
**FLORA AND VEGETATION SURVEY OF THE
PROPOSED KWINANA TO AUSTRALIND
GAS PIPELINE
INFRASTRUCTURE CORRIDOR**

Prepared for:

**Bowman Bishaw Gorham and
Department of Mineral and Petroleum Resources**

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TABLE OF CONTENTS

	Page
1. SUMMARY.....	1
2. INTRODUCTION	2
2.1 Location.....	2
2.2 Climate	2
2.3 Vegetation.....	3
2.4 Declared Rare and Priority Flora.....	3
2.5 Local and Regional Significance	5
2.6 Threatened Ecological Communities.....	6
3. OBJECTIVES	6
4. METHODS	6
4.1 Flora.....	7
4.2 Vegetation.....	7
5. RESULTS	7
5.1 Flora.....	7
5.2 Conservation Status of the Flora.....	8
5.3 Vegetation.....	9
5.4 Significant Vegetation Communities.....	13
6. DISCUSSION.....	13
6.1 Flora.....	13
6.2 Vegetation.....	16
6.2.1 Communities and Disturbance	16
6.2.2 Significance of Vegetation.....	16
6.3 Plant Diseases	17
7. RECOMMENDATIONS.....	18
8. LIST OF PARTICIPANTS	19
9. ACKNOWLEDGEMENTS	19
10. REFERENCES	20

TABLES

- 1: Definition of Rare and Priority Flora Species (Department of Conservation and Land Management 2003)
- 2: Categories of Threatened Flora Species (Environmental Protection and Biodiversity Conservation Act 1999)
- 3: Summary of Location of Priority Species along the alignment of the Kwinana to Australind Infrastructure Corridor
- 4: Total Number of Vegetation Communities along the Kwinana to Australind Infrastructure Corridor
- 5: Specific Requirements for Declared Plant control and landholder obligations (WA Department of Agriculture, 2002)

FIGURES

- 1: Legend Map to Vegetation Communities along Proposed Corridors
- 2-27: Vegetation Maps

APPENDICES

- A: Vascular Plant Species recorded on proposed Kwinana to Australind Pipeline, October 2002 – October 2003
- B: Vascular Plant Species in Vegetation Communities on proposed Kwinana to Australind Pipeline Route, 2002 – 2003

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Bowman Bishaw Gorham on behalf of the Department of Industry and Resources Gas Pipeline Working Group to review the vegetation of the proposed gas pipeline infrastructure corridor from Kwinana to Australind. The proposed project was undertaken to review the option of expanding the existing corridor as compared with alternative options. The proposed parallel corridors traverse some 125 kilometres. The area surveyed is located within the Darling Botanical District of the Southwest Botanical Province (Beard 1990).

The survey of the flora and vegetation values was based on aerial photograph interpretation and on further field studies carried out on the ground, as required. A total of 69 families, 195 genera and 326 plant taxa (including varieties and subspecies) were recorded within the survey area. Species representation was greatest amongst families Myrtaceae, Papilionaceae, Proteaceae and Poaceae, a flora composition typical of the Darling Botanical District.

No plant species listed as Declared Rare Flora under the Wildlife Conservation Act (1950) were located during the survey. No plant species listed as Vulnerable, Threatened, Endangered or Critically Endangered under the EPBC Act (1999) were located during the survey.

One Priority Four species (*Acacia flagelliformis*), one Priority Three species (*Acacia semitrullata*) and one Priority One species (*Boronia juncea* subsp. *juncea*) were located within the proposed corridor alignment. It is recommended that further fieldwork be undertaken in the specific areas and vegetation communities that support these endangered species during the construction phase to determine any methods that can minimize disturbance to the native vegetation.

Seventy-nine introduced species were observed in the survey area. Some of these species are particularly aggressive and therefore require management so that infestations do not spread or intensify during operational activities. These include the declared plants (under Section 37 of the Agriculture and Related Resources Protection Act, 1976). Paterson's Curse (*Echium plantagineum*), Cotton Bush (*Gomphocarpus fruticosus*), Prickly Pear (*Opuntia* spp.), Blackberry (*Rubus fruticosus*) and Arum Lily (*Zantedeschia aethiopica*). Consequently, there is a need to maintain vehicle hygiene and cleaning operations to limit the spread of weeds in the project areas. Several of the introduced species (not native to Western Australia) were planted in paddocks and rehabilitation areas along the route.

