST CERTIFICATE CLAY & FINE SILT - SETTLING METHOD AS 1141.33

**CLIENT:** David Partridge **Job No:** 9939  
**PROJECT:** Sand Investigation **Lab No:** 0102-0502  
**LOCATION:** Wellington Location 1, Lot 1. **Date Tested:** 04/09-06-99  
**Sample ID:** Sample location No's 1 - 5  
**Description:** Silica Sand

Sample No:	1	2	3	4	5
Lab No:	0102	0202	0302	0402	0502

**% VOLUME OF  
CLAY & FINE SILT:**      3            2            4            3            4

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NOTES: Sampled by GEOTECH.



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*[Handwritten signature]*      11/6/99

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## TEST CERTIFICATE CLAY & FINE SILT - SETTLING METHOD AS 1141.33

CLIENT: David Partridge Job No: 9939  
PROJECT: Sand Investigation Lab No: 0602-1002  
LOCATION: Wellington Location 1, Lot 1. Date Tested: 09/10-06-99  
Sample ID: Sample location No's 6 - 10  
Description: Silica Sand

Sample No:	6	7	8	9	10
Lab No:	0602	0702	0802	0902	1002

% VOLUME OF  
CLAY & FINE SILT: 3 1 1 1 3

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NOTES: Sampled by GEOTECH.

Approved Signatory:  (G. Barten) Date: 16/6/99



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Appendix 1

SOIL PROFILE OF BORE HOLES

GEOTECH SOIL & AGGREGATE LABORATORY  
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DATE 28/6/99 No. 6

# GEOTECH

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

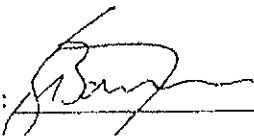
**CLIENT:** David Partridge      **JOB No:** 9939  
**PROJECT:** Sand Investigation      **Lab No:** 1101  
**LOCATION:** Wellington Location 1, Lot 1.      **Date Logged:** 15-06-99  
**Site Location:** Bore hole No 1.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey Sand
1.0 - 2.0	Pale grey Sand
2.0 - 3.0	Pale grey Sand
3.0 - 4.0	Grey fine Sand
4.0 - 5.0	Grey clayey Sand
5.0 - 6.0	Grey clayey Sand
6.0 - 7.0	Grey clayey Sand
7.0 - 8.0	Dark grey heavy clay Sand
8.0 - 9.0	Dark grey fine Sand
9.0 - 10.0	Dark grey fine Sand
10.0 - 11.0	Dark grey fine Sand
11.0 - 12.0	Dark grey fine Sand

GEOTECH SOIL & AGGREGATE LABORATORY  
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DATE 28/6/99 No 6

**Notes:**

- 1) Hole terminated at 12.0m

Approved Signatory :  (G. Barten) Date : 16/6/99



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Telephone (08) 9725 6525 Facsimile (08) 9725 6262

## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                Lab No: 1301  
LOCATION: Wellington Location 1, Lot 1.      Date Logged: 15-06-99  
Site Location: Bore hole No 3.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey white Sand
1.0 - 2.0	Pale grey white Sand
2.0 - 3.0	Pale grey white Sand
3.0 - 4.0	Grey Sand
4.0 - 5.0	Dark grey clayey Sand / heavy grey Clay
5.0 - 6.0	Dark grey clayey Sand
6.0 - 7.0	Dark grey black sandy Clay
7.0 - 8.0	Pale grey Sand
8.0 - 9.0	Grey Sand
9.0 - 10.0	Grey Sand, with a presence of clay fines.
10.0 - 11.0	Grey Sand, with a presence of clay fines.
11.0 - 12.0	Grey Sand, with a presence of clay fines.

GEOTECH SOIL & AGGREGATE LABORATORY  
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DATE 28/6/99 No. 6

**Notes:**

1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

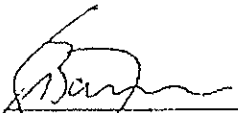
CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                Lab No: 1401  
LOCATION: Wellington Location 1, Lot 1.      Date Logged: 15-06-99  
Site Location: Bore hole No 4.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey white Sand
1.0 - 2.0	Pale grey white Sand
2.0 - 3.0	Pale grey white Sand
3.0 - 4.0	Dark grey brown Sand, with a presence of iron stained sandstone.
4.0 - 5.0	Dark brown fine Sand, with a presence of grey clay.
5.0 - 6.0	Grey Sand / heavy grey Clay
6.0 - 7.0	Grey sandy Clay
7.0 - 8.0	Dark grey sandy heavy Clay
8.0 - 9.0	Black sandy heavy Clay
9.0 - 10.0	Dark grey Sand
10.0 - 11.0	Grey Sand
11.0 - 12.0	Grey Sand

GEOTECH SOIL & AGGREGATE LABORATORY  
CONTROLLED COPY  
DATE 28/6/99 No. 6

Notes:

- 1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

**CLIENT:** David Partridge      **JOB No:** 9939  
**PROJECT:** Sand Investigation      **Lab No:** 1501  
**LOCATION:** Wellington Location 1, Lot 1.      **Date Logged:** 15-06-99  
**Site Location:** Bore hole No 5.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Grey Sand
1.0 - 2.0	Pale grey white Sand
2.0 - 3.0	Grey Sand
3.0 - 4.0	Dark brown black iron stained Sand, with a presence of small sandstone particles.
4.0 - 5.0	Grey brown Sand, with a presence of iron staining.
5.0 - 6.0	Sandy grey heavy Clay
6.0 - 7.0	Grey sandy Clay
7.0 - 8.0	Pale grey Sand
8.0 - 9.0	Grey Sand
9.0 - 10.0	Grey Sand
10.0 - 11.0	Dark grey clayey Sand
11.0 - 12.0	Dark grey clayey Sand

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**Notes:**

1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

CLIENT: David Partridge      JOB No: 9939  
PROJECT: Sand Investigation      Lab No: 1601  
LOCATION: Wellington Location 1, Lot 1.      Date Logged: 15-06-99  
Site Location: Bore hole No 6.

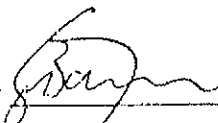
Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Grey Sand
1.0 - 2.0	Grey Sand
2.0 - 3.0	Pale grey white Sand
3.0 - 4.0	Pale grey white Sand
4.0 - 5.0	Pale yellow brown Sand, with a presence of small sandstone particles.
5.0 - 6.0	Brown Sand
6.0 - 7.0	Dark brown iron stained Sand
7.0 - 8.0	Grey clayey Sand
8.0 - 9.0	Grey sandy heavy Clay
9.0 - 10.0	Pale grey Sand
10.0 - 11.0	Grey Sand
11.0 - 12.0	Grey clayey Sand

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Notes:

- 1) Hole terminated at 12.0m

Approved Signatory:



(G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

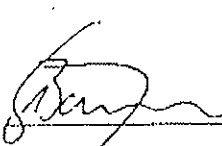
CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                 Lab No: 1701  
LOCATION: Wellington Location 1, Lot 1.     Date Logged: 15-06-99  
Site Location: Bore hole No 7.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey Sand
1.0 - 2.0	Pale grey Sand
2.0 - 3.0	Yellow orange Sand, with a presence of small sandstone particles.
3.0 - 4.0	Pale yellow Sand
4.0 - 5.0	Pale grey Sand
5.0 - 6.0	Pale grey Sand
6.0 - 7.0	Grey clayey Sand
7.0 - 8.0	Grey clayey Sand
8.0 - 9.0	Dark grey clayey Sand
9.0 - 10.0	Grey Sand
10.0 - 11.0	Pale grey Sand
11.0 - 12.0	Grey brown Sand

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Notes:

- 1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

**CLIENT:** David Partridge **JOB No:** 9939  
**PROJECT:** Sand Investigation **Lab No:** 1801  
**LOCATION:** Wellington Location 1, Lot 1. **Date Logged:** 15-06-99  
**Site Location:** Bore hole No 8.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey white Sand
1.0 - 2.0	Pale grey white Sand
2.0 - 3.0	Yellow brown Sand, with a presence of small sandstone particles.
3.0 - 4.0	Yellow Sand
4.0 - 5.0	Yellow Sand
5.0 - 6.0	Pale yellow grey Sand
6.0 - 7.0	Pale yellow grey Sand
7.0 - 8.0	Pale yellow grey Sand
8.0 - 9.0	Pale yellow grey clayey Sand
9.0 - 10.0	Grey sandy heavy Clay
10.0 - 11.0	Grey Sand
11.0 - 12.0	Pale grey white Sand

GEOTECH SOIL & AGGREGATE LABORATORY

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DATE 28/6/99 No. 6

**Notes:**

- 1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                Lab No: 1901  
LOCATION: Wellington Location 1, Lot 1.      Date Logged: 15-06-99  
Site Location: Bore hole No 9.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey white Sand
1.0 - 2.0	Pale grey white Sand
2.0 - 3.0	Yellow Sand
3.0 - 4.0	Pale yellow Sand
4.0 - 5.0	Pale yellow grey Sand
5.0 - 6.0	Grey Sand
6.0 - 7.0	Pale grey Sand
7.0 - 8.0	Grey clayey Sand
8.0 - 9.0	Dark grey sandy heavy Clay
9.0 - 10.0	Pale grey Sand
10.0 - 11.0	Pale grey Sand
11.0 - 12.0	Grey Sand

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Notes:

- 1) Hole terminated at 12.0m

Approved Signatory:  (G. Barten) Date: 16/6/99

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## TEST CERTIFICATE

### SOIL PROFILE OF BORE HOLE

CLIENT: David Partridge                      JOB No: 9939  
PROJECT: Sand Investigation                Lab No: 2001  
LOCATION: Wellington Location 1, Lot 1.      Date Logged: 15-06-99  
Site Location: Bore hole No 10.

Bore Hole Depth (m)	Soil Description
0.0 - 1.0	Pale grey Sand
1.0 - 2.0	Pale grey Sand
2.0 - 3.0	Grey brown Sand, with a presence of small sandstone particles.
3.0 - 4.0	Grey Sand
4.0 - 5.0	Heavy blue grey Clay
5.0 - 6.0	Dark grey clayey Sand
6.0 - 7.0	Grey Sand
7.0 - 8.0	Grey Sand
8.0 - 9.0	Grey Sand, with a presence of clay fines.
9.0 - 10.0	Grey Sand, with a presence of clay fines.
10.0 - 11.0	Grey Sand, with a presence of clay fines.
11.0 - 12.0	Grey brown Sand

Notes:

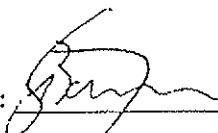
1) Hole terminated at 12.0m

GEOTECH SOIL & AGGREGATE LABORATORY

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DATE 28/6/99 No. 6

Approved Signatory :



(G. Barten) Date : 16/6/99

Appendix 2

TEST PIT / BORE HOLE  
SITE LOCATIONS

GEOTECH SOIL & AGGREGATE LABORATORY  
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DATE 28/6/99 No. 6

# GEOTECH

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NATA Accreditation No 3029 ACN No 078 149 425

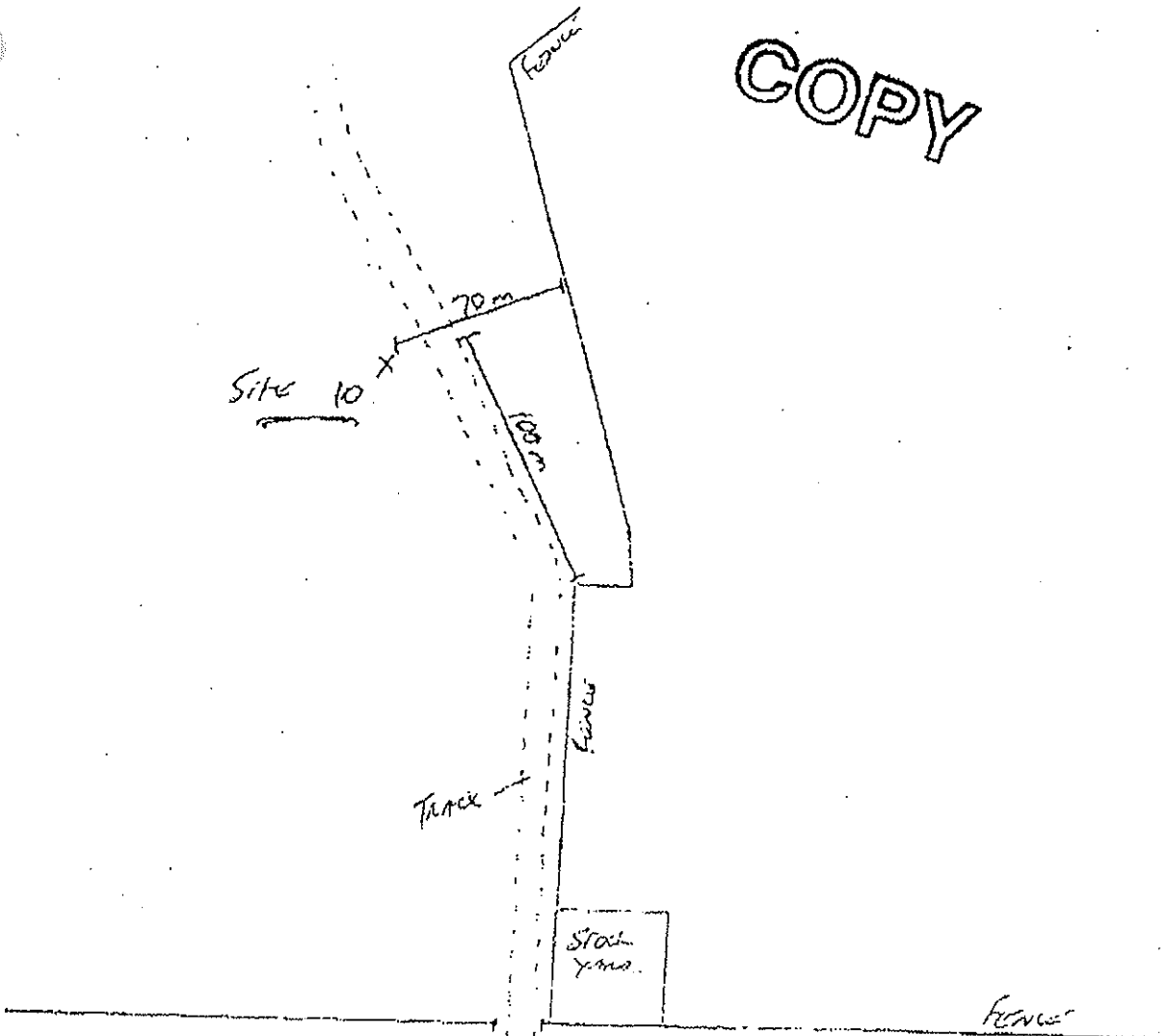
Unit 3/28 Major Street, Bunbury Western Australia 6230

Telephone (08) 9725 6262 Facsimile (08) 9725 6262

## SKETCH OF SITE LOCATIONS

CLIENT: David Partridge  
PROJECT: Sand Investigation  
LOCATION: Wellington Location 1, Lot 1.

Job No: 9939  
Lab No: 01-10  
Date Tested: 04-06-99



MAN cleaning

X - Denotes test location

# GEOTECH

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*Area shown*

## SKETCH OF SITE LOCATIONS

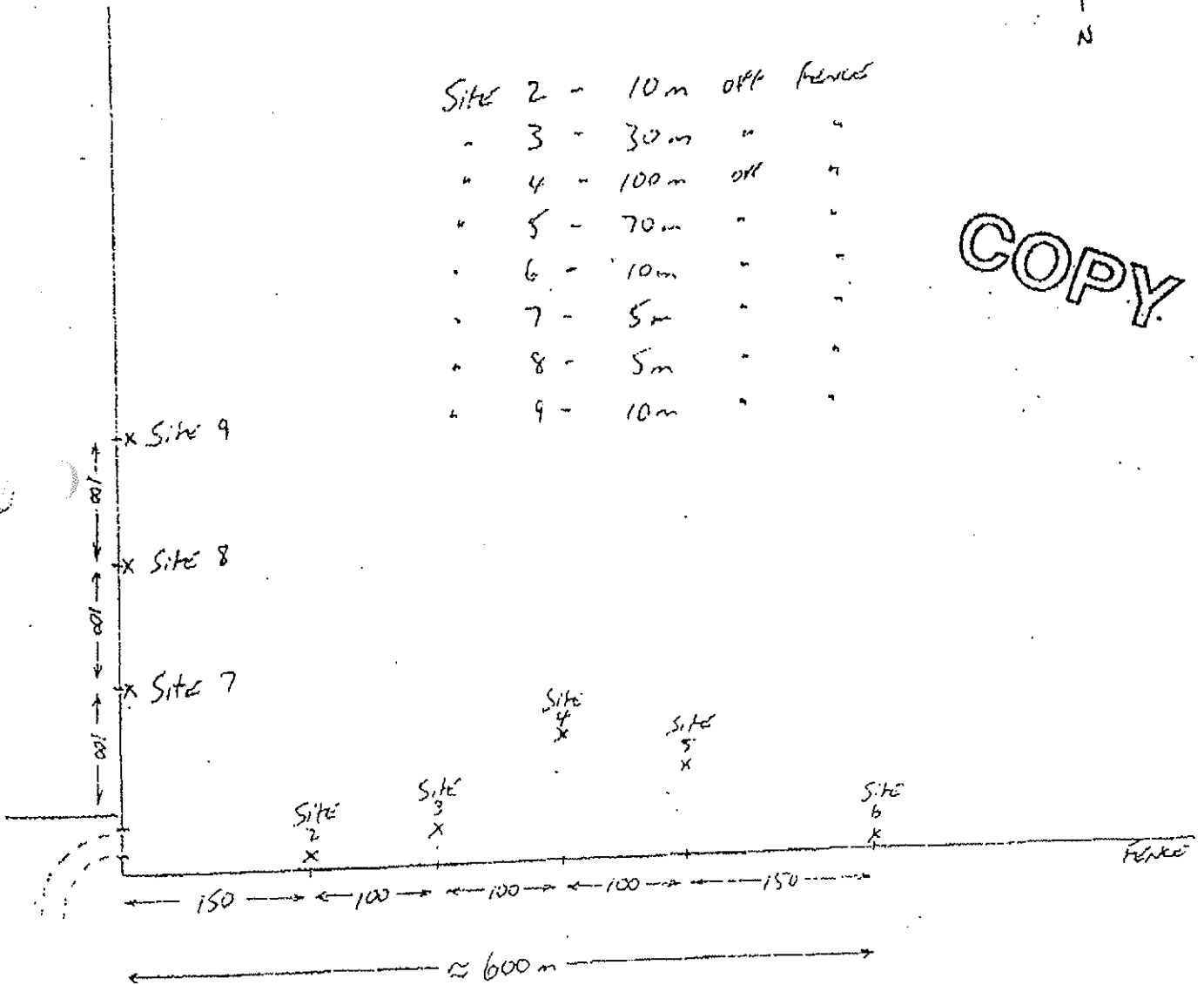
CLIENT: David Partridge  
PROJECT: Sand Investigation  
LOCATION: Wellington Location 1, Lot 1.

Job No: 9939  
Lab No: 01-10  
Date Tested: 04-06-99

*Site n°1 - Via main track through centre of block,  
and south of clearing. Unusable to measure  
location from any reference point.*

- Site 2 - 10m off fence
- " 3 - 30m " "
- " 4 - 100m off "
- " 5 - 70m " "
- " 6 - 10m " "
- " 7 - 5m " "
- " 8 - 5m " "
- " 9 - 10m " "

**COPY**



X - Denotes test location

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 26/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: A

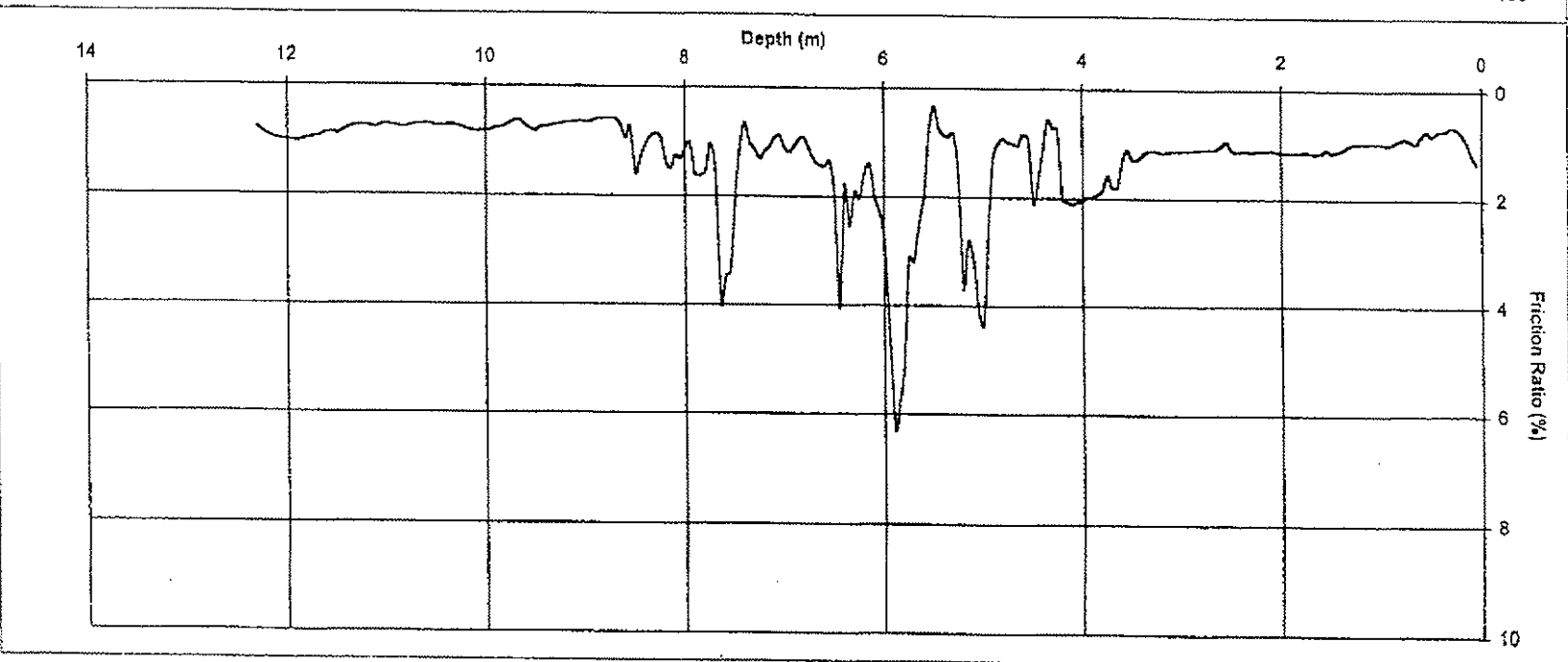
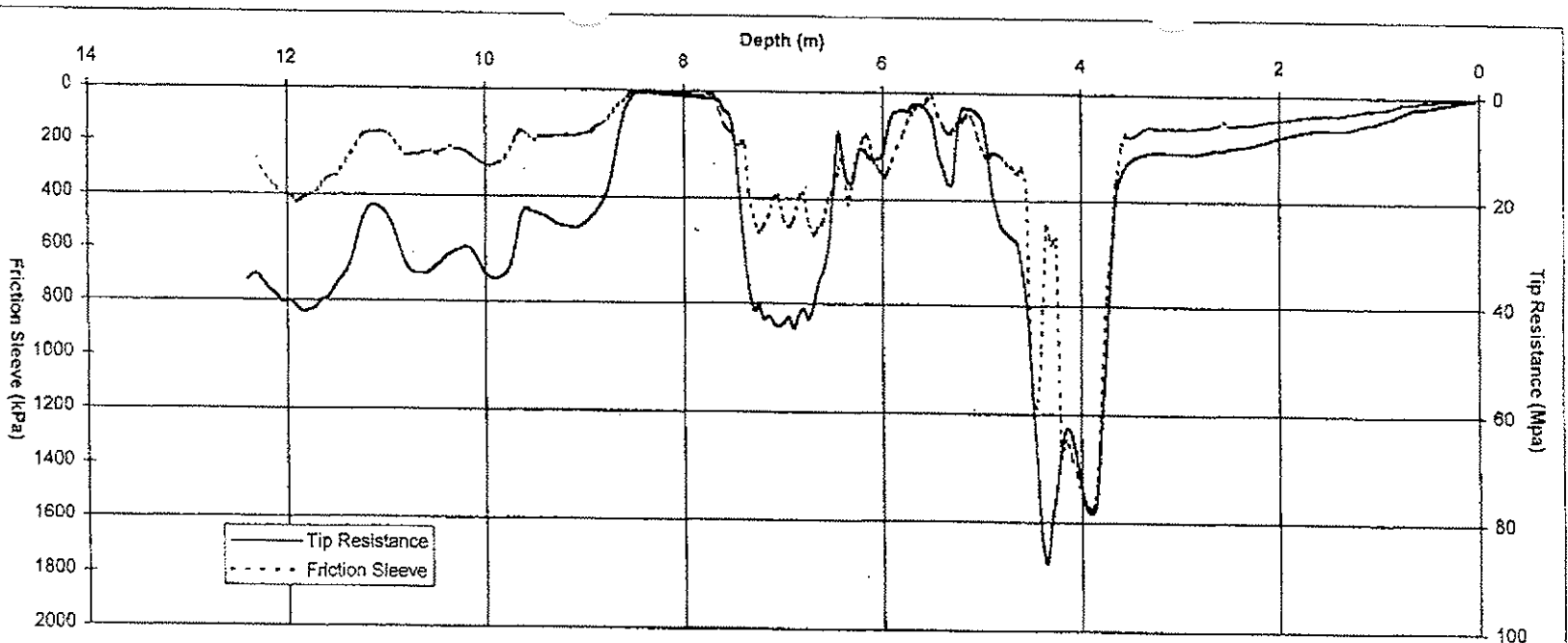
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0386822 E 6327328 N



PROBEDRILL PT. 178

Tested in accordance with AS 1289.6.5.1 - 1999

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 26/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: B

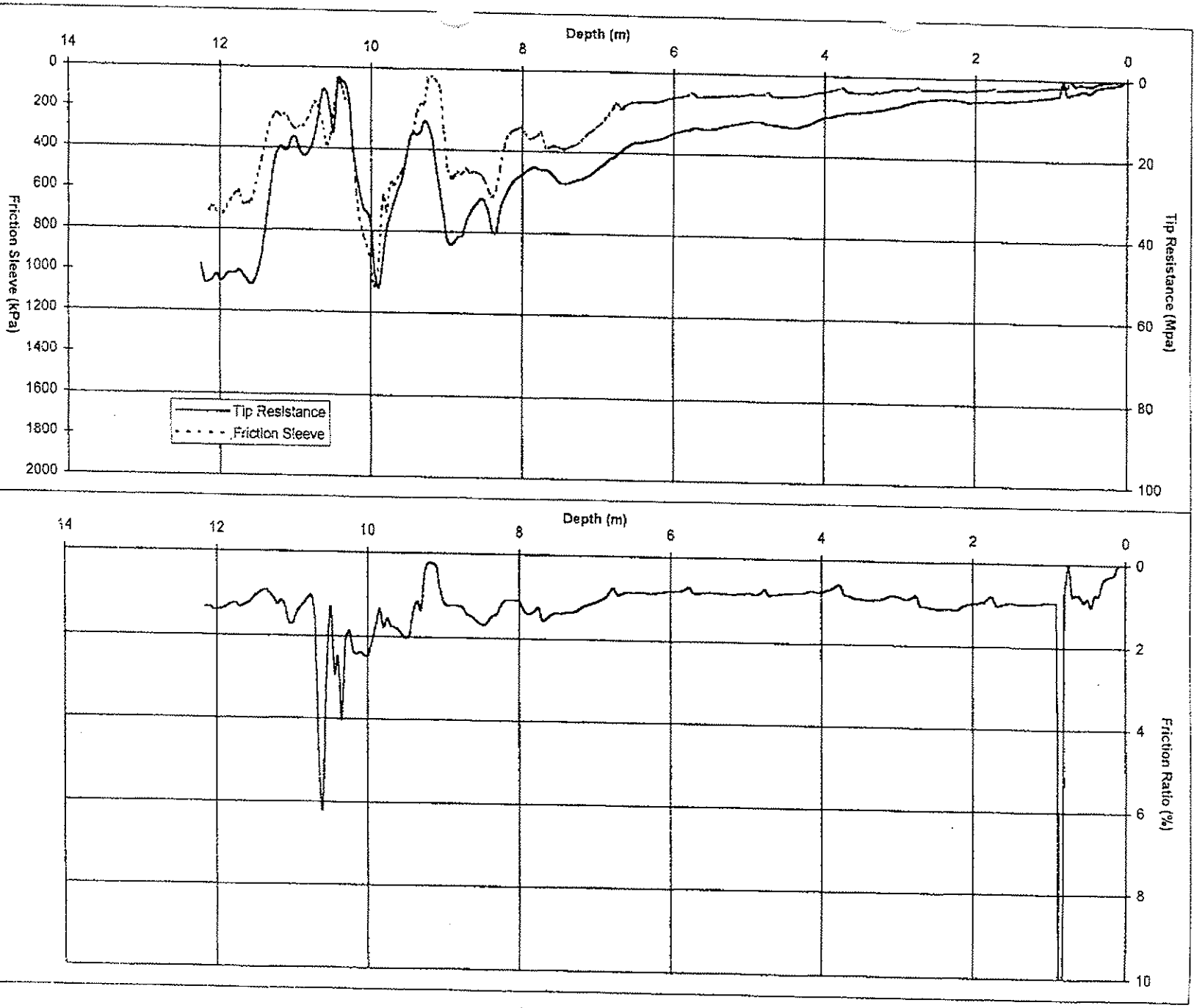
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0387008 E 6327297 N



# ELECTRIC FRICTION-CONE PENETROMETER

Date: 26/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: C

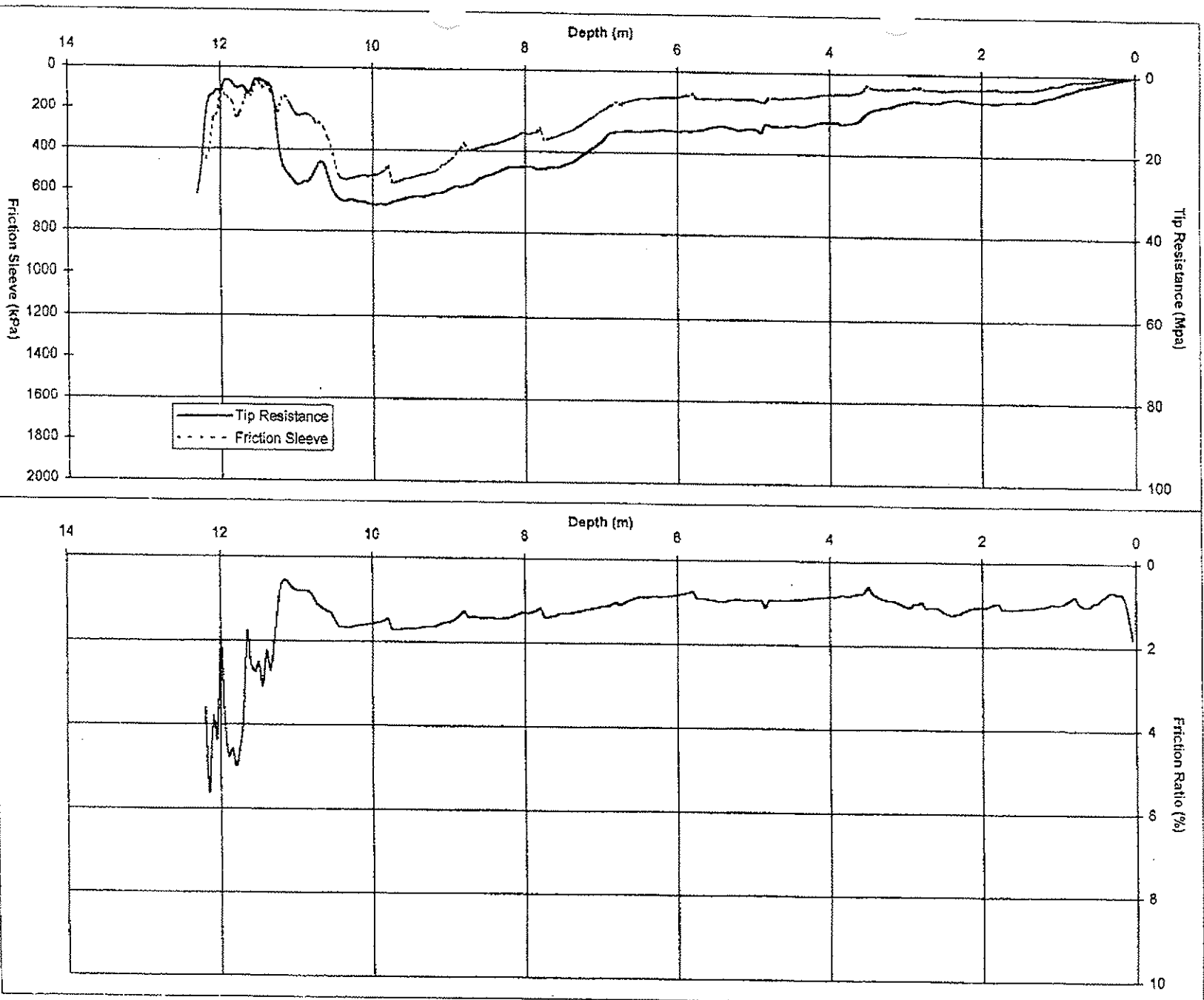
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0386785 E 6327417 N



PROBEDRILL PT/LM

Tested in accordance with AS 1289 6.5.1 - 1999

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 26/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: D

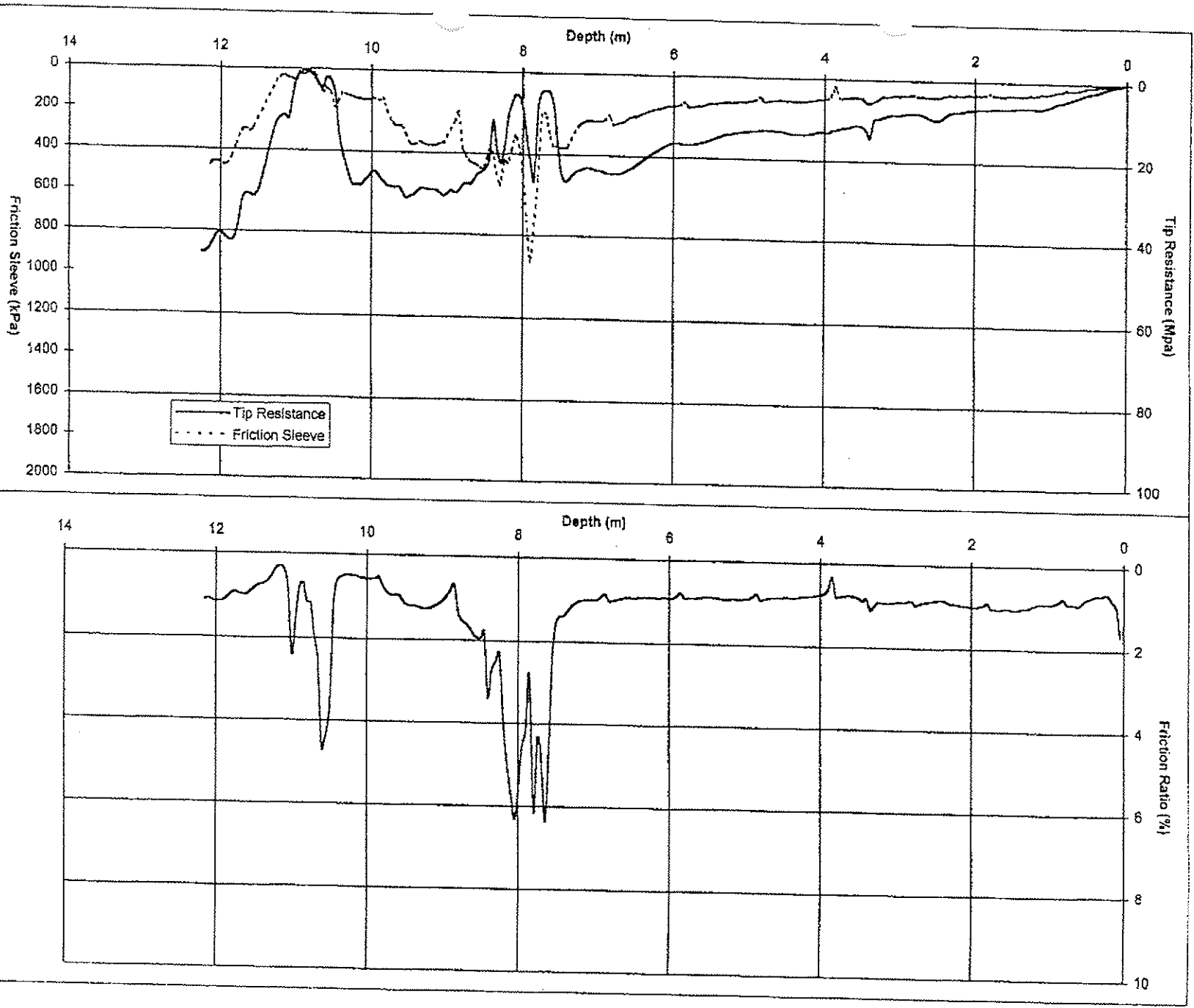
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0386560 E 6327508 N



PROBEDIPT PT.11X

Tested in accordance with AS 1289.6.5.1 - 1999

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: E

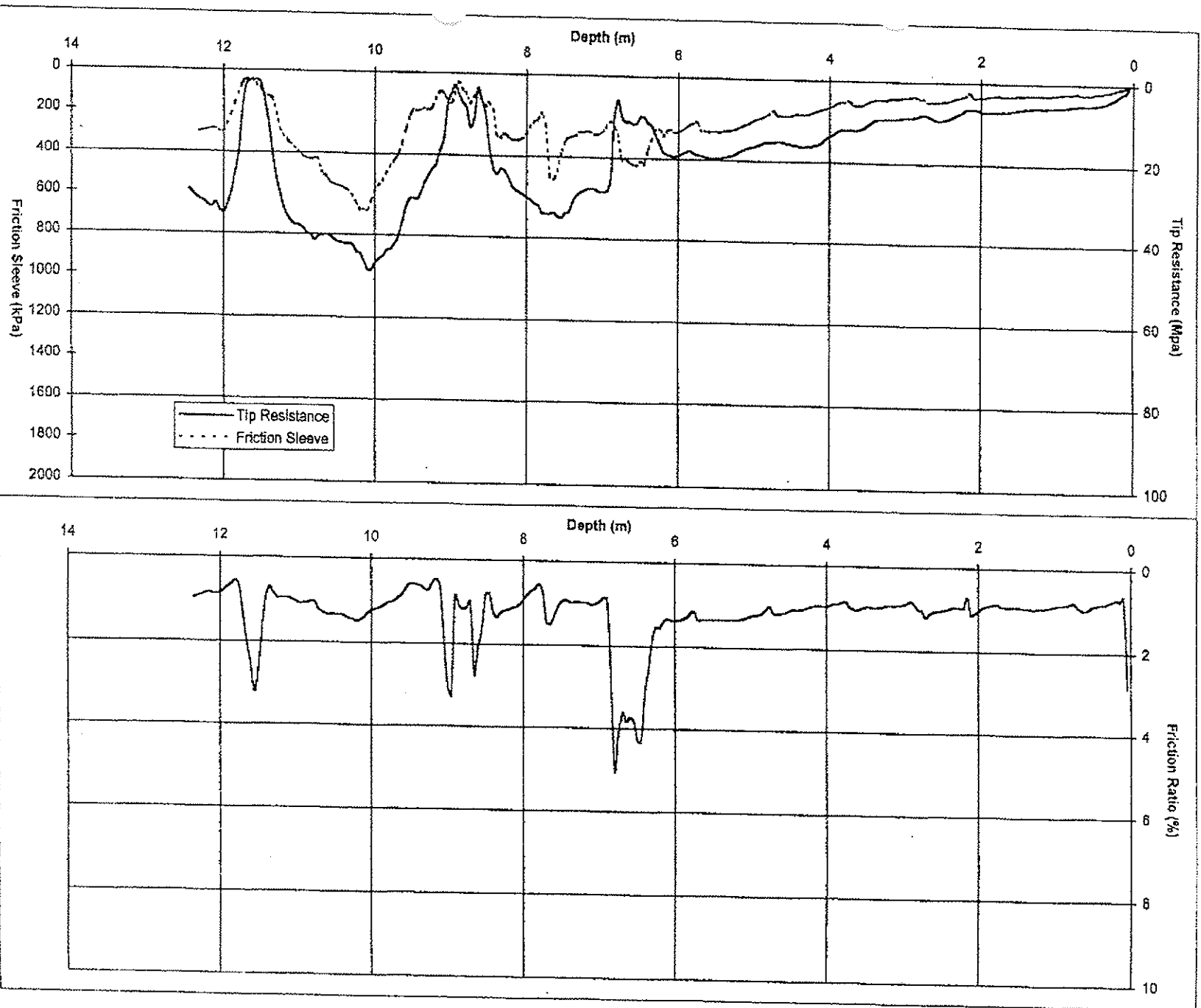
Project: DAVID PARTTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0386784 E 6327594 N