A total of forty-two vegetation communities were recorded on the infrastructure corridor.

Seven vegetation communities are defined as locally significant. The locally significant communities are associated with the presence of Priority Flora, restricted or isolated remnants and the presence of flora exhibiting range extension.

The Threatened Ecological Community (C2 which is equivalent to 3a community as defined by Gibson *et al.* 1994 and recommended for listing by English and Blyth 1997 and 1999; occurred on five localized areas on the alignment. However the community was very degraded and in most cases only the occasional *Corymbia calophylla* or *Kingia australis* plants were present.

Consequently the pockets of C2 community were so disturbed, fragmented and small that they were considered to be not sustainable, nor regarded of any value. This community is listed pursuant to Schedule 2 of the Environmental Protection Biodiversity Conservation Act (1999); however in view of the degree of degradation there should be no need for referral to Environment Australia.

Many of the vegetation communities occurring within the corridor are classified as Degraded (5) according to the standardized scale commonly used in the Perth Metropolitan area and in Bush Forever publications (Keighery, 1994). These are communities occurring as fragments within grazing paddocks in the southern dairy farming areas.

Based on relative conservation values of the various alternative routes recommendations have been made as to the preferred alternative routes. The key issues appear to relate to the Leda section of the route where the route options are constrained and choices have to be made between loss of vegetation in reserves, conservation category wetlands and an EPP lake. The majority of the remaining route has relatively low native biological values, as large sections on the central and eastern option for the southern section near Bunbury and Australind. have been largely cleared and/or disturbed and through the Kemerton area the route largely follows already cleared alignments, tracks or paddocks.

2. INTRODUCTION

2.1 Location

Mattiske Consulting Pty Ltd was commissioned by Bowman Bishaw Gorham on behalf of the Department of Industry and Resources Gas Pipeline Working Group to review the vegetation of the proposed gas pipeline infrastructure corridor from Kwinana to Australind. The proposed project was undertaken to review the options of expanding the existing corridor as compared with alternative route options. The area surveyed is located within the Darling Botanical District of the Southwest Botanical Province (Beard 1990).

The survey was conducted by several botanists from Mattiske Consulting Pty Ltd in a series of field trips from October 2002 to October 2003. The multiple surveys occurred as result of alternative routes formulated by environmental officers from Bowman Bishaw Gorham.

2.2 Climate

The Darling Botanical District experiences a Dry Mediterranean climate with 5-6 dry months each year. The Dry Mediterranean climate falls in the relatively humid zone of the southwest (Beard 1990).

2.3 Vegetation

The survey area lies within the Darling Botanical District of the Southwest Botanical Province (Beard 1990) and thus exhibits characteristics of this province.

Dominant plant families within the Drummond Botanical Sub-district of the Darling Botanical District include Proteaceae (*Grevillea*, *Banksia*), Myrtaceae (*Eucalyptus*, *Melaleuca*) and Mimosaceae (*Acacia*). The Drummond Botanical Sub-district is characterised by *Banksia* woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) on less leached soils (Beard, 1990).

2.4 Declared Rare and Priority Flora

In general, legislation regulates the destruction of indigenous flora. The prohibition of picking wildflowers exists in most circumstances unless special authorization is obtained. Uncontrolled disturbance of indigenous flora would lead to the destruction of some species, particularly of those that are more susceptible to the effects of picking than others.

The Department of Conservation and Land Management assign conservation status to flora that are restricted geographically or threatened by local processes. Regulations aim to protect populations and conserve species.

Declared Rare Flora species are gazetted under section 2 of section 23F of the Wildlife Conservation Act (1950) and therefore it is an offence to “take” or damage rare flora without Ministerial approval. Section 23F of the Wildlife Conservation Act (1950) defines “to take” as “... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means”. Those species listed as Declared Rare Flora may not be taken without the specific written approval of the Minister for the Environment. This prohibition applies equally to both Crown and private land; to licensed and unlicensed persons; and to the owners and occupiers of land on which rare flora is found (Department of Conservation and Land Management 2003).