PROBEHILL PT/LTR

Tested in accordance with AS 1289.6.5.1 - 1999

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: F

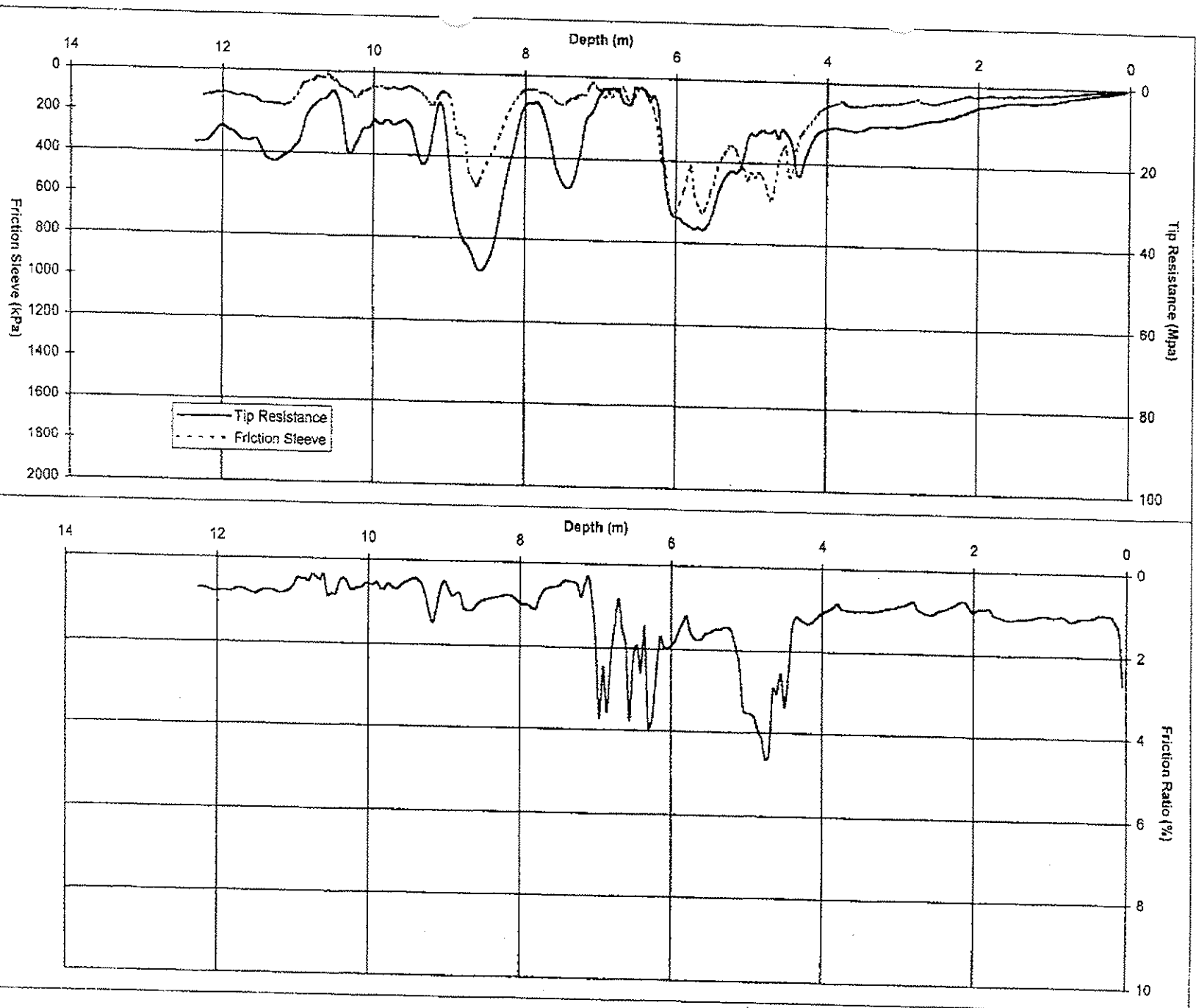
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0387026 E 6327835 N



PROBDRILL P711A

Tested in accordance with AS 1289.6.5.1 - 1999

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: G

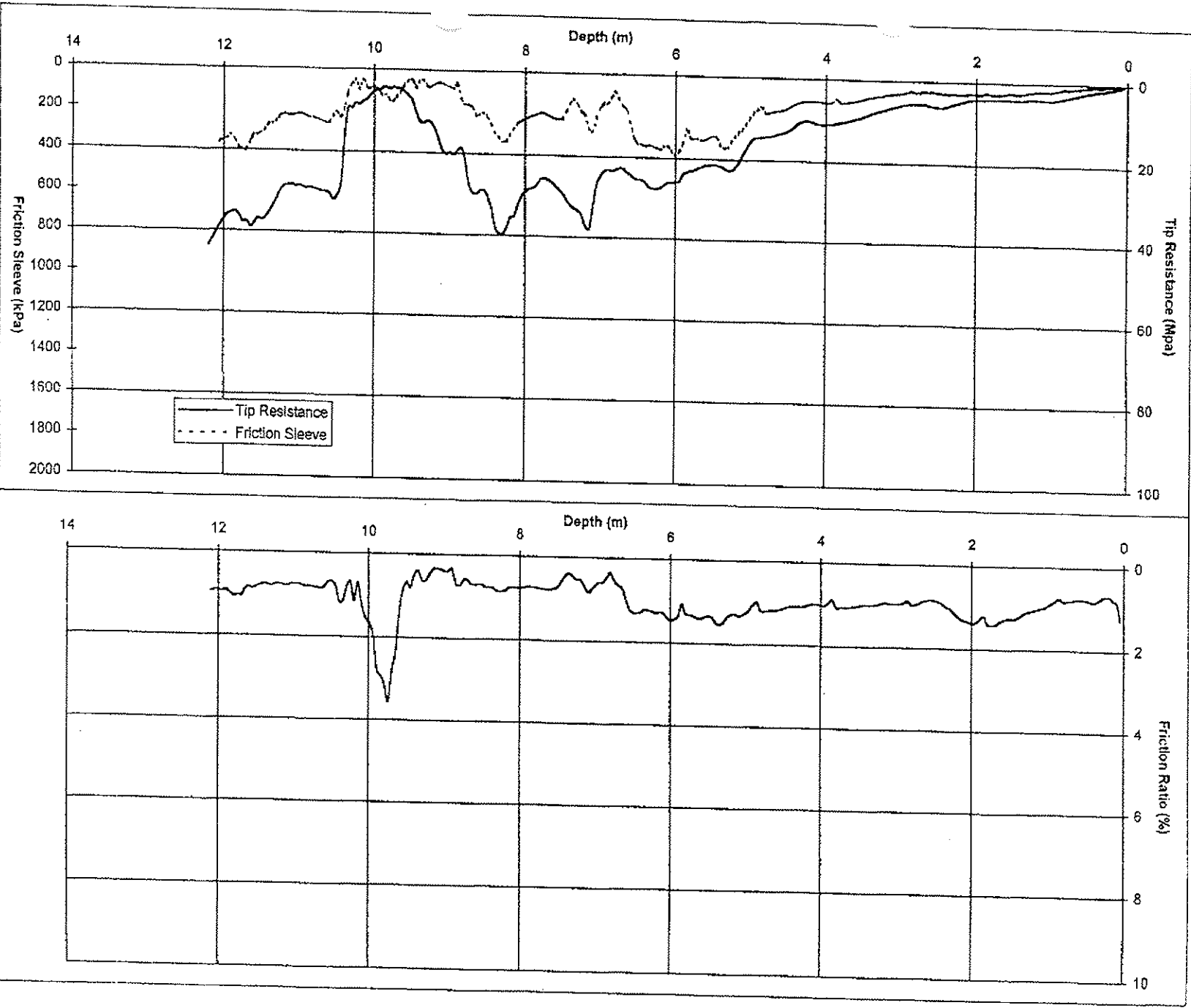
Project: DAVID PARTIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0387237 E 6327835 N



# ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LA WYERS

Probe No.: H

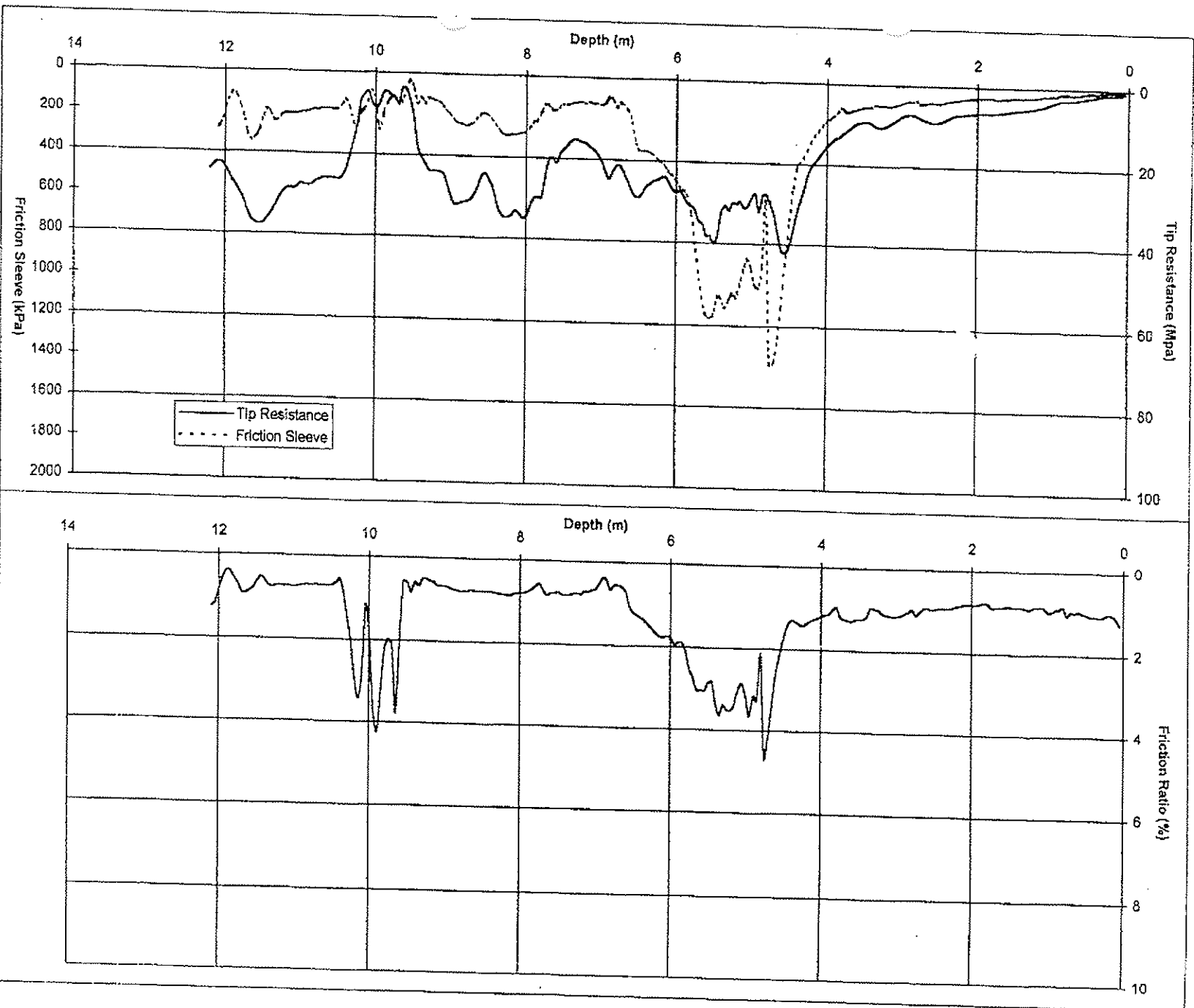
Project: DAVID PARKTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

R.L.:

Co-ordinates: 0387077 E 6327906 N



PROBE/RILL HT/IR

# ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: 1

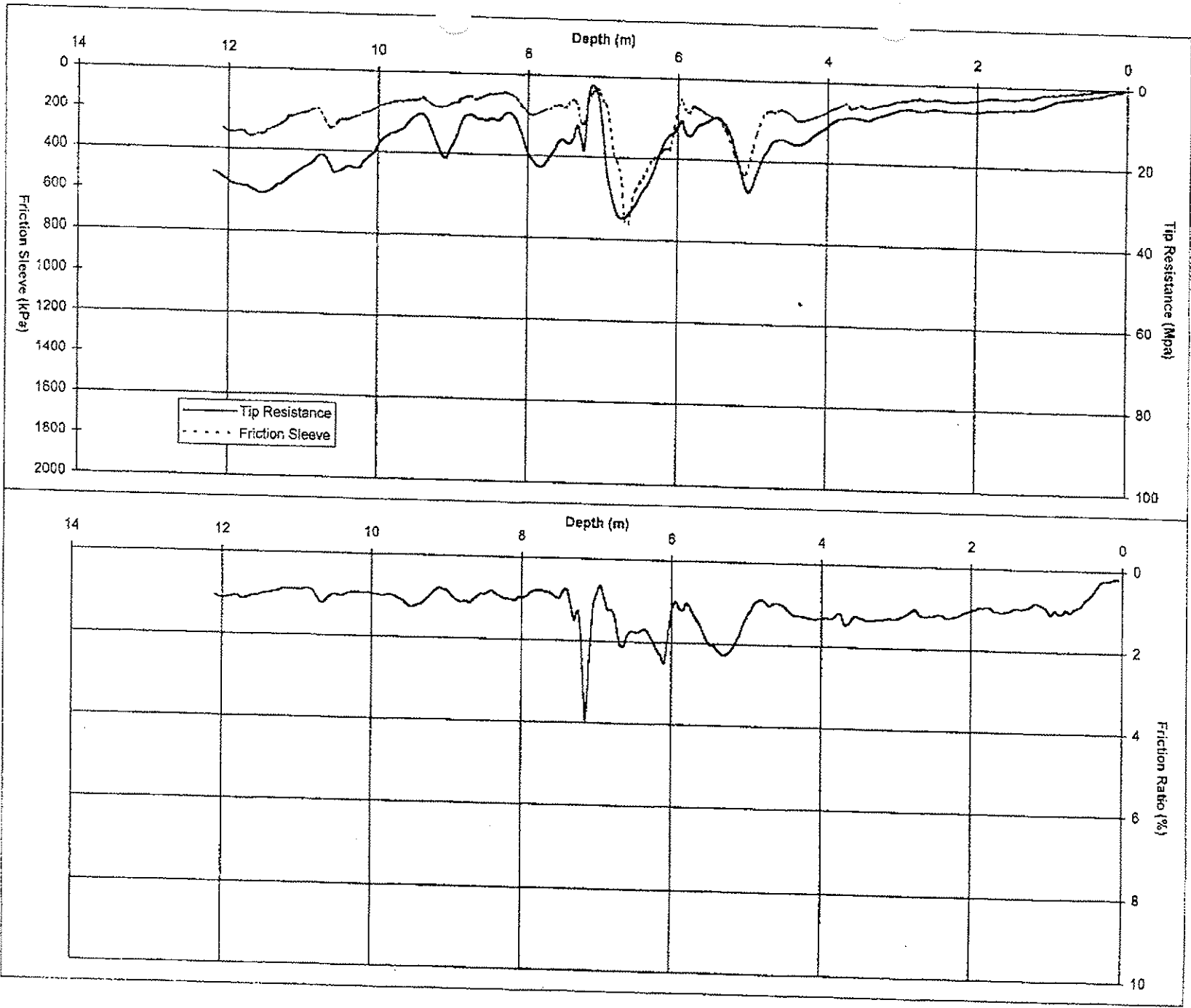
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

RL.:

Co-ordinates: 0387064 E 6328207 N



PROBEHILL PT/LIB

Tested in accordance with AS 1289.6.5.1 - 1999

ELECTRIC FRICTION-CONE PENETROMETER

Date: 27/04/02

Client: HAMMOND WORTHINGTON LAWYERS

Probe No.: J

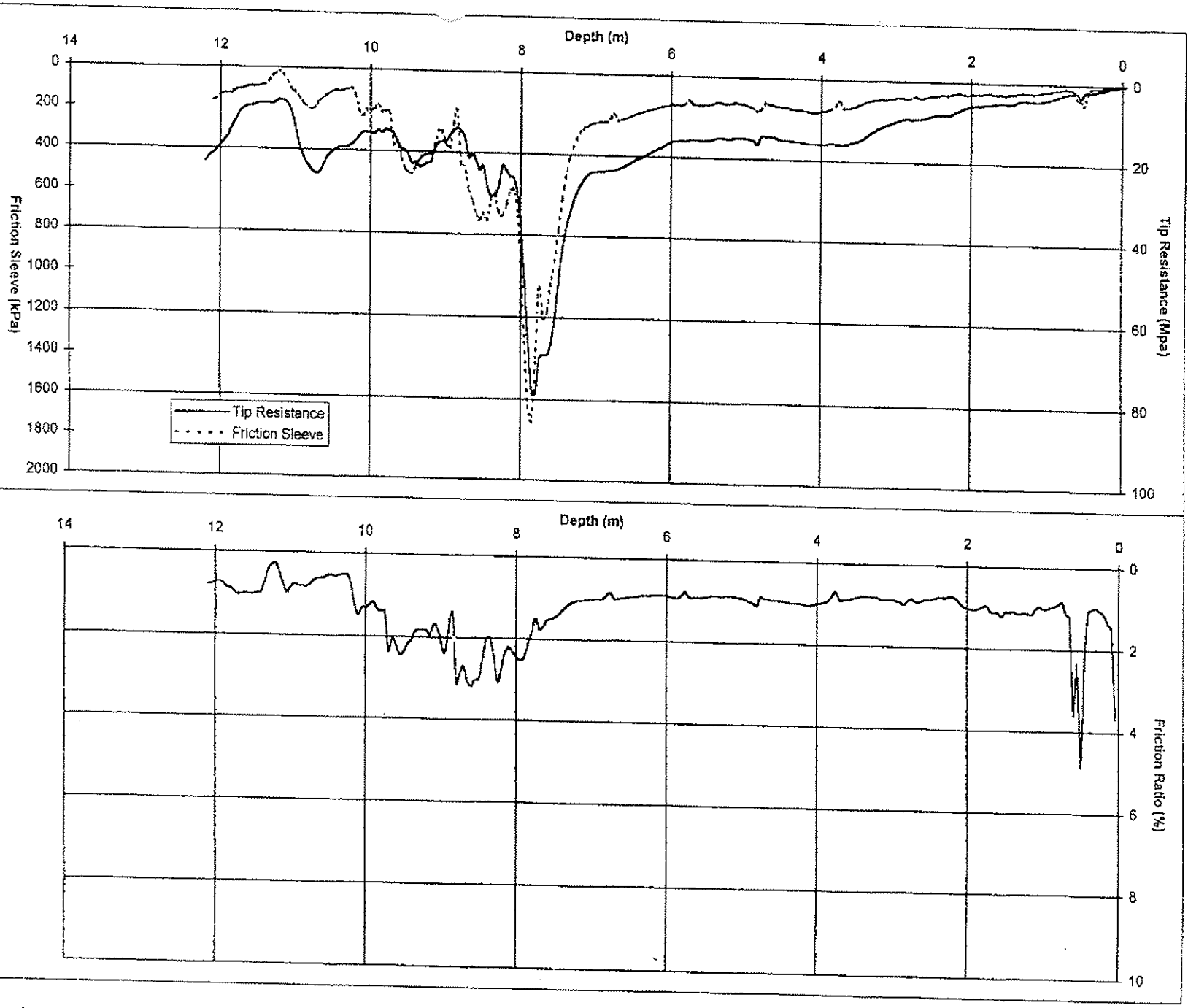
Project: DAVID PARTRIDGE

Job Number: (FILE # 36206/018)

Location: WELLINGTON LOT 1

RL.:

Co-ordinates: 0386867 E 6328213 N



PROBENRILL PPT/18

Tested in accordance with AS 1289 6.5.1 - 1999

Kennedon  
Wellington  
FAUNA

IN THE SUPREME COURT OF WESTERN AUSTRALIA

CIV 1413 of 1999  
Consolidated with CIV 1887 of 2000

B E T W E E N:

**DAVID PARTRIDGE PTY LTD (ACN 008 718 750)  
and IAN PARTRIDGE PTY LTD (ACN 008 719 506)**

First Applicants

AND

**DAVID WALTER PARTRIDGE  
ELIZABETH RONA MACKAY PARTRIDGE  
MICHAEL STEPHEN PARTRIDGE  
DAVID PARTRIDGE PTY LTD**

Second Applicants

AND

**WESTERN AUSTRALIAN LAND AUTHORITY**

Respondent

(Action consolidated by order dated 3 July 2000)

---

**WITNESS STATEMENT OF JOHN DELL**

---

Date of document:

Date of filing:

Filed on behalf of:

the Respondent

Prepared by:

McLEODS  
SOLICITORS  
220-222 STIRLING HIGHWAY  
CLAREMONT WA 6010

Telephone: 9383 3133  
Facsimile: 9383 4935  
Reference: McL/B12 8882

- 
- 1 My full name is John Dell.
  - 2 My address is 3A York Street, Inglewood in the State of Western Australia.
  - 3 I have made all enquiries within the time available which I consider to be desirable and appropriate to this

case and no matters of significance which I consider to be relevant have, to my knowledge, been withheld from the court.

4 The scope of this evidence relates to a request from the lawyers for the Respondent to provide evidence on the following:

- My professional qualifications and experience as an Environmental Officer.
- My employment with and the general process procedures adopted by the Environmental Protection Authority (EPA) and the Department of Environmental Protection (DOE) as part of environmental assessments carried out under Part IV of the *Environmental Protection Act* in operation in mid 1997.
- The assessment of fauna and fauna habitat values for local and regional significance in 1997.
- The work of consultants providing expert advice in relation to fauna for the Applicants.

5 I have been employed by the Department of the Environment (as it now is) since June 2000 as an Environmental Officer. I was previously employed at the WA Museum in the Biogeography and Ecology section of the Department of Terrestrial Vertebrates and was involved in State-wide faunal surveys for approximately 28 years. Part of this work included conducting research projects relating to fauna assemblage surveys on the Swan Coastal Plain. My

curriculum vitae setting out my qualifications and experience and a list of publications, scientific papers, reports and books in respect of which I was the author or co-author is annexed hereto as Annexure 1.

6 My main work duties in the Terrestrial Ecosystems Branch of the EPA Service Unit are to provide competent professional advice to the EPA/DoE/Government on terrestrial biodiversity policy and biodiversity conservation issues particularly pertaining to terrestrial fauna. I do this through a variety of mechanisms, including:

- EPA policy/guidelines development including:  
EPA Guidance Statement No 56 *Terrestrial fauna surveys for environmental impact assessment in Western Australia*. (Copies are available on EPA website).
- Biodiversity advice to the EPA on site-specific EIA and planning proposals (including region plans), and review of EIA scoping documents, consultant reports and EIA reports.
- Bush Forever biodiversity conservation advice and implementation through EPA and interagency committee processes.
- Bioregional scale biodiversity conservation planning (Bush Forever / proposed System 6 update ('Country' Bush Forever) /EPA System recommendations).
- Biodiversity input to Regional Planning Schemes (e.g. EPA involvement in the Greater Bunbury

Region Scheme) and Terrestrial biodiversity input to NRM Regional Strategies.

- 7 I am instructed that my evidence is specifically required to evaluate the fauna, fauna habitat and conservation values that could be impacted if the hypothetical sand mining operation which I understand the Applicants in this matter propose could have been carried out on Lot 1 Wellesley Road, Kemerton (Lot 1) in 1997 (the proposal) had Lot 1 not been resumed for the purposes of the Kemerton Buffer Zone.
- 8 I am advised that the proposal is described as the hypothetical extraction of 10 million cubic metres of sand from Lot 1 specifically from the parts of Lot 1 vegetated by Bassendean Central and South vegetation, such sand to be extracted at the rate of 200,000 cubic metres per annum.
- 9 I am currently employed within the Terrestrial Ecosystems Branch of the Policy and Coordination Division of the Department of the Environment. There are 4 people within this Branch. This Branch provides terrestrial (other than marine) biodiversity advice to the EPA with respect to proposals referred to the EPA pursuant to the *Environmental Protection Act 1986*. I consider proposals and provide information and comment on the local and regional fauna, fauna habitat and conservation values of project areas and the impact the proposal could have on these values.
- 10 I consider that if the proposal had been referred to the DEP for assessment under the *Environmental Protection Act 1986* in 1997, the issues in relation to fauna and

faunal habitat and related fauna conservation values that would have been relevant to Lot 1 would be as follows:

- the lot was likely to support populations of native fauna based on fauna known to occur in the Kemerton area. A copy of vertebrate fauna assessments of the Kemerton Silica Sands Project Area in December 1992-December 1993 are annexed hereto as Annexures 2 and 3 and copies of Kemerton Fauna Studies and Reviews are annexed hereto as Annexures 4 and 5.
- the lot was likely to support populations of Specially Protected fauna. A copy of the Wildlife Conservation (Specially Protected Fauna) Notice 1996 is annexed hereto as Annexure 6.
- the lot was likely to support populations of CALM Priority listed fauna.. A copy of CALM's Priority Fauna List as at February 1996 is annexed hereto as Annexure 7.
- the lot was likely to be part of an area of bushland which supported a relatively intact assemblage of species which had declined regionally on the Coastal Plain. Copies of background papers are annexed hereto as Annexures 8 and 9.

11 In relation to fauna and faunal habitat issues, I am of the view that in order to enable the DEP (now DOE) and ultimately the EPA to assess the proposal, the proponent would have had to prepare a fauna and fauna habitat report on the lot and an assessment of the local, regional and

national conservation values of the lot for the DEP's consideration.

12 I visited Lot 1 on 16 September 2004 and spent approximately seven hours traversing parts of the Lot by vehicle and foot. During this site inspection I made notes on the habitats present and vertebrate fauna identified. Although this information is limited because the entire site was not traversed and only a single visit was made, the following vertebrate fauna were recorded:

-Birds 42 species

-Native Mammals 3 species

-Reptiles 2 species

-Amphibians 5 species.

Accordingly, the information and comment below are based on data obtained by me on 16 September 2004, aerial photography interpretation, and reference to a series of reports and publications. The reports and publications are previously referred to as Annexures 2,3,4,and 5 and two other publications annexed hereto as Annexures 8 and 9. In the context of a hypothetical assessment of this case, I have the following comments to make in relation to my inspection:

- An assessment of the conservation values of Lot 1 is currently limited as there is not adequate specific area information available for Lot 1, i.e. flora, vegetation and fauna data. However, regional information, the limited site specific information on the Lot and other data on the Coastal Plain and the Kemerton Bushland indicate the following:

- The Bassendean Dune uplands and sumplands support the most intact areas of vegetation.
- The upland habitat remnants of the Lot have high conservation values for terrestrial vertebrate fauna. These habitats support a large assemblage of terrestrial vertebrate fauna many of which, especially habitat specialist species, are supported exclusively by resources of these habitats. Other species utilize these habitats together with adjacent areas as feeding and or breeding areas.
- The Lot supports a series of wetlands and wetland habitats associated with the edges of the sand rises (receiving their moisture from water percolating from them) probably best described as paluslopes. These areas provide habitat for breeding frogs and are likely to contain significant terrestrial fauna.
- Lot 1 is part of a naturally vegetated east/west and north/south ecological linkage from the larger Kemerton bushland to the Wellesley River system.
- Lot 1 is part of the large and diverse area of bushland remaining at Kemerton. The large size and diverse range of landforms/vegetation are key factors in the area's significance and ability to support the wide range of fauna that have been recorded from the area.

13 I am familiar with the faunal values of the Kemerton area and prepared a background paper in September

2000 for the EPA titled "A Draft Summary Assessment of the Fauna Values of the Kemerton Bushland". This report is annexed hereto as Annexure 10. I have previously visited areas within the Kemerton bushland as follows:

- the proposed Goyder sand extraction operation in September 2000,
- the Kemerton Silica Sands operation in September 2000,
- the Giacci extension to sand mining operation in September 2000

and wrote a briefing report on these sites for the EPA titled "Brief Summary Fauna Notes for Debriefing on the EPA Visit to Kemerton 13 September 2000". This report is annexed hereto as Annexure 11.

I have visited the Kemerton Silica Sands area in obtain information on faunal values in November 2003 and February 2004.

- 14 My conclusions with regard to my inspection of Lot 1 are that Lot 1 supports a rich and diverse vertebrate assemblage including a number of conservation significant species including species specially protected under the Wildlife Conservation Act, species listed as Priority Species by CALM, and species considered regionally significant as they have declined on the Swan Coastal Plain. The fauna conservation values identified above establish that the areas proposed to be mined are regionally significant. As a consequence, I would have recommended to the Evaluation Division in 1997 that

the proposal would likely cause significant environmental impacts through clearing of native vegetation and the associated loss of fauna and should be formally assessed by the Environmental Protection Authority.

15 In relation to the SMEC report provided to me I make the following comments on the report in relation to the fauna, fauna habitat and conservation values of Lot 1:

- the SMEC report does not contain any significant site specific information on fauna or fauna habitats;
- if an environmental assessment had been conducted in 1997 it would have had to address the four dot points listed in statement 14 above;
- the SMEC report in 2002 fails to address those criteria;
- as the SMEC report fails to address those criteria its conclusions are neither cogent nor sustainable;
- recognizing the inadequacies of the SMEC report I would recommend to the EPA that a report that addressed the dot points listed in statement 14 (above) be required to assess the fauna, fauna habitat and conservation values of Lot 1 be provided before an environmental assessment could be undertaken.

---

JOHN DELL

16 February 2006

Kemerton Wellington

FLORA  
VEGE

IN THE SUPREME COURT OF WESTERN AUSTRALIA

CIV 1413 of 1999  
Consolidated with CIV 1887 of 2000

B E T W E E N :

**DAVID PARTRIDGE PTY LTD (ACN 008 718 750)  
and IAN PARTRIDGE PTY LTD (ACN 008 719 506)**

First Applicants

AND

**DAVID WALTER PARTRIDGE  
ELIZABETH RONA MACKAY PARTRIDGE  
MICHAEL STEPHEN PARTRIDGE  
DAVID PARTRIDGE PTY LTD**

Second Applicants

AND

**WESTERN AUSTRALIAN LAND AUTHORITY**

Respondent

(Action consolidated by order dated 3 July 2000)

---

**WITNESS STATEMENT OF BRONWEN JEAN KEIGHERY**

---

Date of document:

Date of filing:

Filed on behalf of:

the Respondent

Prepared by:

McLEODS  
SOLICITORS  
220-222 STIRLING HIGHWAY  
CLAREMONT WA 6010

Telephone: 9383 3133  
Facsimile: 9383 4935  
Reference: McL/B12 8882

- 
- 1 My full name is name Bronwen Jean Keighery.
  - 2 My address is 224 Hamersley Road Subiaco in the State of Western Australia.
  - 3 I have made all enquires within the time available which I consider to be desirable and appropriate to this case

and that no matters of significance which I regard as relevant have, to my knowledge, been withheld from the Court

- 4 I am a botanist employed as a Senior Environmental Officer in the Department of Environmental Protection. I have been employed in this position for almost 8 years. I was engaged as a consultant with the Department for 3 years prior to this.). My curriculum vitae is annexed hereto as Annexure 1.
  
- 5 My role at the Department as a consultant, and then employee, was as a recognised expert on the flora and vegetation of the Swan Coastal Plain (SCP). My principal role was to work on the System 6 and part of the System 1 Update project. The main aim of this project was to develop a conservation plan for the Swan Coastal Plain south of the Moore River for the Department and the Environmental Protection Authority (EPA). My principal tasks on this project were:
  - coordinating and conducting survey of the natural values, with particular reference to flora and vegetation, of the SCP;
  - working, in conjunction with others, to identify regionally significant natural areas;
  - to develop a standard format and associated explanatory text for determining and describing regionally significant natural areas on the SCP;
  - to prepare descriptions of specific natural areas after the standard format; and

- to coordinate the preparation of a complete set of descriptions of regionally significant natural areas.

The part of this project that pertains to the Perth Metropolitan Region, evolved into Perth's Bushplan, which was the draft of the Bush Forever strategy.

Since 1994, I have also been providing technical flora and vegetation information and commenting on the information prepared by others, particularly in relation to environmental impact assessment on the SCP.

This work drew heavily on floristic surveys, which I conducted in conjunction with a number of other botanists, from 1991 to 1997. Over this period I personally recorded vegetation and floristic data for over 790 10x10m plots and hundreds of natural areas on the SCP. Three of these 10x10m plots are located within 5 kms of Lot 1. This information has contributed to a series of reports and publications on the flora, vegetation and conservation values of many natural areas on the SCP. The information, reports and publications have contributed to an improved understanding of the flora and vegetation of the SCP.

- 6 I am instructed that my evidence is specifically required to evaluate, the flora, vegetation and related conservation values, that could be impacted if the hypothetical sand mining operation which I understand the Applicants in this matter propose could have been carried out on Lot 1 Wellesley Road, Kemerton (Lot 1) in mid 1997 (the proposal) had Lot 1 not been resumed for the purposes of the Kemerton Buffer Zone.

- 7 I am advised that the proposal is described as the hypothetical extraction of 10 million cubic metres of sand from Lot 1 specifically from the parts of Lot 1 vegetated by Bassendean Central and South vegetation, such sand to be extracted at the rate of 200,000 cubic metres per annum.
- 8 I am currently employed within the Terrestrial Ecosystems Branch of the Policy and Coordination Division of the Department. There are 4 people within this branch. This branch provides terrestrial (other than marine) biodiversity advice to the EPA with respect to proposals referred to the EPA pursuant to the *Environmental Protection Act 1986*. I consider proposals and provide information and comment on the regional flora, vegetation and conservation values of the area and the impact the proposal could have on these values.
- 9 I consider that if the proposal had been referred to the DOE for assessment under the *Environmental Protection Act 1986* in 1997, the issues related to flora, vegetation and related conservation values which would have been relevant to Lot 1 would be as follows:
- Landscape features
  - Soils
  - Vegetation (Heddle *et al.* 1980, Gibson *et al.* 1994, DEP 1996)  
Structural units (both upland and wetland units)  
Vegetation Condition (Keighery 1994)
  - Flora  
Total Flora

Significant flora (Atkins 1996, Gibson *et al.* 1994, Keighery 1996b, Mattiske 1993a&b)

- Wetlands (Hill *et al.* 1996a, Hill *et al.* 1996b):  
Wetland Types, Consanguineous suite, Wetland Management Objective and Lake EPP (Government of WA 1992 ).
- Linkage

Reports and publications listed are base references on regional datasets and/or reports from comparable areas of vegetation and are annexed hereto as Annexure 2.

- 10 I am of the view that in order to enable the DOE and ultimately the EPA to assess the proposal, the proponent would have had to prepare reports for the DOE's consideration which address the following information on flora, vegetation and related conservation values concerning Lot 1 and its surrounds:

**(A) National and Regional Information Sets for the Swan Coastal Plain**

- Landform and soils (various sources)
- Vegetation and flora
  - Vegetation Complex (Hedde *et al.* 1980)
  - Floristic Community Types (Gibson *et al.* 1994, DEP 1996)
- Wetlands
  - Wetland Types (Hill *et al.* 1996a, Hill *et al.* 1996b)
  - Consanguineous suite (Hill *et al.* 1996a, Hill *et al.* 1996b)
  - Wetland Management Objective (Hill *et al.* 1996a, Hill *et al.* 1996b)

Lake EPP (Government of WA 1992 ).

- Threatened Ecological Communities (English and Blyth 1997)
- Threatened Species (CALM current Declared Rare and Priority Flora and Fauna Lists, reports, own survey)
- International and National Significance  
Reference to international treaties, listing on the register of the National Estate etc.

**(B) Specific Area Information** (the limitations of any survey work should be clearly stated)

- Landscape features
- Vegetation and Flora (any existing information and own survey)

Structural units (should be mapped and related to on the ground descriptions)

Vegetation Condition (should be mapped after Keighery 1994)

- Total Flora, including total flora (level of survey should be indicated), significant flora (DRF, priority taxa, range extensions, species at geographic limits etc.)
- Linkage (adjacent bushland areas)

Reports and publications listed are base references on regional datasets and are annexed hereto as Annexure 2.

Information compiled under section (B) would have been expected to be carried out in spring. If this was not the case this would have been a 'limitation'. This information would

be the basis for addressing the regional flora and vegetation values hence conservation significance of the Lot 1.

11 The reports and publications referenced above and other reports and publications used to consider the values of Lot 1 are annexed here to as Annexure 2. Only one of these reports, SMEC 2004, contained any site specific information on flora and vegetation and this is minimal.

12 I visited Lot 1 on 16<sup>th</sup> September 2004 and spent approximately seven hours traversing the Lot 1 by vehicle and foot. Observations were recorded as field notes and photographs. This information is limited

- as the entire site was not traversed;
- in being confined to a single visit; and
- a report has not been prepared from the field notes.

Accordingly, the information and comment below are based on the field inspection, aerial photography interpretation and a series of reports and publications.

- Lot 1 supports contiguous areas of upland and wetland native vegetation in a range of conditions from at least very good condition to a completely degraded condition (condition scale after Keighery 1994). Activities associated with grazing (grazing and burning) and cultivation (clearing and cultivation) appear to have been the degrading processes.

- The broad upland and wetland vegetation mapping (Hill *et al.* 1996b) is as accurate as to be expected considering the scale of the mapping.
  
- Wetlands
  - Preliminary wetland vegetation mapping based on Hill *et al.* and the field work shows the wetlands as slightly more extensive than mapped by Hill *et al.*.
  
  - The wetland type is generally consistent with Hill *et al.* being wetlands palusplain (not numbered), 78, 87, 91, 101 and 113 on Map Sheet 2031 SW. An additional wetland type was observed on the edges of the sand ridges adjacent to the palusplain, hereafter referred to as paluslope wetlands. These appear to be formed by seepage of groundwater from below the dunes where they meet the clayey soils of the river flats. Within Lot 1 the vegetation on these wetlands is in generally in a degraded to very degraded condition. The mid-slope wetlands extend into adjacent northern Lot and here support *Melaleuca raphiophylla* Low Woodland in better than good condition. One priority species, *Cyathochaeta teretifolia* was observed in these wetlands. Some individuals of this species are likely to occur in Lot 1. These paluslope wetlands are apparently formed in a similar manner to mound springs on the SCP. As mound springs often support a threatened ecological community these require further investigation.

- The wetland management category is consistent with current management category data (this was not published in Hill *et al.* 1996b but is available on current databases).
- The wetland vegetation is generally typical of wetlands of the Bassendean Dunes and Pinjarra Plain in the broader Kemerton area, except for the paluslope wetlands.
- The wetland vegetation on the Wellesley River is dominated by *Melaleuca raphiophylla* and *Eucalyptus rudis* Forest to Woodland and generally in a completely degraded condition. For approximately two thirds of its length in Lot 1 the Wellesley River is bordered by palusplain wetlands then paluslope wetlands where the Plain meets the Bassendean Dunes. Scattered to clumped *Melaleuca raphiophylla*, *Eucalyptus rudis* and *E. calophylla* trees are found on the palusplain areas. For the remaining third of its length in Lot 1 the Wellesley River is bordered by a Bassendean Dune.
- Uplands
  - The upland areas support the largest areas of the most intact vegetation, generally in very good to degraded condition with areas in a completely degraded condition.
  - The upland areas are dominated by *Banksia attenuata* Woodlands supporting a typical range of those species typical of the Bassendean Dunes in

the broader Kemerton area (Mattiske 1993a&b). One priority species, *Acacia semitrullata* was observed in these dune woodlands. At times, co-dominants in the *Banksia attenuata* Woodlands are *Banksia ilicifolia*, Peppermint (*Agonis flexuosa*) and Jarrah (*Eucalyptus marginata*). While most Jarrah trees are suckering regrowth from cut Jarrah, scattered large Jarrah, are found in woodlands.

13 In the context of a hypothetical assessment of this case, I have the following comments to make in relation to my inspection and consideration of the reports.

Lot 1 supports contiguous upland and wetland native vegetation in a range of conditions from at least very good condition to a completely degraded condition. This vegetation is part of the larger Kemerton Bushland, which has regional conservation significance as:

- it is a very large native vegetation remnant containing upland and wetland vegetation;
- supports contiguous vegetation from three major landform units on the Plain - Spearwood Dunes, Bassendean Dunes and Pinjarra Plain which are contiguous with vegetation to the coast to the west and the Wellesley River to the east;
- it contains wetlands of conservation significance; and
- the most intact assemblage of vertebrate species on the Coastal Plain.

Lot 1 contributes to the regional conservation significance of the larger Kemerton Bushland as it:

- contains a significant landscape feature where the Bassendean Dune is contiguous with the Wellesley River;
- supports a native vegetation remnant containing upland and wetland vegetation from two major landform units on the Plain - Bassendean Dunes and Pinjarra Plain which are contiguous with vegetation to the west and the Wellesley River to the east;
- supports a variety of naturally vegetated dunes, wetlands and wetland/upland interfaces (palusplain/dune, dune/paluslope; river/dune, sumpland/dune and dampland/dune) which provide a large diversity of habitats for flora and fauna;
- contains wetlands of conservation significance and it supports areas of paluslope wetland which may be of very high conservation value; and
- contains one, and possibly two priority flora species.

It is expected that if the upland vegetation in degraded or better condition was fenced that the vegetation condition would improve to good to excellent condition. As a consequence the wetlands would be expected to change their management category to either Conservation or Resource Enhancement.

- 14 The System 6 report identifies three wetland areas within 5 kilometres of Lot 1: C63 (part of a western wetland chain in the Spearwood Dunes); C65 (Benger

Swamp a Pinjarra Plain wetland) and the southern Wellesley River. The Wellesley River is not a numbered recommendation as there were a series of general recommendations for rivers in the Bunbury area, recognising their linkage value. The Wellesley River System 6 'area' was mapped to approximately one kilometre south of Lot 1.

The System 6 and part System One Update recognised that there were considerable regional conservation values not addressed in the System 6 report. Submissions to the Update programme identified sections of the Kemerton Bushland and the entire length of the Wellesley River. The Kemerton Bushland and the full extent of Wellesley River were expected to be identified as areas of regional conservation significance. The boundary of both areas is yet to be finalised. Continuing work on the flora and vegetation values of the Kemerton Bushland/ Wellesley River areas is identifying increasing values for the area. Examples include the Wellesley River Muchea Limestones located about 2km to the north of Lot 1 (Keighery 1998) and the sandy spur/river interface and paluslope wetlands identified in Lot 1.

- 15 To my knowledge there are no mined areas on the Swan Coastal Plain that have been successfully rehabilitated to support vegetation in good or better condition.
- 16 The flora, vegetation and related conservation values identified above indicate that the areas proposed to be mined are regionally significant. As a consequence, the recommendation to the Evaluation Division in 1997

would have been that the proposal should be formally assessed.

- 17 As outlined above the SMEC report does not contain any significant site specific information, relying only on regional datasets to address regional conservation value of Lot 1. This report does not provide an adequate assessment of the natural values of Lot 1 in that it fails to address the site specific detail outlined in 15.