As there is a large Western Australian flora, there are many species that are known from only a few collections, or a few sites, but which have not been adequately surveyed. Such flora may be rare or threatened, but cannot be considered for declaration as rare flora until such survey has been undertaken. These flora species are included on a supplementary conservation list called the Priority Flora List. Priority Flora species are under consideration for declaration as ‘rare flora’ but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents a definition of Declared Rare and the four Priority Flora ratings.

Table 1: Definition of Rare and Priority Flora Species (Department of Conservation and Land Management 2003)

Conservation Code	Category
R	<p>Declared Rare Flora – Extant Taxa</p> <p>“Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.”</p>
P1	<p>Priority One – Poorly Known Taxa</p> <p>“Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey.”</p>
P2	<p>Priority Two – Poorly Known Taxa</p> <p>“Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as ‘rare flora’, but urgently need further survey.”</p>
P3	<p>Priority Three – Poorly Known Taxa</p> <p>“Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as ‘rare flora’ but need further survey.”</p>
P4	<p>Priority Four – Rare Taxa</p> <p>“Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.”</p>

Threatened species are a matter of national environmental significance under the Environmental Protection and Biodiversity Conservation Act (1999). A person must not take an action that has, will have, or is likely to have a significant impact on a listed threatened species or ecological community, without approval from the Commonwealth Minister for the Environment and Heritage. Table 2 presents the definitions of the categories of threatened species under the EPBC Act (1999).

Table 2: Categories of Threatened Flora Species (Environmental Protection and Biodiversity Conservation Act 1999)

Category Code	Category
Ex	Extinct Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

2.5 Local and Regional Significance

Vegetation communities are referred to as Locally Significant where the presence of Priority Flora species has been recorded, where they provide a range extension of particular taxa from previously recorded locations, or where they are very restricted to one or two locations or occur as small isolated communities. In addition, communities that exhibit unusually high structural and species diversity are also of Local Significance (Mattiske, pers. comm.).

Vegetation communities are referred to as Regionally Significant where they are limited to specific landform types, are uncommon or restricted vegetation community types within the regional context, or support populations of Declared Rare Flora significance (Mattiske, pers. comm.).

2.6 Threatened Ecological Communities

Communities are described as ‘Threatened Ecological Communities’ (TEC’s) if they have been defined by the Western Australian Threatened Ecological Communities’ Scientific Advisory Committee and found to be Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). For definitions of TEC categories and criteria refer to English and Blyth (1997, 1999).

Selected vegetation communities have also been listed as “Threatened Ecological Communities” under the EPBC Act (1999). The TEC’s at the national level are defined on the Environment Australia website (www.ea.gov.au).

3. OBJECTIVES

The general objective of this project was to describe and define the botanical values associated with the proposed gas pipeline infrastructure corridors from Kwinana to Australind for Bowman Bishaw Gorham on behalf of the Department of Industry and Resources Development Gas Pipeline Working Group. The specific objectives of the flora and vegetation survey were to:

- collect and identify the vascular plant species present in the field survey area,
- search for any rare, endangered or significant flora species,
- review the conservation status of the vascular plant species by reference to current literature and current listings by the Department of Conservation and Land Management (2003) and plant collections held at the State Herbarium and current listings associated with the Environmental Protection Biodiversity Conservation Act (1999),
- identify any weed species present,
- define and map the plant communities present,
- review the local and regional significance of the plant communities recorded,
- assess relative conservation values of the various alternative routes, and
- prepare a report that summarizes the findings.

4. METHODS

The vegetation of the Kwinana to Australind infrastructure corridors was surveyed following the pipeline alignments by all accessible tracks and where time permitted, traversing areas on foot. Field surveys were conducted between October 2002 and October 2003 by botanists from Mattiske Consulting Pty Ltd. The multiple surveys occurred as result of the alternative routes formulated by environmental officers from Bowman Bishaw Gorham.

The recording sites were selected in areas, which supported native species. Detailed recordings were undertaken to identify baseline structure of communities and further sites were recorded where local variation occurred. Aerial photography was then used to extrapolate the distribution of the vegetation and the community boundaries.

4.1 Flora

A database search was undertaken of records held by the Department of Conservation and Land Management for Declared Rare and Priority Flora species likely to occur in the vicinity of the project area. Relevant species were examined at the Western Australian State Herbarium prior to the field survey being undertaken.