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BRONWEN JEAN KEIGHERY

7 October 2004

## ANNEXURE 1

### Curriculum Vitae

#### 1. Personal Particulars

Name: **Bronwen Jean Keighery** (nee Banyard)  
Date of birth: 10th September 1951  
Address: 224 Hamersley Rd SUBIACO WA. 6008  
Telephone: 3814062  
Marital Status: Married (1973) with three children

#### 2. Qualifications

Bachelor of Science from the University of Western Australia with majors in Botany and Zoology and First Class Honours in Botany, 1969-1972.  
Diploma of Education, Teaching Certificate and Diploma of Teaching from the University of Western Australia and the Nedlands Secondary College, 1973

#### 3. Experience

##### 1971 - 97 Botanist/Consultant Botanist

##### Areas of expertise

- **Vegetation and flora survey:** general assistance flora survey in south west, road survey (preconstruction and roadsides), rare flora survey, regional and area survey for the identification of conservation areas on the Swan Coastal from Moore River to Dunsborough, System 6/1 Update/Perth's Bushplan technical work
- **Urban Bushland:** joint author of pivotal discussion paper on identification and values of urban bushland in WA, identification of threats to urban bushland and management to alleviate these threats
- **Educator on vegetation and flora:** university tutor/demonstrator, package activities for primary school students, plant survey book, workshops, seminars etc on vegetation and flora and management of bushland, workshop coordination
- **Taxonomic work:** cytogenetics studies, assisted with the revision of the Genus *Baeckea*, *Astartea* and *Scholtzia* (Myrtaceae), Australian Biological Resources Study.
- **Independent assessor to the Australian Heritage Commission**

##### 1997 - 2004 Current employment

Senior Environmental Officer (Level 6/4) with the Department of Environmental Protection in Conservation Branch (Policy Coordination Division) with the following areas of responsibility: project coordinator System 6/1 Update/Perth's Bushplan in DEP (principal author of Volume 2 of Perth's Bushplan and Bush Forever); flora and vegetation regional and area survey for the identification of conservation areas on the Swan Coastal from Moore River to Dunsborough for System 6/1 Update/Perth's Bushplan and general conservation and vegetation and flora issues for the Department.

#### Reports

(This is not a complete listing of reports but is indicative of the breadth of areas covered.)

Clarke K and Keighery BJ 1999 *Vegetation Assessment of Part Bushplan Site 378 – Henderson Airfield, Lot 164 Yangedi Rd, Peel Estate.*

Clarke K and Keighery BJ 1999 *Preliminary Vegetation Assessment Lot 2 Rowley Rd, Lot 111 ? Rd and Lot 264 Lake Rd, Part of Bushplan Site 345 – Forrestdale Lake & Adjacent Bushland, Forrestdale.*

Clarke K and Keighery BJ 1999 *Assessment of Proposed Additional Bushland Areas – Errina Road Bushland, Alexander Heights.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000a *Preliminary Vegetation Assessment of Part Bushplan Site 196 – Gnangara Road Bushland, Landsdale/ Cullacabardee Telstra's Perth International Telecommunications Centre in Relation to a Proposed Negotiated Planning Solution.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000b *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 125 - Holmes Street Bushland, Southern River/Huntingdale.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000c *Preliminary Vegetation Assessment Lots 4 & 5 Armadale Rd, Part of Bushplan Site 345 – Forrestdale Lake & Adjacent Bushland, Forrestdale.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000d *Vegetation Assessment of Bushplan Site 70 – Duckpond Bushland, Peel Estate.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000e *Preliminary Vegetation Assessment of the City Beach High School, Part of Bushplan Site 312 – Bold Park and Adjacent Bushland, City Beach.* Unpublished report prepared for the Ministry for Planning.

Keighery BJ 1993a *A Report for the Belmont City Council on the Heritage Value of some Urban Bushland areas within the City.*

Keighery BJ 1993b *Swan Coastal Plain Survey, 1990 - 93.* A Report to the Wildflower Society of WA for the National Estate Program.

Keighery BJ 1993c *Bushland Plant Survey - Plant Community Survey for the Community.* A Report to the Wildflower Society of WA for the National Estate Program.

Keighery BJ 1994 *Objection Assessment of the values of the flora of the Hepburn Heights - Pinnaroo Park Area.* An unpublished report for the Australian Heritage Commission

Keighery BJ 1995a *Objection Assessment of the values of the flora and vegetation of the Beeliar Wetlands.* An unpublished report for the Australian Heritage Commission

Keighery BJ 1995b *Knowing and Managing the Brixton Street Wetlands.* Unpublished report for the Friends of Brixton Street and the Perth Branch of the Wildflower Society.

Keighery BJ 1995c *Natural Areas at the Pearce Airforce Base, Western Australia.* Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995d *Vegetation and Flora of Lot 139 Brentwood Road, Kenwick (part Threatened and Poorly Reserved Community area Brixton 1)*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995e *Vegetation and Flora Report for ACTIV— an area recognised as in need of interim protection under the System Six Update program)*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995f *Vegetation and Flora Report for Lot 106 Wanaping Road, Kenwick, part interim protected area under the System Six Update Program*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995g *Department of Environmental Protection System 6 Update program: Flora List and Vegetation Notes for M52, Perth Airport*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995h *Description of the Vegetation of part Pearce 4 — Area to the North and South of Kimberley Street*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1996a *Flora Information for Roadside Protection Plans in the Shire of Serpentine - Jarrahdale*. Unpublished report to the Roadside Care Volunteers, Shire of Serpentine - Jarrahdale.

Keighery BJ 1996b *A description of remnant vegetation of Bennett Brook (System Six Area M41)*. Report prepared for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1999a *Assessment of Proposed Additional Bushland Areas – Lot 10 Flynn Drive, Neerabup*. Unpublished report prepared for the ministry of Planning.

Keighery BJ 1998 *Vegetation and Flora Conservation Values of the Kemerton Silica Sands Project Area*. Unpublished report for the Department of Environmental Protection.

Keighery BJ 2000 *Conservation assessment of part lot 52 on plan 16832 (Certificate of title volume 2112 folio 88) based on information available prior to 5<sup>th</sup> May 1998*. Unpublished report for the Department of Environmental Protection to the Crown Solicitor's Office, Western Australia.

Keighery BJ 2001 *Review of Expert Environmental Documents for *TRANDOS v WESTERN AUSTRALIAN PLANNING COMMISSION: SUPREME COURT 2353 OF 1999:PART LOT 52 BURNS BEACH ROAD (FORMERLY LOT 9), NEERABUP**. Unpublished report for the Department of Environmental Protection to the Crown Solicitor's Office, Western Australia.

Keighery BJ and Clarke K 1999b *Detailed Assessment of Values for a Negotiated Planning Solution Part Bushplan Site 303 - Pinnaroo Cemetery Bushland*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K 2000a *Assessment of Proposed Additional Bushland Areas – Lot 204 Lyon Road, Banjup*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K 2000b *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 270 - Sandy lake and Adjacent Bushland, Anketell*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K 2000 *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 342 - Anstey/Keane Dampland and Adjacent Bushland, Forrestdale*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ, Gibson N and Keighery GJ 1997 *The regional Significance of the Flora and Vegetation of Garden Island*. IN: The proceedings of the Environment and Energy Conference, Royal Australian Navy Directory of Environmental Management, April 1997.

Keighery BJ, Keighery GJ and Santich S. 2002 *A description of natural values of the south Bunbury to Capel coastal corridor*. Unpublished report for the Department of Environmental Protection, Western Australia.

Keighery BJ, Keighery GJ Gibson N and Gunness, AG 2001. *The vegetation and flora of the Quairading Nature Reserve, Shire of Quairading*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1992 *Burns Beach* Unpublished report to the Department of Conservation and Land Management, Western Australia.

Keighery GJ and Keighery BJ 1995 *Muchea Limestones - Floristics*. Unpublished report to Australian Nature Conservation Authority National Reserves Network and the Department of Conservation and Land Management, Western Australia.

Keighery GJ and Keighery BJ 1996 *Vegetation and Flora of Lambkin Reserve, Serpentine (Reserve 32352)*. An unpublished report for the Department of Conservation and Land Management.

Keighery GJ and Keighery BJ 1998 *Floristics of System Six Reserves and Bushland. Part XVI: Point Heathcote Foreshore (M65), Minim Cove (M 57), Mosman Park (M56), Peppermint Grove Foreshore (M 54) and Point Resolution (M59)*. Unpublished report for the Departments of Conservation and Land Management and Environmental Protection, Perth, Western Australia.

Keighery GJ and Keighery BJ 2000 *Flora of the Greater Brixton St Wetlands*. IN: Marshal, J (ed) 2000 *The Greater Brixton St Wetlands Management Guidelines, Natural History and Research*. Unpublished report for the Friends of Brixton St Wetlands and the World Wide Fund for Nature.

Keighery GJ, Keighery BJ and Gibson N 1994 *Vegetation and Flora of CTCR 53*. An unpublished report for Department of Environmental Protection, Shire of Waroona and the Department of Conservation and Land Management.

Keighery GJ, Keighery BJ and Gibson N 1997 *Flora and Vegetation of Dardanup Forest Block*. An unpublished report for Department of Environmental Protection and the Department of Conservation and Land Management.

Keighery BJ and Trudgen, ME 1992 *The Remnant Vegetation of the Eastern Side of the Swan Coastal Plain* A Report to the Department of Conservation of Land Management for the National Estate Program.

Trudgen ME and Keighery BJ 1990a *A Report on the Flora and Vegetation of the Alkimos area and Conservation Issues affecting it*. Unpublished report for Landcorp, WA.

Trudgen ME and Keighery BJ 1990b *A Report on the Flora and Vegetation of the Ningana area and Conservation Issues affecting it*. Unpublished report for Landcorp, WA.

Trudgen, ME, Griffin EA. and Keighery BJ 1990 *A Report on the Flora and Vegetation of areas at Wilbinga and Breton Bay proposed as alternatives for a future industrial site*. Unpublished report for Halpern Glick and Maunsell.

Trudgen, M. and Keighery BJ 1994 *The Remnant Vegetation in the City of Gosnells*. A Report to the City of Gosnells.

## **Publications**

### **A. Authored Publications**

Banyard BJ and James SH 1979 Biosystematic Studies in the *Stylidium crassifolium* Species Complex (Stylidiaceae) Aust. J. Bot., 27, 27-37

Gibson N and Keighery BJ (Editors) 1992 *Bushland in Our Backyard*. Proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Gibson N, Keighery BJ, Keighery GJ and Burbidge AH 1994 *Effects of Urban Living on Plant Communities*. In Proceedings National Greening Aust. Conference - A Vision for a greener City. The Role of Vegetation in Urban Environments Editor M. Scheltema.

Gibson N, Keighery BJ, Keighery GJ, Burbidge A and Lyons M. 1994 *A Floristic survey of the southern Swan Coastal Plain* A Report to the Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Gibson N, Keighery GJ and Keighery BJ 1997 *Contributions of NH. Speck to the biogeography of Proteaceae in Western Australia*. Journ. Royal Society Western Australia.80: 73-77.

Gibson N, Keighery GJ and Keighery BJ 2000 Threatened plant communities of Western Australia. 1. The ironstone communities of the Swan and Scott Coastal Plains. *Journal of the Royal Society of Western Australia* 83: 1-12.

Gibson N, Keighery GJ, Lyons MN and Keighery BJ 2003 Threatened plant communities of Western Australia. 2. The argillaceous vernal pools of the south west. In preparation.

Gibson N, Keighery BJ, and Griffin EA 2002 *The occurrence of Tuart in plant communities on the Swan Coastal Plain*. In Keighery BJ and Longman VM (Editors) 2002 Tuart (*Eucalyptus gomphocephala*) and Tuart Communities. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 126 - 146.

Griffin, EA and Keighery BJ 1989 *Moore River to Jurien Sandplain Survey*. WA Wildflower Society, Nedlands, WA 90 pages

Keighery BJ 1991 *Sharing a Wonderful Dream*. Wildflower Society and Library and Information Services, Perth.

Keighery BJ 1994a *Bushland Plant Survey*. A guide to plant community survey for the community. Wildflower Society of WA, Nedlands, WA.

Keighery BJ 1994b *Regional Conservation Assessment*. In Proceedings of the Public Forum concerning the State Government's Draft Urban Bushland Strategy. Urban Bushland Council (WA).

Keighery B. J. and Gibson N 1992 *Who is Managing Urban Bushland?* In Bushland in Our Backyard. Proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Keighery BJ and Gray M. 1992 *Towards an Urban Bushland Policy for the National Trust (WA). A Discussion Paper*. In National Trust (WA) Urban Bushland Policy.

Keighery BJ and Huston J. 1994 *Our Wild Plants*. A Package of Information and Activities for Primary School on Native Plant Communities. Greening Western Australia. .

Keighery BJ and Keighery GJ 1995 *Management Guidelines for Urban Bushland and Fire Effects*. In Burning our Bushland, edited by J Harris, Urban Bushland Council (WA).

Keighery BJ, Keighery GJ and Gibson N 2003 *Vernal Pools of South-Western Australia*. In abstracts for the on the Conference on Comparative Biology of Monocotyledons, 31<sup>st</sup> March to 4<sup>th</sup> April 2003 at the Rancho Santa Ana Botanic Gardens, California USA.

Keighery BJ, Keighery GJ Gibson N and Gunness AG 1999 *Knowing and Understanding the Plants in our Bushland*. In K Tullis and K McLean (editors) 1999 Managing Our Bushland. Proceedings of a 1998 conference on the protection and management of urban bushland. Urban Bushland Council (Inc), Perth, WA.

Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Keighery BJ, Keighery GJ and Gibson N 1995a *Community participation in Bushland Plant Survey in Western Australia*. In Nature Conservation 4: The Role of Networks edited by DA Saunders JL, Craig and EM Mattiske. Surrey Beaty and Sons , Chipping Norton, NSW.

Keighery BJ, Keighery GJ and Gibson N 1995b *Floristics of Reserves and Bushland Areas of the System Six Region Part X: Floristics of Lowlands*. Wildflower Society of Western Australia (Inc.), Nedlands..

Keighery BJ, Keighery GJ and Gibson N 1996c *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1996d *Part II: Floristics of the Ambergate Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1996e *Part IV: Floristics of the Capel Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997a *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997b *Part XI: Floristics of the Mundijong Road Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997c *Part XIII: Floristics of the Neerabup National Park*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997d *Part XIV: Floristics of the Lakes Coo loongup and Walyungup Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Shepherd D 2002 *The Distribution and Conservation of Tuart and the community with which it lives*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 6 - 86.

Keighery BJ and Pieroni, M. 1989 *Gum Tree Pack*. Western Australian Wildflower Society, Nedlands, WA 40 pages

Keighery GJ, Harvey, JM and Keighery BJ 1990 *The Vegetation and Flora of Bold Park*. West. Aust. Naturalist 18:100-122

Keighery GJ and Keighery BJ, 1991. *Floristics of Reserves and Bushland Areas of the System Six Region II. Brixton Street Wetlands, Kenwick*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts II-IV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1992 *Plant Communities of the Northern Swan Coastal Plain - with special reference to uncommon and potentially Rare Plant Communities*. In *Bushland in Our Backyard*. proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Keighery GJ and Keighery BJ 1993a. *Part VII: Floristics of Three Bushland Areas on the Eastern Side of the Swan Coastal Plain* In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1993b *Part VIII: Floristics of Wandi Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1993c *Part IX: The Flora of Three Coastal Bushland Areas (System 6 Areas M46, M91 and M106)*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1996a Rediscovery of *Schoenus natans* (Cyperaceae). W.A. Naturalist 21: 65 - 68.

Keighery GJ and Keighery BJ 1996b Biology, Biogeography and Conservation of *Franklandia* R.Br. page 29, Abstracts of the International Conference on the Biology of the Proteaceae, University of Melbourne, 29 Sept. to Oct. 2, 1996.

Keighery BJ and Keighery GJ 2003 *Juncaginaceae in Western Australia*. In abstracts for the Third International Conference on Comparative Biology of Monocotyledons, 31<sup>st</sup> March to 4<sup>th</sup> April 2003 at the Rancho Santa Ana Botanic Gardens, California USA.

Keighery GJ, Keighery BJ and Gibson N 1996 *Part I: Floristics of the Carburnup Bushland*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1)*. Parts I - IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1996 *Part II: Floristics of the Ruabon Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1)*. Parts I - IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Gibson N and Keighery BJ 1997 *Part XII: Floristics of the Seabird Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1997 *Part XII: Floristics of Bullsbrook Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Gibson N and Keighery BJ 1997 *Part XII: Floristics of the Seabird Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1997 *Part XII: Floristics of Bullsbrook Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Lamont B, Keighery BJ, Penny L and Wallace J 1987 A numeric, geographic and structural analysis of the *Hakea falcata* group (Proteaceae) *Botanical Journal of the Linnean Society*, 94: 433-451

Longman VM and Keighery BJ 2002 *Tuart Issues*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 292 - 330.

Powell, R and Keighery BJ 1995 *Soil types and plant communities of the Perth metropolitan region*. In *Managing Perth's Bushland*, Eds: Scheltema, M and Harris, J., Greening Western Australia.

Powell R and Keighery BJ 2002 *Tuart in the Landscape*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 279 - 286.

Powell R and Keighery BJ 2003 *Cherish the Tuart*. *Landscape*, Volume 18 No 4 Autumn 2003. Department of Conservation and Land Management. Perth, WA

## **B. Government and EPA Planning and Policy Publications**

Key:

# principal contributor  
\* contributor

# Environmental Protection Authority (EPA) 2002 *A Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme portion of the Swan Coastal Plain*. Environmental Protection Authority. Perth, WA.

\* Environmental Protection Authority (EPA) 2003 *Guidance for the Assessment of Environmental Factors No. 10. Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of System 1 region* Environmental Protection Authority, WA.

\*Government of WA 1998a *Perth's Bushplan Volume 1*. Published by the Western Australian Planning Commission, Perth, WA.

#Government of WA 1998b *Perth's Bushplan Volume 2: Directory of Bush Forever Sites* Published by the Department of Environmental Protection, Perth, WA.

\*Government of WA 2000a *Bush Forever Volume 1: Policies Principles and Processes*.  
Ministry for Planning, Perth, Western Australia.

#Government of WA 2000b *Bush Forever Volume 2: Directory of Bush Forever Sites*.  
Department of Environmental Protection, Perth, Western Australia.

Bronwen Keighery  
October 2004

## ANNEXURE 2

### REFERENCES

Atkins, KJ 21/10/1996 *Declared Rare and Priority List for Western Australia*. Department of Conservation and Land Management, WA

DEP — refer to Department of Environmental Protection.

DEP 1996 *System 6 and Part System 1 Update Programme*. Unpublished bushland plot and area records and analysis. Department of Environmental Protection, Perth, Western Australia.

Department of Conservation and Environment 1983 *Conservation Reserves for Western Australia. The Darling System - System 6*. Parts 1 & 2. Report 13.

Department of Environmental Protection — refer to DEP.

Environmental Protection Authority — refer to EPA.

EPA 1990 *A Guide to Wetland Management in Perth* (Bulletin 374). Environmental Protection Authority, Perth, Western Australia.

EPA 1993 *A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area* (Bulletin 686). Environmental Protection Authority, Perth, Western Australia.

EPA and WAWA 1990 *Jenny Arnold's Perth Wetlands Resource Book: Chapters 1-15* (Bulletin 266). Environmental Protection Authority, Perth, Western Australia.

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH and Lyons, MN 1994 *A Floristic Survey of the Southern Swan Coastal Plain*. Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Government of WA 1992 *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*. Western Australian Government Gazette, 24 December, 1992, pp 6287-93.

Government of WA 1998a *Perth's Bushplan* Volume 1. Published by the Western Australian Planning Commission, Perth, WA.

Government of WA 1998b *Perth's Bushplan* Volume 2 Part A. Published by the Department of Environmental Protection, Perth, WA.

Government of WA 1998b *Perth's Bushplan* Volume 2 Part B. Published by the Department of Environmental Protection, Perth, WA.

Government of WA 1998b *Perth's Bushplan* Volume 2 Part C. Published by the Department of Environmental Protection, Perth, WA.

Hedde, EM, Loneragan, OW and Havel, JJ 1980 Vegetation of the Darling System. IN: DCE 1980 *Atlas of Natural Resources, Darling System, Western Australia*. Department of Conservation and Environment, Perth, Western Australia.

Hill AL and Del Marco A 1996 Wetland evaluation. IN: Hill *et al.* 1996a *Wetlands of the Swan Coastal Plain. Volume 1: Wetland Mapping, Classification and Evaluation — Main Report*. Prepared for the Water and Rivers Commission and the Department of Environmental Protection, Perth, Western Australia.

Hill AL, Semeniuk CA, Semeniuk V and Del Marco A 1996b *Wetlands of the Swan Coastal Plain. Volume 2: Wetland Mapping, Classification and Evaluation — Wetland Atlas*. Prepared for the Water and Rivers Commission and the Department of Environmental Protection, Perth, Western Australia.

IUCN 1991 *Caring for the Earth – a strategy for sustainable living*. World Conservation Union: United Nations Environment Program, Glan Switzerland.

Keighery BJ 1994 *Bushland Plant Survey*. A guide to plant community survey for the community. Wildflower Society of WA, Nedlands, WA.

Keighery BJ and Trudgen ME 1992 *The Remnant Vegetation of the Eastern Side of the Swan Coastal Plain*. Unpublished report to the Department of Conservation of Land Management for the National Estate Grants Program.

Keighery BJ, Keighery GJ and Gibson N 1996a *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1996b *Part IV: Floristics of the Capel Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Marchant NG, Wheeler JR, Rye BL, Bennett EM, Lander NS and Macfarlane TD 1987 *Flora of the Perth Region: Parts One and Two*. Western Australian Herbarium, Department of Agriculture, Perth, Western Australia.

Mattiske, E.M. and Associates 1993a Gwalia Consolidated Limited - Kemerton Sand Project: Flora and Vegetation Studies. Unpublished report prepared for John Consulting Services.

Mattiske, E.M. and Associates 1993b Gwalia Consolidated Limited - Kemerton Sand Project Updated Flora and Vegetation Report. Unpublished report prepared for John Consulting Services.

Powell R 1990 *Leaf and Branch*. Department of Conservation and Land Management, Perth, Western Australia.

Safstrom, R and Craig, G 1996 Environmental Evaluation of Native Vegetation in the Wheatbelt of Western Australia. Principles and Criteria Used to Appraise Land Clearing Proposals. Unpublished report for the Department of Environmental Protection.

Semeniuk, V&C Research Group 1997 *Verification of the Conservation Category Wetlands in the Perth Metropolitan Area*. Unpublished report for the Water and Rivers Commission, Perth WA.

SMEC 2002 Wellington Location Lot 1 Sand Excavation Environmental Assessment and Management Plan. Unpublished report for David Partridge Pty Ltd and Ian Partridge Pty Ltd.

Thackway, R and Cresswell, ID 1995 (Eds) *An Interim Biogeographic Regionalisation for Australia: A framework for establishing the national system of reserves, Version 4*. Australian Nature Conservation Agency, Canberra ACT.

Water Authority of Western Australia - refer to WAWA.

Water and Rivers Commission – refer to WRC

Western Australian Herbarium 2001 *Florabase – Information on the Western Australian Flora*. Department of Conservation and Land Management

WRC 1996a GIS *Basin and Channel Wetlands* after Hill *et al.* 1996b. Water & Rivers Commission, Perth, Western Australia.

WRC 1996b GIS *Consanguineous suites* after Hill *et al.* 1996b. Water & Rivers Commission, Perth, Western Australia.

WRC 1996c GIS *Conservation Category Wetlands* after Hill *et al.* 1996b. Water & Rivers Commission, Perth, Western Australia.

WRC 1997b GIS *Verified Conservation Category Wetlands* after Semeniuk, V&C Research Group 1997. Water & Rivers Commission, Perth, Western Australia.

WRC 2000 GIS *Geomorphic Wetlands –Wedge Island to Busselton*. Water & Rivers Commission, Perth, Western Australia.

## ANNEXURE 1

### Curriculum Vitae

#### 1. Personal Particulars

Name: **Bronwen Jean Keighery** (nee Banyard)  
Date of birth: 10th September 1951  
Address: 224 Hamersley Rd SUBIACO WA. 6008  
Telephone: 3814062  
Marital Status: Married (1973) with three children

#### 2. Qualifications

Bachelor of Science from the University of Western Australia with majors in Botany and Zoology and First Class Honours in Botany, 1969-1972.  
Diploma of Education, Teaching Certificate and Diploma of Teaching from the University of Western Australia and the Nedlands Secondary College, 1973

#### 3. Experience

##### 1971 - 97 Botanist/Consultant Botanist

##### Areas of expertise

- **Vegetation and flora survey:** general assistance flora survey in south west, road survey (preconstruction and roadsides), rare flora survey, regional and area survey for the identification of conservation areas on the Swan Coastal from Moore River to Dunsborough, System 6/1 Update/Perth's Bushplan technical work
- **Urban Bushland:** joint author of pivotal discussion paper on identification and values of urban bushland in WA, identification of threats to urban bushland and management to alleviate these threats
- **Educator on vegetation and flora:** university tutor/demonstrator, package activities for primary school students, plant survey book, workshops, seminars etc on vegetation and flora and management of bushland, workshop coordination
- **Taxonomic work:** cytogenetics studies, assisted with the revision of the Genus *Baeckea*, *Astartea* and *Scholtzia* (Myrtaceae), Australian Biological Resources Study.
- **Independent assessor to the Australian Heritage Commission**

##### 1997 - 2004 Current employment

Senior Environmental Officer (Level 6/4) with the Department of Environmental Protection in Conservation Branch (Policy Coordination Division) with the following areas of responsibility: project coordinator System 6/1 Update/Perth's Bushplan in DEP (principal author of Volume 2 of Perth's Bushplan and Bush Forever); flora and vegetation regional and area survey for the identification of conservation areas on the Swan Coastal from Moore River to Dunsborough for System 6/1 Update/Perth's Bushplan and general conservation and vegetation and flora issues for the Department.

#### Reports

(This is not a complete listing of reports but is indicative of the breadth of areas covered.)

Clarke K and Keighery BJ 1999 *Vegetation Assessment of Part Bushplan Site 378 – Henderson Airfield, Lot 164 Yangedi Rd, Peel Estate.*

Clarke K and Keighery BJ 1999 *Preliminary Vegetation Assessment Lot 2 Rowley Rd, Lot 111 ? Rd and Lot 264 Lake Rd, Part of Bushplan Site 345 – Forrestdale Lake & Adjacent Bushland, Forrestdale.*

Clarke K and Keighery BJ 1999 *Assessment of Proposed Additional Bushland Areas – Errina Road Bushland, Alexander Heights.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000a *Preliminary Vegetation Assessment of Part Bushplan Site 196 – Gnangara Road Bushland, Landsdale/ Cullacabardee Telstra's Perth International Telecommunications Centre in Relation to a Proposed Negotiated Planning Solution.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000b *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 125 - Holmes Street Bushland, Southern River/Huntingdale.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000c *Preliminary Vegetation Assessment Lots 4 & 5 Armadale Rd, Part of Bushplan Site 345 – Forrestdale Lake & Adjacent Bushland, Forrestdale.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000d *Vegetation Assessment of Bushplan Site 70 – Duckpond Bushland, Peel Estate.* Unpublished report prepared for the Ministry for Planning.

Clarke K and Keighery BJ 2000e *Preliminary Vegetation Assessment of the City Beach High School, Part of Bushplan Site 312 – Bold Park and Adjacent Bushland, City Beach.* Unpublished report prepared for the Ministry for Planning.

Keighery BJ 1993a *A Report for the Belmont City Council on the Heritage Value of some Urban Bushland areas within the City.*

Keighery BJ 1993b *Swan Coastal Plain Survey, 1990 - 93.* A Report to the Wildflower Society of WA for the National Estate Program.

Keighery BJ 1993c *Bushland Plant Survey - Plant Community Survey for the Community.* A Report to the Wildflower Society of WA for the National Estate Program.

Keighery BJ 1994 *Objection Assessment of the values of the flora of the Hepburn Heights - Pinnaroo Park Area.* An unpublished report for the Australian Heritage Commission

Keighery BJ 1995a *Objection Assessment of the values of the flora and vegetation of the Beelihar Wetlands.* An unpublished report for the Australian Heritage Commission

Keighery BJ 1995b *Knowing and Managing the Brixton Street Wetlands.* Unpublished report for the Friends of Brixton Street and the Perth Branch of the Wildflower Society.

Keighery BJ 1995c *Natural Areas at the Pearce Airforce Base, Western Australia.* Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995d *Vegetation and Flora of Lot 139 Brentwood Road, Kenwick (part Threatened and Poorly Reserved Community area Brixton 1)*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995e *Vegetation and Flora Report for ACTIV— an area recognised as in need of interim protection under the System Six Update program*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995f *Vegetation and Flora Report for Lot 106 Wanaping Road, Kenwick, part interim protected area under the System Six Update Program*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995g *Department of Environmental Protection System 6 Update program: Flora List and Vegetation Notes for M52, Perth Airport*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1995h *Description of the Vegetation of part Pearce 4 — Area to the North and South of Kimberley Street*. Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1996a *Flora Information for Roadside Protection Plans in the Shire of Serpentine - Jarrahdale*. Unpublished report to the Roadside Care Volunteers, Shire of Serpentine - Jarrahdale.

Keighery BJ 1996b *A description of remnant vegetation of Bennett Brook (System Six Area M41)*. Report prepared for the Department of Environmental Protection, Perth, Western Australia.

Keighery BJ 1999a *Assessment of Proposed Additional Bushland Areas – Lot 10 Flynn Drive, Neerabup*. Unpublished report prepared for the ministry of Planning.

Keighery BJ 1998 *Vegetation and Flora Conservation Values of the Kemerton Silica Sands Project Area*. Unpublished report for the Department of Environmental Protection.

Keighery BJ 2000 *Conservation assessment of part lot 52 on plan 16832 (Certificate of title volume 2112 folio 88) based on information available prior to 5<sup>th</sup> May 1998*. Unpublished report for the Department of Environmental Protection to the Crown Solicitor's Office, Western Australia.

Keighery BJ 2001 *Review of Expert Environmental Documents for *TRANDOS v WESTERN AUSTRALIAN PLANNING COMMISSION: SUPREME COURT 2353 OF 1999: PART LOT 52 BURNS BEACH ROAD (FORMERLY LOT 9), NEERABUP**. Unpublished report for the Department of Environmental Protection to the Crown Solicitor's Office, Western Australia.

Keighery BJ and Clarke K 1999b *Detailed Assessment of Values for a Negotiated Planning Solution Part Bushplan Site 303 - Pinnaroo Cemetery Bushland*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K. 2000a *Assessment of Proposed Additional Bushland Areas – Lot 204 Lyon Road, Banjup*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K. 2000b *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 270 - Sandy lake and Adjacent Bushland, Anketell*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ and Clarke K. 2000 *Detailed Assessment of Values for a Negotiated Planning Solution Bushplan Site 342 - Anstey/Keane Dampland and Adjacent Bushland, Forrestdale*. Unpublished report prepared for the Ministry for Planning.

Keighery BJ, Gibson N and Keighery GJ. 1997 *The regional Significance of the Flora and Vegetation of Garden Island*. IN: The proceedings of the Environment and Energy Conference, Royal Australian Navy Directory of Environmental Management, April 1997.

Keighery BJ, Keighery GJ and Santich S. 2002 *A description of natural values of the south Bunbury to Capel coastal corridor*. Unpublished report for the Department of Environmental Protection, Western Australia.

Keighery BJ, Keighery GJ Gibson N and Gunness, AG. 2001. *The vegetation and flora of the Quairading Nature Reserve, Shire of Quairading*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ. 1992 *Burns Beach*. Unpublished report to the Department of Conservation and Land Management, Western Australia.

Keighery GJ and Keighery BJ. 1995 *Muchea Limestones - Floristics*. Unpublished report to Australian Nature Conservation Authority National Reserves Network and the Department of Conservation and Land Management, Western Australia.

Keighery GJ and Keighery BJ. 1996 *Vegetation and Flora of Lambkin Reserve, Serpentine (Reserve 32352)*. An unpublished report for the Department of Conservation and Land Management.

Keighery GJ and Keighery BJ. 1998 *Floristics of System Six Reserves and Bushland. Part XVI: Point Heathcote Foreshore (M65), Minim Cove (M 57), Mosman Park (M56), Peppermint Grove Foreshore (M 54) and Point Resolution (M59)*. Unpublished report for the Departments of Conservation and Land Management and Environmental Protection, Perth, Western Australia.

Keighery GJ and Keighery BJ. 2000 *Flora of the Greater Brixton St Wetlands*. IN: Marshal, J (ed) 2000 *The Greater Brixton St Wetlands Management Guidelines, Natural History and Research*. Unpublished report for the Friends of Brixton St Wetlands and the World Wide Fund for Nature.

Keighery GJ, Keighery BJ and Gibson N. 1994 *Vegetation and Flora of CTCR 53*. An unpublished report for Department of Environmental Protection, Shire of Waroona and the Department of Conservation and Land Management.

Keighery GJ, Keighery BJ and Gibson N 1997 *Flora and Vegetation of Dardanup Forest Block*. An unpublished report for Department of Environmental Protection and the Department of Conservation and Land Management.

Keighery BJ and Trudgen, ME 1992 *The Remnant Vegetation of the Eastern Side of the Swan Coastal Plain* A Report to the Department of Conservation of Land Management for the National Estate Program.

Trudgen ME and Keighery BJ 1990a *A Report on the Flora and Vegetation of the Alkimos area and Conservation Issues affecting it*. Unpublished report for Landcorp, WA.

Trudgen ME and Keighery BJ 1990b *A Report on the Flora and Vegetation of the Ningana area and Conservation Issues affecting it*. Unpublished report for Landcorp, WA.

Trudgen, ME, Griffin EA. and Keighery BJ 1990 *A Report on the Flora and Vegetation of areas at Wilbinga and Breton Bay proposed as alternatives for a future industrial site*. Unpublished report for Halpern Glick and Maunsell.

Trudgen, M. and Keighery BJ 1994 *The Remnant Vegetation in the City of Gosnells*. A Report to the City of Gosnells.

## **Publications**

### **A. Authored Publications**

Banyard BJ and James SH 1979 Biosystematic Studies in the *Stylidium crassifolium* Species Complex (Stylidiaceae) Aust. J. Bot., 27, 27-37

Gibson N and Keighery BJ (Editors) 1992 *Bushland in Our Backyard*. Proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Gibson N, Keighery BJ, Keighery GJ and Burbidge AH 1994 *Effects of Urban Living on Plant Communities*. In Proceedings National Greening Aust. Conference - A Vision for a greener City. The Role of Vegetation in Urban Environments Editor M. Scheltema.

Gibson N, Keighery BJ, Keighery GJ, Burbidge A and Lyons M. 1994 *A Floristic survey of the southern Swan Coastal Plain* A Report to the Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Gibson N, Keighery GJ and Keighery BJ 1997 *Contributions of NH. Speck to the biogeography of Proteaceae in Western Australia*. Journ. Royal Society Western Australia.80: 73-77.

Gibson N, Keighery GJ and Keighery BJ 2000 Threatened plant communities of Western Australia. 1. The ironstone communities of the Swan and Scott Coastal Plains. *Journal of the Royal Society of Western Australia* 83: 1-12.

Gibson N, Keighery GJ, Lyons MN and Keighery BJ 2003 Threatened plant communities of Western Australia. 2. The argillaceous vernal pools of the south west. In preparation.

Gibson N, Keighery BJ, and Griffin EA 2002 *The occurrence of Tuart in plant communities on the Swan Coastal Plain*. In Keighery BJ and Longman VM (Editors) 2002 Tuart (*Eucalyptus gomphocephala*) and Tuart Communities. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 126 - 146.

Griffin, EA and Keighery BJ 1989 *Moore River to Jurien Sandplain Survey*. WA Wildflower Society, Nedlands, WA 90 pages

Keighery BJ 1991 *Sharing a Wonderful Dream*. Wildflower Society and Library and Information Services, Perth.

Keighery BJ 1994a *Bushland Plant Survey*. A guide to plant community survey for the community. Wildflower Society of WA, Nedlands, WA.

Keighery BJ 1994b *Regional Conservation Assessment*. In Proceedings of the Public Forum concerning the State Government's Draft Urban Bushland Strategy. Urban Bushland Council (WA).

Keighery B. J. and Gibson N 1992 *Who is Managing Urban Bushland?* In Bushland in Our Backyard. Proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Keighery BJ and Gray M. 1992 *Towards an Urban Bushland Policy for the National Trust (WA)*. A Discussion Paper. In National Trust (WA) Urban Bushland Policy.

Keighery BJ and Huston J. 1994 *Our Wild Plants*. A Package of Information and Activities for Primary School on Native Plant Communities. Greening Western Australia. .

Keighery BJ and Keighery GJ 1995 *Management Guidelines for Urban Bushland and Fire Effects*. In Burning our Bushland, edited by J Harris, Urban Bushland Council (WA).

Keighery BJ, Keighery GJ and Gibson N 2003 *Vernal Pools of South-Western Australia*. In abstracts for the on the Conference on Comparative Biology of Monocotyledons, 31<sup>st</sup> March to 4<sup>th</sup> April 2003 at the Rancho Santa Ana Botanic Gardens, California USA.

Keighery BJ, Keighery GJ Gibson N and Gunness AG 1999 *Knowing and Understanding the Plants in our Bushland*. In K Tullis and K McLean (editors) 1999 Managing Our Bushland. Proceedings of a 1998 conference on the protection and management of urban bushland. Urban Bushland Council (Inc), Perth, WA.

Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Keighery BJ, Keighery GJ and Gibson N 1995a *Community participation in Bushland Plant Survey in Western Australia*. In Nature Conservation 4: The Role of Networks edited by DA Saunders JL, Craig and EM Mattiske. Surrey Beaty and Sons , Chipping Norton, NSW.

Keighery BJ, Keighery GJ and Gibson N 1995b *Floristics of Reserves and Bushland Areas of the System Six Region Part X: Floristics of Lowlands*. Wildflower Society of Western Australia (Inc.), Nedlands..

Keighery BJ, Keighery GJ and Gibson N 1996c *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1996d *Part II: Floristics of the Ambergate Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1996e *Part IV: Floristics of the Capel Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997a *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997b *Part XI: Floristics of the Mundijong Road Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997c *Part XIII: Floristics of the Neerabup National Park*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Gibson N 1997d *Part XIV: Floristics of the Lakes Coo loongup and Walyungup Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery BJ, Keighery GJ and Shepherd D 2002 *The Distribution and Conservation of Tuart and the community with which it lives*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 6 - 86.

Keighery BJ and Pieroni, M. 1989 *Gum Tree Pack*. Western Australian Wildflower Society, Nedlands, WA 40 pages

Keighery GJ, Harvey, JM and Keighery BJ 1990 *The Vegetation and Flora of Bold Park*. West. Aust. Naturalist 18:100-122

Keighery GJ and Keighery BJ, 1991. *Floristics of Reserves and Bushland Areas of the System Six Region II. Brixton Street Wetlands, Kenwick*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts II-IV*. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1992 *Plant Communities of the Northern Swan Coastal Plain - with special reference to uncommon and potentially Rare Plant Communities*. In Bushland in Our Backyard. proceedings of a workshop held by the Wildflower Society of WA June, 1992.

Keighery GJ and Keighery BJ 1993a. *Part VII: Floristics of Three Bushland Areas on the Eastern Side of the Swan Coastal Plain* In Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1993b *Part VIII: Floristics of Wandj Nature Reserve*. In Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1993c *Part IX: The Flora of Three Coastal Bushland Areas (System 6 Areas M46, M91 and M106)*. In Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts V-IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ and Keighery BJ 1996a Rediscovery of *Schoenus natans* (Cyperaceae). W.A. Naturalist 21: 65 - 68.

Keighery GJ and Keighery BJ 1996b Biology, Biogeography and Conservation of *Franklandia* R.Br. page 29, Abstracts of the International Conference on the Biology of the Proteaceae, University of Melbourne, 29 Sept. to Oct. 2, 1996.

Keighery BJ and Keighery GJ 2003 *Juncaginaceae in Western Australia*. In abstracts for the Third International Conference on Comparative Biology of Monocotyledons, 31<sup>st</sup> March to 4<sup>th</sup> April 2003 at the Rancho Santa Ana Botanic Gardens, California USA.

Keighery GJ, Keighery BJ and Gibson N 1996 *Part I: Floristics of the Carbinup Bushland*. In *Floristics of Reserves and Bushland Areas of the Busselton Region (System 1)*. Parts I - IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1996 *Part II: Floristics of the Ruabon Nature Reserve*. In Floristics of Reserves and Bushland Areas of the Busselton Region (System 1). Parts I - IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Gibson N and Keighery BJ 1997 *Part XII: Floristics of the Seabird Bushland*. In Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1997 *Part XIII: Floristics of Bullsbrook Nature Reserve*. In Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Gibson N and Keighery BJ 1997 *Part XII: Floristics of the Seabird Bushland*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Keighery GJ, Keighery BJ and Gibson N 1997 *Part XII: Floristics of Bullsbrook Nature Reserve*. In *Floristics of Reserves and Bushland Areas of the Perth Region (System 6)*. Parts XI - XV. Wildflower Society of Western Australia (Inc.), Nedlands.

Lamont B, Keighery BJ, Penny L and Wallace J 1987 A numeric, geographic and structural analysis of the *Hakea falcata* group (Proteaceae) *Botanical Journal of the Linnean Society*, 94: 433-451

Longman VM and Keighery BJ 2002 *Tuart Issues*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 292 - 330.

Powell, R and Keighery BJ 1995 *Soil types and plant communities of the Perth metropolitan region*. In *Managing Perth's Bushland*, Eds: Scheltema, M and Harris, J., Greening Western Australia.

Powell R and Keighery BJ 2002 *Tuart in the Landscape*. In Keighery BJ and Longman VM (Editors) 2002 *Tuart (Eucalyptus gomphocephala) and Tuart Communities*. Perth Branch Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia. Pages 279 - 286.

Powell R and Keighery BJ 2003 *Cherish the Tuart*. *Landscape*, Volume 18 No 4 Autumn 2003. Department of Conservation and Land Management. Perth, WA

## **B. Government and EPA Planning and Policy Publications**

Key:

# principal contributor  
\* contributor

# Environmental Protection Authority (EPA) 2002 *A Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme portion of the Swan Coastal Plain*. Environmental Protection Authority. Perth, WA.

\* Environmental Protection Authority (EPA) 2003 *Guidance for the Assessment of Environmental Factors No. 10. Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of System 1 region* Environmental Protection Authority, WA.

\*Government of WA 1998a *Perth's Bushplan Volume 1*. Published by the Western Australian Planning Commission, Perth, WA.

#Government of WA 1998b *Perth's Bushplan Volume 2: Directory of Bush Forever Sites* Published by the Department of Environmental Protection, Perth, WA.

\*Government of WA 2000a *Bush Forever Volume 1: Policies Principles and Processes*.  
Ministry for Planning, Perth, Western Australia.

#Government of WA 2000b *Bush Forever Volume 2: Directory of Bush Forever Sites*.  
Department of Environmental Protection, Perth, Western Australia.

Bronwen Keighery  
October 2004

## KEIGHERY Bronwen

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**From:** KEIGHERY Bronwen  
**Sent:** Thursday, 7 October 2004 4:50 PM  
**To:** 'Linda Rowley'  
**Subject:** Partridge Witness Statements

Dear Linda

Attached are both John and my witness statements. If you need to contact us tomorrow please get back to John rather than myself. John will be able to contact me.

Regards Bronwen



ANNEXURE



ANNEXURE



REVISED-WITNESS PartridgeWS\_B\_Kei



1BJK\_Partridge.doc 2BJK\_Partridge.doc TATEMENT-JOHN... ghery.doc

**Bronwen Keighery**

*Senior Environmental Officer*

*Terrestrial Ecosystem Branch*

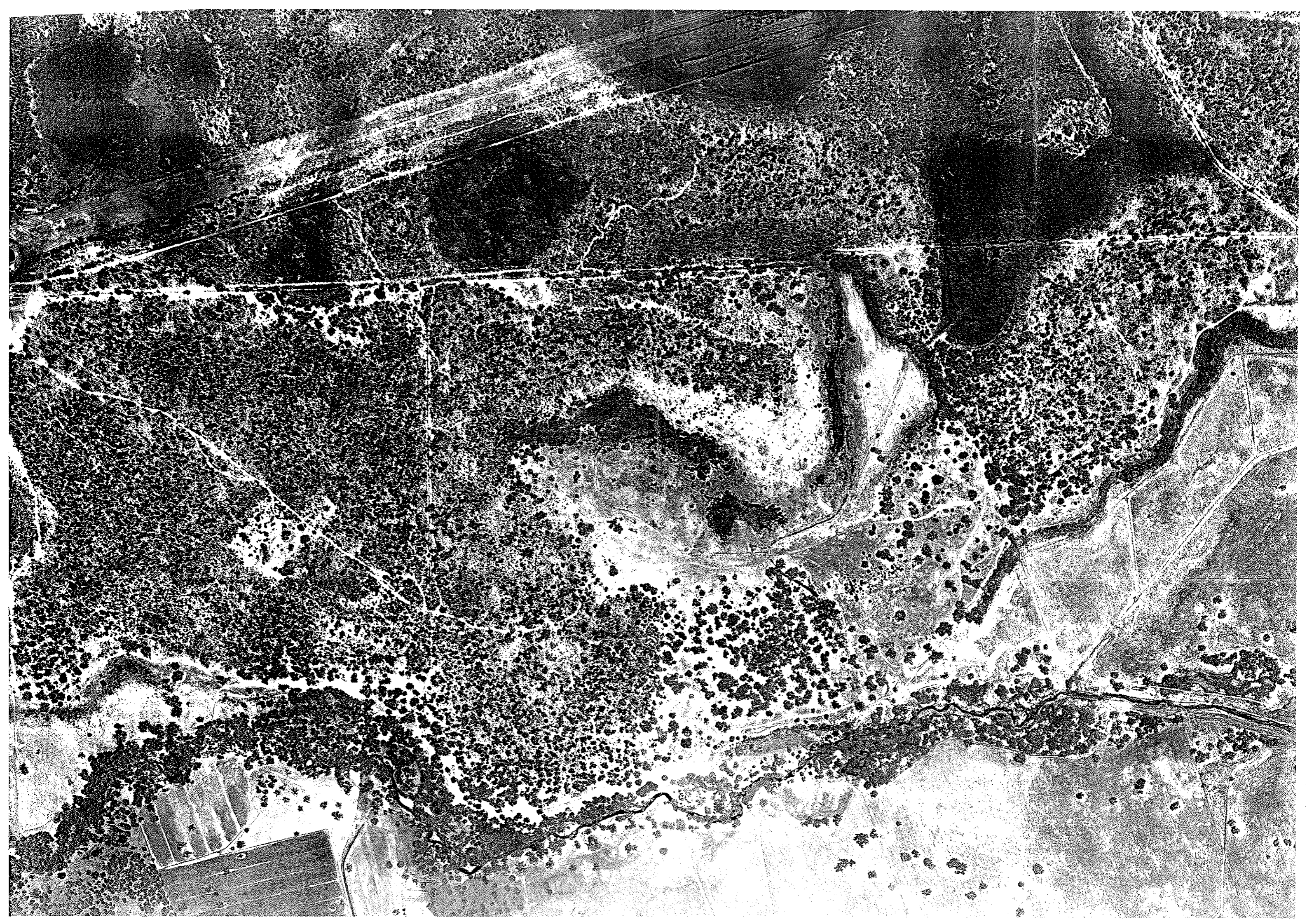
*Policy and Coordination Division*

*EPA Service Unit*

*Department of Environment*

*Telephone 9222 7028*

*Fax 9322 2850*



EJK Oct 2004



Uplands

Wellington Location 1 Cot 1

Kemerton 'Wellington'

Wetlands



Wetland



Wetland - palustrine



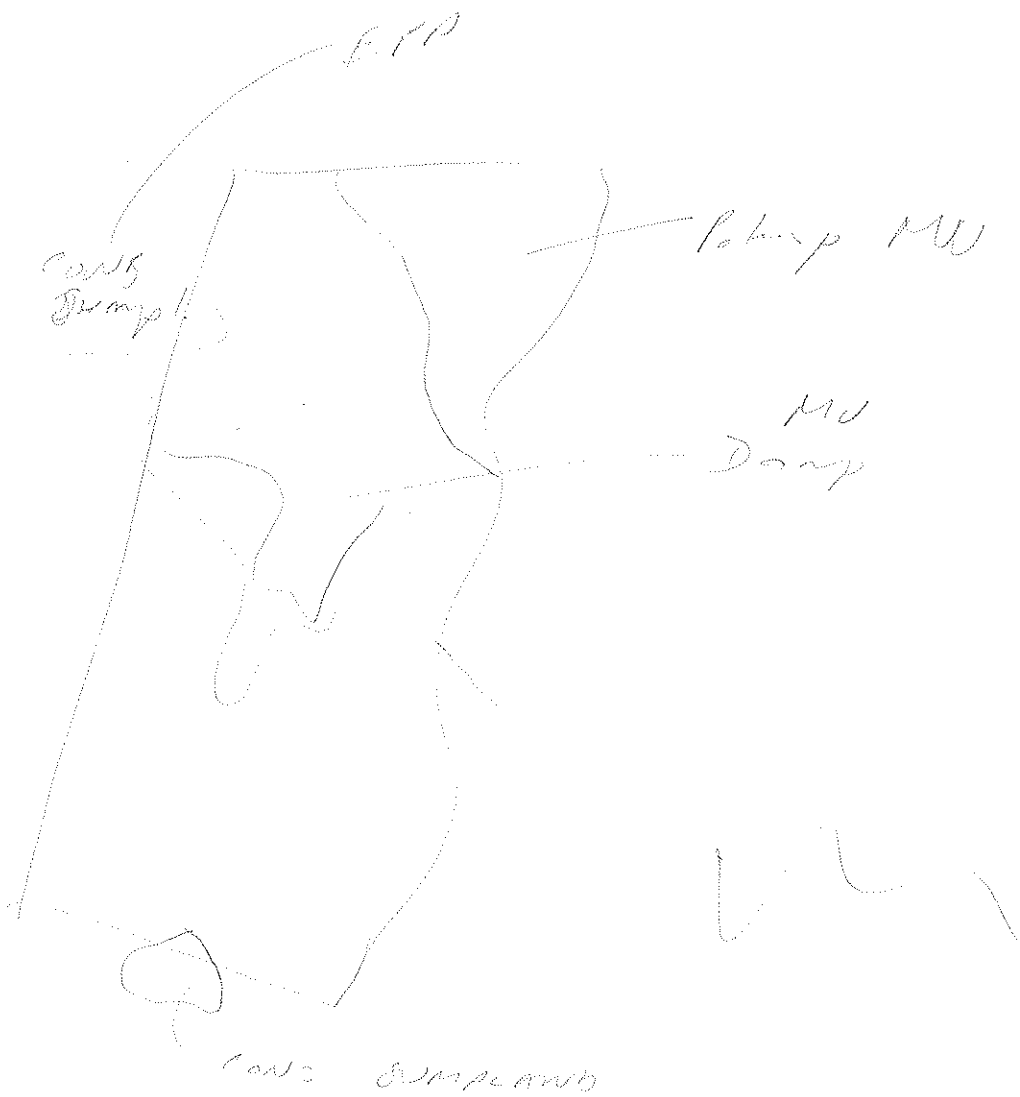
Possible wetlands, need further ground truthing



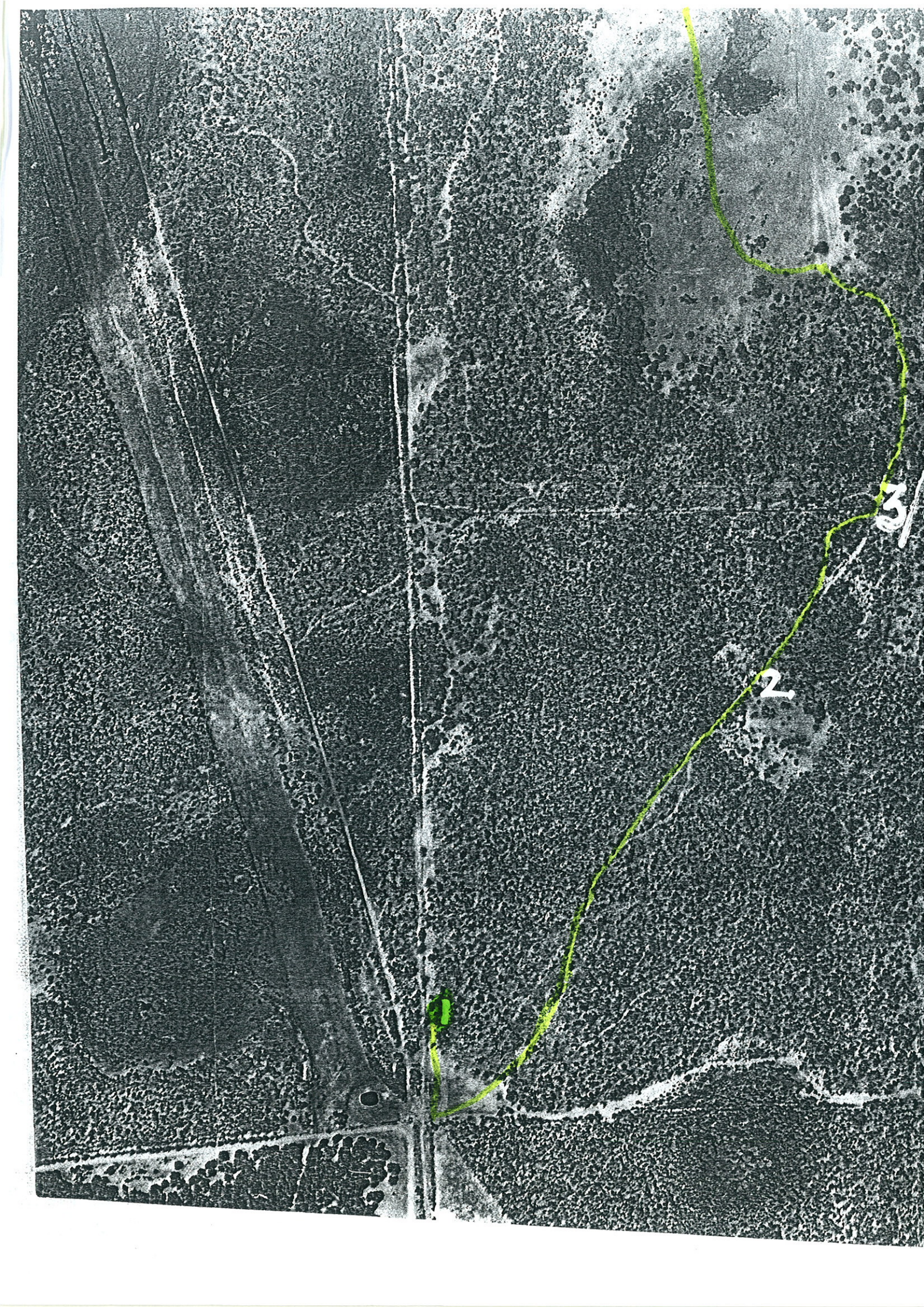
Wetland species - mined area?

Lot 1 Wetlands

Poles Plain



Boe



Stop 5

1273 - Floodplain area

← Stop 3 - Double 'breck'

1269 view E

1270 John's Direction

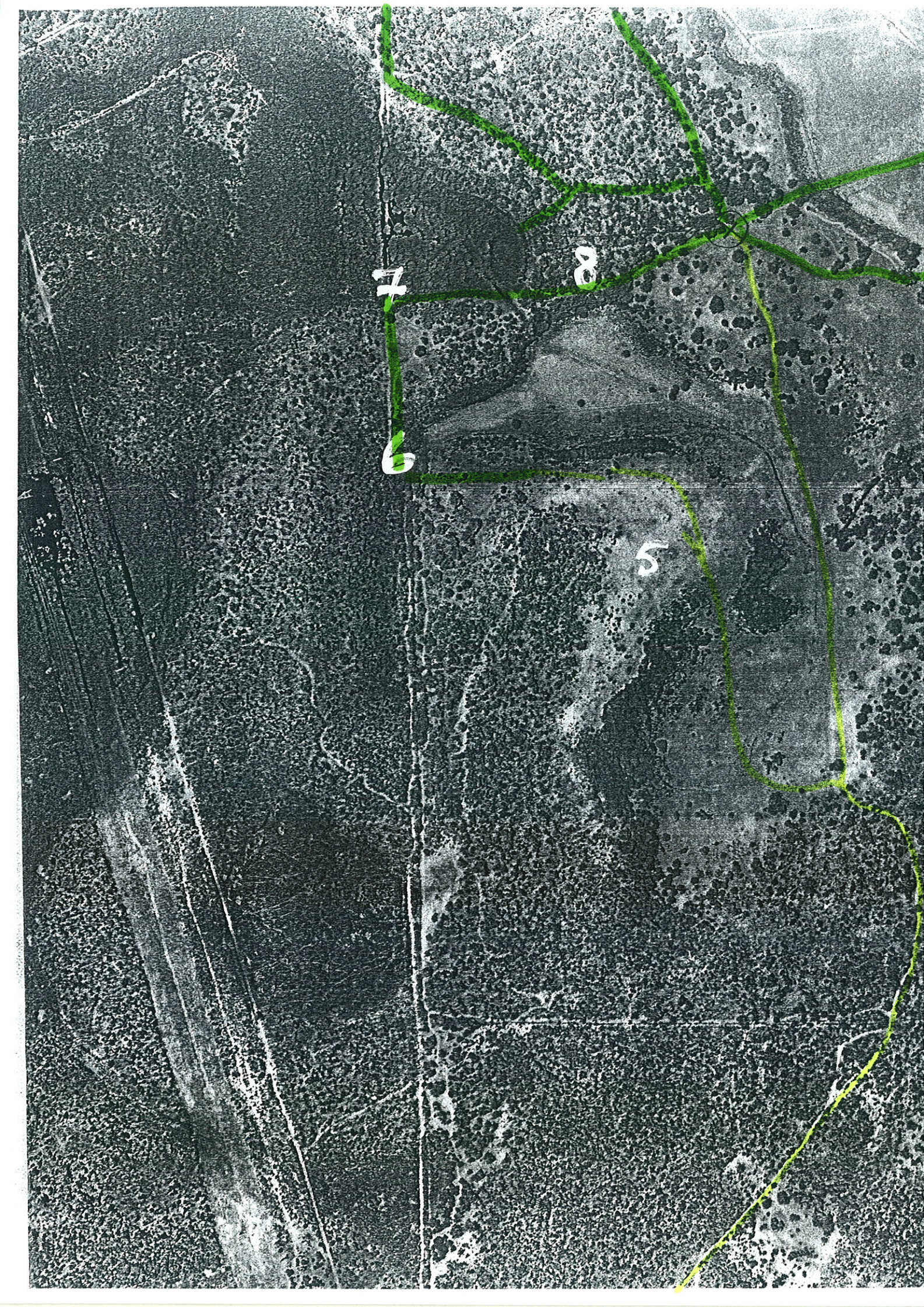
Stop 4 1271 Edge track - incremental clearing

1272 - see Stop 2

Stop 2 Wetland 1.

1266 'wet' area } Mel pui  
1267 Edge above } Memi  
1268 Hyp. argus } Peppermint

1272 - Skink -  
from this area



6

7

8

5

Step 7

- 1278 } Transect N → S
- 1279 } over fence where not
- 1280 } grazed
- 1281 Lot 1 edge - Frog?
- 1282 Wetland 2
- 1294 } Wetland area
- 1295 } Wading (after lunch)
- 1296 }

Step 6

- 1274 - General view
- 1275 - Mel
- 1276 } Acacia
- 1277 }

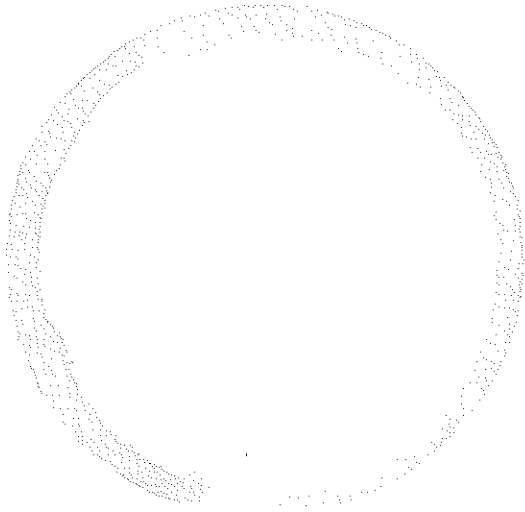
Step 8

- btwn Wetland 2 & Stopping Point
- 1283 (before lunch)
- 1297 } views 1299 (1301) FIS
- 1298 } 1300

Step 9

- Flood plain
- 1284-1285
- Looking back to Step 8 rise
- 1286 River edge N
- 1287 } Pond - Alissina
- 1288 }
- 1289 View over Floodplain E (at Pond area)
- 1290 } Ranunculus
- 1291 }
- 1292 River S
- 1293 River / car





— 1305

Step 11

Step 10

Seep

1302/3 N

130'4 E

Step 12 = Step 1  
but occ Agon's

# WETLANDS OF MAP SHEET 2031 I SW (Harvey SW)



## BASIN AND FLAT WETLANDS

- lake (permanently inundated), estuary (permanently inundated)
- sumpland, floodplain (seasonally inundated), estuary (peripheral)
- dampland, palusplain (seasonally waterlogged)
- other basin wetlands

## CHANNEL WETLANDS

- River (permanently inundated)
- Creek (seasonally inundated)
- Artificial channel
- Gravity or Pressure Drainage Pipes (metro area)

## WETLAND TYPE

- L Lake
- CR Creek
- S Sumpland
- D Dampland
- AL Artificial Lake
- F Floodplain
- P Palusplain
- R River
- EW Estuary (Waterbody)
- E Estuary (Peripheral)
- PS Paluslope

## ZONES OF INFLUENCE

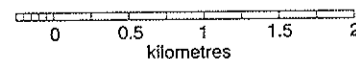
- Zone of Critical Influence 50 metre boundary
- Zone of Secondary Influence 200 metre boundary
- Road Boundary
- Property Boundary

## WETLAND MAP IDENTIFICATION NOS. EG. 12, 320, 678

Map Identification Numbers have been assigned to each wetland according to their type and method of classification. Map Identification Numbers less than 300 represent wetlands mapped by the V & C Semeniuk Research Group for the Water Authority.

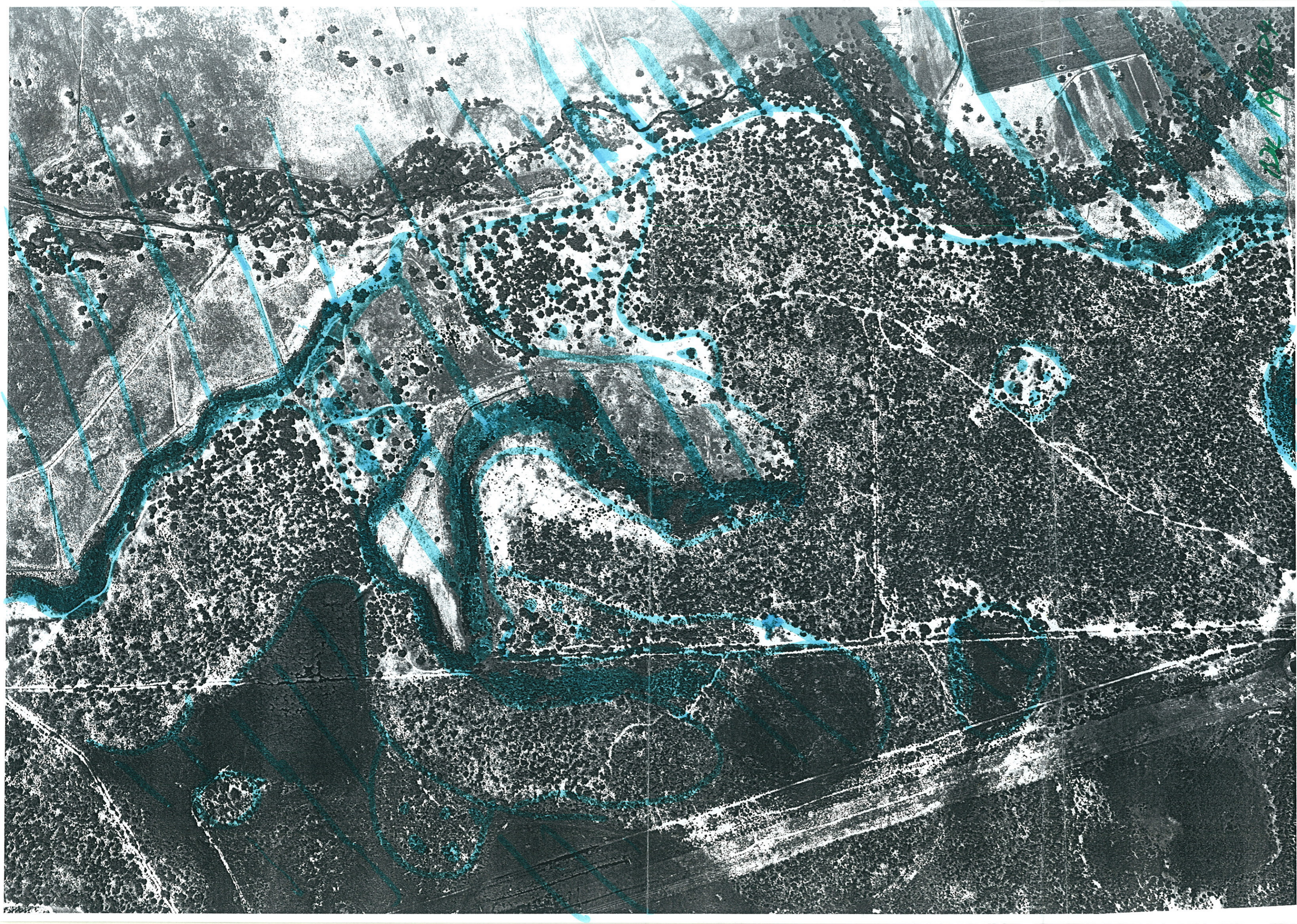
Map Identification Numbers ranging from 301 to 600 have been assigned to basin wetlands (mostly rock pools and dams) and numbers 601 and greater to channel wetlands (rivers, creeks, and artificial channels). Wetlands numbered 301 and greater have been described from complimentary DOLA digital hydrographic mapping.

SCALE 1:50 000



NORTH







5/11/1975

1000

1000

1000

1000

## ENTERED ON GIS

**Name:** Bengier Swamp Nature Reserve Management Plan  
**Date:** 28/04/2006  
**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

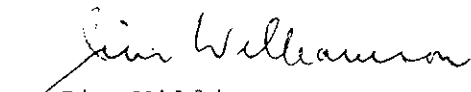
Content – Captured without problems

BENGER SWAMP NATURE RESERVE

MANAGEMENT PLAN

Please find enclosed a copy of the final plan and summary of public submissions for the Benger Swamp Nature Reserve.

This plan was approved by Barry Hodge, Minister for Conservation and Land Management, on 1 December 1987, and will be in effect for 5 years (1987 - 1992).

  
Jim Williamson  
BRANCH MANAGER  
PLANNING

31 December, 1987



Department of Conservation and Land Management, Western Australia

aerial photo  
cadastre  
benger-swamp-nature-reserve  
High!

# *Benger Swamp Nature Reserve Management Plan*



*1987-1992*

**Full document  
available  
on request**

**Management Plan No. 7**



## ENTERED ON GIS

**Name:** Bengier Swamp – Biological Data  
**Date:** 28/04/2006  
**Capture Author:** Thomas Leong

**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
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*Attributes*

Report Info – Captured without problems

Custodial/Contact – Captured without problems

Content – Captured without problems

**AREA INFORMATION**

System 6 Area (C or M) or Update Area (Update)

C65

DJK 17/5/95

<b>Conservation Area</b>
Nature Reserve
Reserve No
National Park
Reserve No
Local Government
Reserve No C34211 for cons Flora + Fauna - WA Wildlife Auth.
Other
<b>Proposed Conservation Areas</b>
Local Government
Reserve No
Other Dep Fisheries + Wildlife (AOI) + private.

**Conservation Area**

Nature Reserve
Reserve No
National Park
Reserve No
Local Government
Reserve No
Other

**TOTAL AREA**

Bushland Area	system boundaries	968.125	hectares	CALM boundaries	608.125
Completely Degraded		771.9375 ha			420.125
Typha flats and pasture, scattered Melaleucas					

**AREA MAPPED FLORISTIC UNITS**

Units	Site (Condition)	Code	Bound	Boundaries	
				System 6	CALM
Area (ha)	Area (ha)				
?13	NO SITES, whole area		B	196 1875	178.00
	degraded Melaleucas understory				
	generally lacking condition 4-5,				
	mostly 5				
	Note: boundaries approximately				
	based vege map (CALM 1986)				
	and to give 'reasonable' area.				

Boundaries determined by use of

aerial photograph	NO AERIAL PHOTO
orthophoto	2031 1 SW Aug 1991
vegetation map	part area CALM 1986
soil map	

R. A. O. U. TRACKING DATABASE

23/06/96

PARK SIGHTINGS REPORT

Page No. 1

Benger Swamp (C65)

ORDER:	REF:	BIRD NAME		NO. SIGHTINGS
0018	0216	Blue-billed Duck	3	1
0019	0217	Musk Duck	3	1
0022	0203	Black Swan		1
0025	0207	Australian Shelduck		1
0028	0202	Australian Wood Duck		1
0032	0208	Pacific Black Duck		1
0033	0212	Australasian Shoveler	3	1
0035	0211	Grey Teal		1
0039	0213	Pink-eared Duck	3	1
0040	0215	Hardhead	3	1
0041	0061	Australasian Grebe		1
0042	0062	Hoary-headed Grebe		1
0129	0100	Little Pied Cormorant		1
0132	0097	Little Black Cormorant		1
0135	0106	Australian Pelican		1
0139	0188	White-faced Heron		1
0145	0187	Great Egret		1
0155	0197	Australasian Bittern		1
0157	0179	Australian White Ibis		1
0158	0180	Straw-necked Ibis		1
0170	0228	Whistling Kite	4	1
0174	0219	Swamp Harrier		1
0186	0237	Peregrine Falcon	1	1
0187	0240	Nankeen Kestrel		1
0204	0058	Purple Swamphen		1
0208	0059	Eurasian Coot		1
0233	0154	Wood Sandpiper	2	1
0386	0294	Australian Ringneck		1
0387	0290	Red-capped Parrot		1
0397	0307	Elegant Parrot		1
0471	0532	Splendid Fairy-wren	3	1
0524	0476	Inland Thornbill	3	1
0537	0638	Red Wattlebird		1
0583	0597	Brown Honeyeater		1
0653	0401	Rufous Whistler		1
0671	0415	Magpie-Lark		1
0673	0361	Grey Fantail		1
0676	0364	Willie Wagtail		1
0678	0424	Black-faced Cuckoo-shrike		1
0683	0430	White-winged Triller		1
0691	0546	Black-faced Woodswallow	3	1
0695	0702	Grey Butcherbird		1
0698	0705	Australian Magpie		1

(1) 1  
 (2) 1  
 (3) 8  
 (4) 1

			Page No.	
0706	0930	Australian Raven	1	
0725	0647	Richard's Pinit	1	
0763	0357	Welcome Swallow	1	
0765	0355	Tree Martin	1	
0768	0824	Clamorous Reed-Warbler	1	
0772	0522	Little Grassbird	1	
0781	0574	Silvereye	1	

\*\*\* END OF REPORT \*\*\*

SUMMARY REPORT

TOTAL BIRDS SIGHTED	8	30
TOTAL NUMBER OF CARDS	8	1

\*\*\* END OF SUMMARY \*\*\*

C.65



N →

- Metaleuca
- Completely Degraded (G)

--- CALM MP  
veg map boundary  
most land  
been repaired

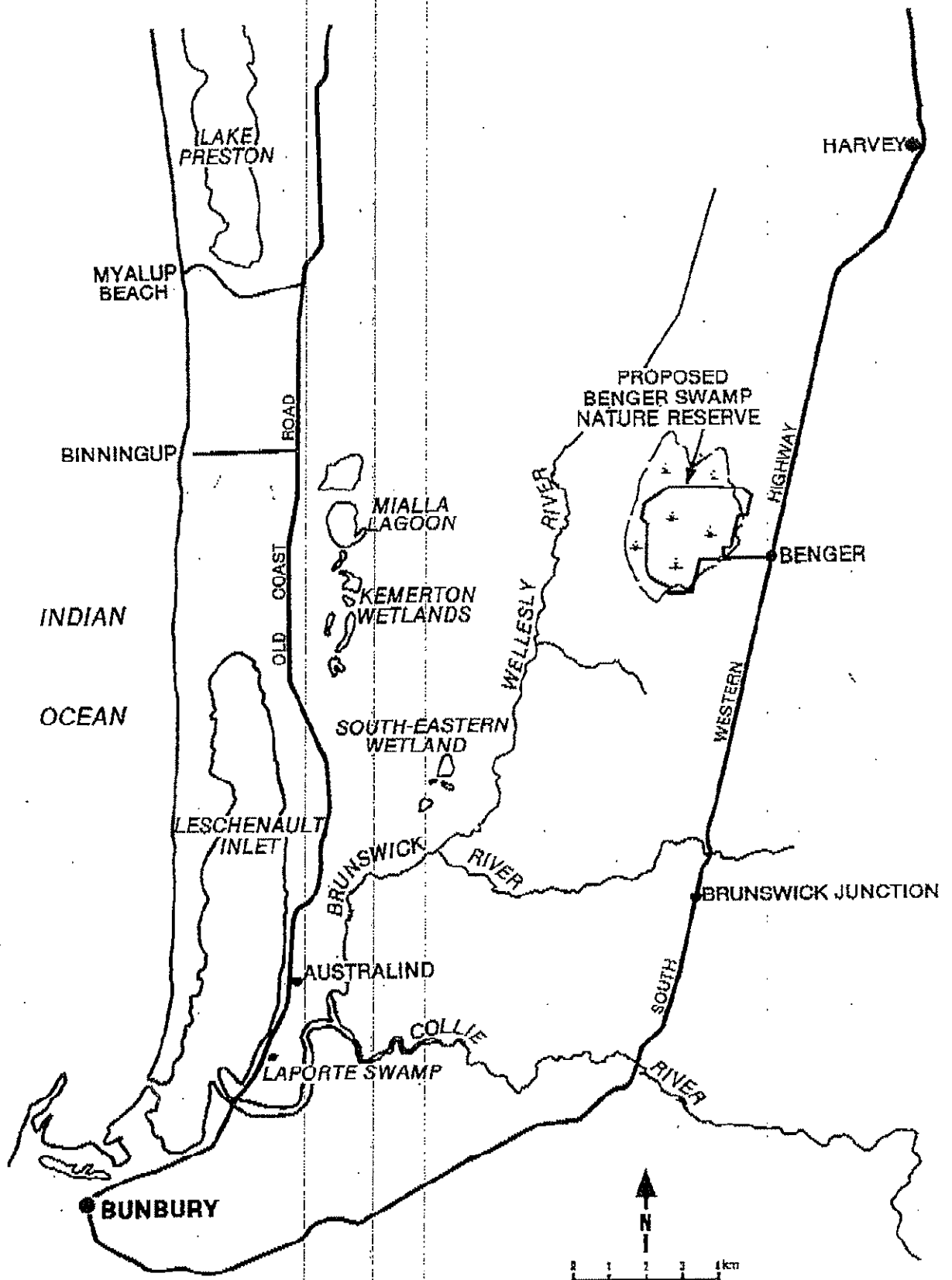


Figure 1. Location of the proposed Benger Swamp Nature Reserve and major regional wetlands.

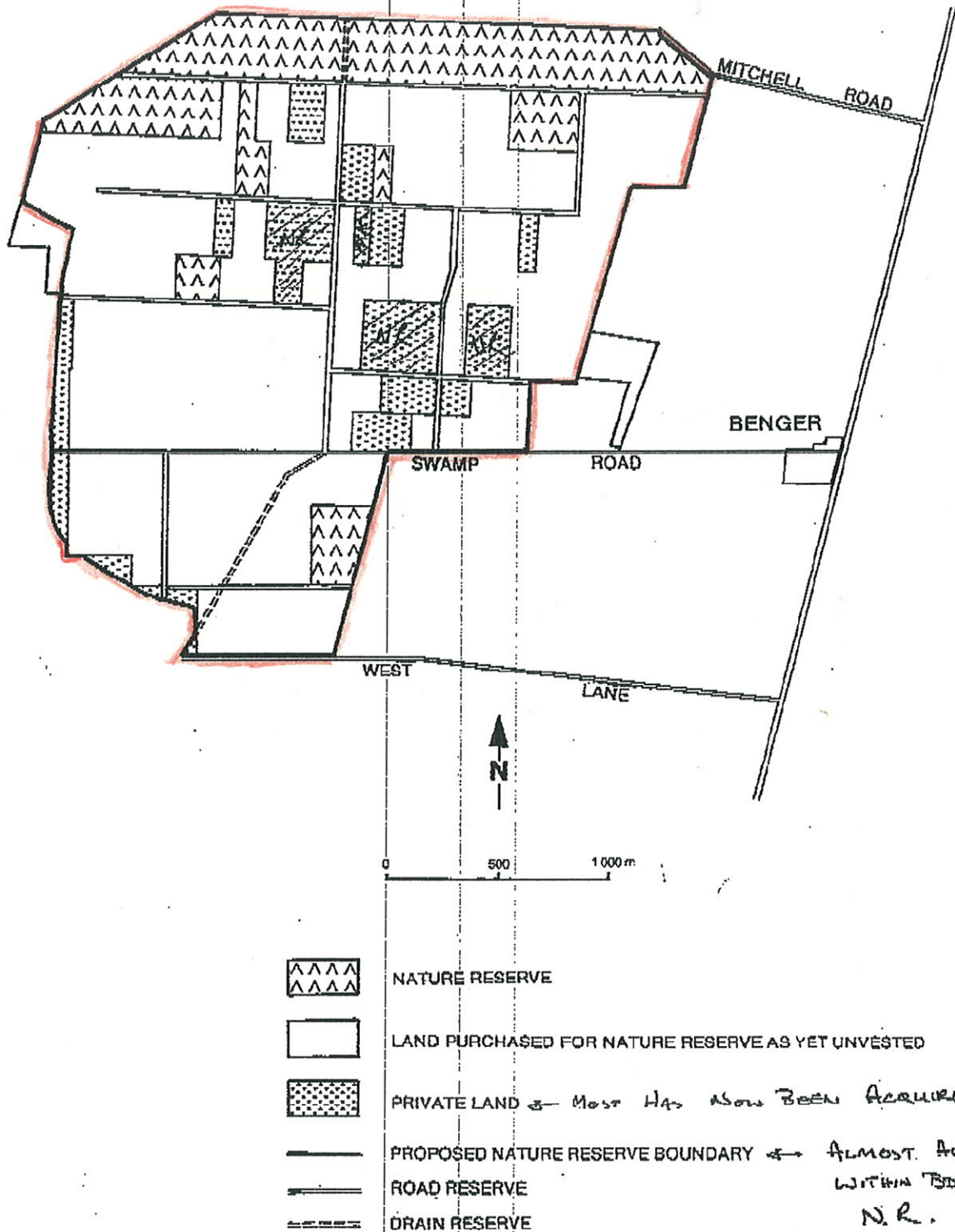


Figure 2. Land tenure of the proposed Benger Swamp Nature Reserve (July 1987).

from: CALM 1986 Benger Swamp Nature Reserve Draft Management Plan

Syst6 library C65.1

18/5/95

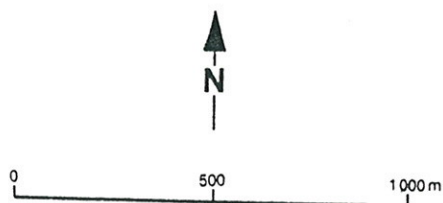
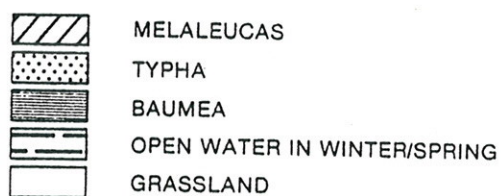
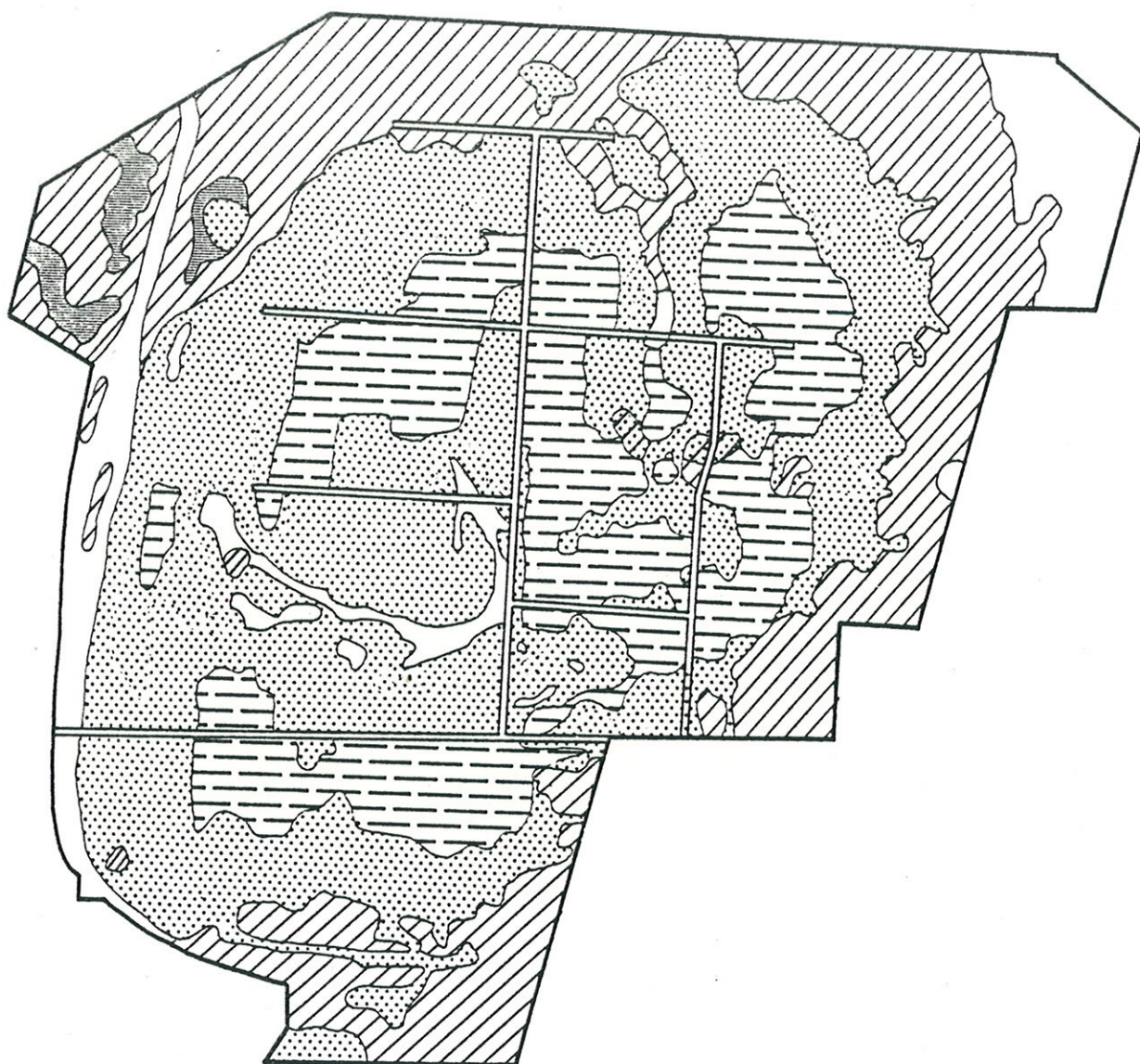


Figure 10. Vegetation of the proposed Benger Swamp Nature Reserve, 1986.