The flora of the survey area was described and collected systematically at each survey site by botanists from Mattiske Consulting Pty Ltd during field trips from October 2002 to May 2003. All plant specimens collected during the field survey were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified and then compared with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded follows the Western Australian Herbarium (2003) database.

4.2 Vegetation

The vegetation communities occurring along the survey corridor were described in detail. The use of a standard data collection form ensured the data was collected in a systematic and consistent manner. At each site the following records were made: topography, percentage litter cover, soil type, percentage of bare ground, outcropping rocks and their type, pebble type and size, and time since fire. For each species recorded, the average height and percent foliage cover of species both alive and dead was noted.

Aerial photography was used to extrapolate and map plant communities in combination with running notes made during the course of the survey. The vegetation maps and descriptions provided in this report includes all vegetation communities occurring within the infrastructure corridors.

5. RESULTS

5.1 Flora

A total of 69 families, 195 genera and 326 plant taxa (including varieties and subspecies) have been recorded along the various Kwinana to Australind proposed gas pipeline infrastructure corridors (Appendix A). Within these families, the genera *Eucalyptus*, *Melaleuca* and *Banksia* are predominant in the Woodland communities and *Agonis* and *Astartea* were predominant in the shrubland communities. Among the perennial plant population, the Myrtaceae and Proteaceae contained the greatest number of taxa and typify the remnant *Eucalyptus* Woodlands of the southwest region

A total of seventy-nine introduced species were observed in the route option areas (Appendix A). Five of these were Declared Plants under Section 37 of the Agriculture and Related Resources Protection Act (1976), those being Arum Lily (*Zantedeschia aethiopica*), Blackberry (*Rubus fruticosus*), Cotton Bush (*Gomphocarpus fruticosus*), Paterson's Curse (*Echium plantagineum*) and Prickly Pear (*Opuntia* sp.). Several of the introduced species (not native to Western Australia) were planted in paddocks and rehabilitation areas along the route.

5.2 Conservation Status of the Flora

No plant species listed as Declared Rare Flora under the Wildlife Conservation Act (1950) were located during the survey. No plant species listed as Vulnerable, Threatened, Endangered or Critically Endangered, under the EPBC Act (1999) were located during the survey.

The Priority Four species, *Acacia flagelliformis* was found in only one location within the proposed corridor alignments whilst the Priority Three species, *Acacia semitrullata* was found to occur in a number of locations within a number of vegetation communities along the proposed corridors. One Priority One species, *Boronia juncea* subsp. *juncea* was located in a number of locations within the proposed corridor alignments. It is recommended that further fieldwork be undertaken in the specific areas and vegetation communities that support these endangered species during the construction phase to determine any methods that can minimise disturbance to the native vegetation.

The recorded locations of the Priority species are summarised below in Table 3.

Table 3: Summary of Location of Priority Species along the alignment of the Kwinana to Australind Infrastructure Corridor

* Note that all locations are in WGS84.

Priority Species	Conservation Status	MGA mE	MGA mN
<i>Boronia juncea</i> subsp. <i>juncea</i>	P1	384831	6331840
		386651	6328707
		386707	6330653
		387300	6334560
<i>Acacia semitrullata</i>	P3	384438	6320945
		384523	6320925
		384550	6331840
		384620	6331800
		384640	6330340
		385270	6338653
		385340	6323032
		386200	6336000
		386958	6340798
		386637	6336388
		386645	6336262
386721	6330941		
388636	6351340		
<i>Acacia flagelliformis</i>	P4	384610	6330650

Marsdenia velutina was located within communities G4 and G5 which occur on all the proposed Leda section routes of the proposed gas pipeline corridor. This species was found approximately 2200km outside its previously recorded range, with the closest recorded occurrences being located in the Eastern Kimberley and far North Kimberley coast. This species is acting as an introduced species in this environment.

5.3 Vegetation

A total of 42 vegetation communities were recorded along the proposed routes for the alignment of the Kwinana to Australind gas pipeline infrastructure corridor. The vegetation communities recorded on the alignment have been grouped into twelve structural groups for the project area (Table 4).

Table 4: The Total Number of Vegetation Communities along the Kwinana to Australind Infrastructure Corridor

Group	Total Communities
<i>Agonis flexuosa</i> Woodlands and Forests	2
<i>Banksia</i> Woodlands	6
<i>Corymbia calophylla</i> Woodlands	7
<i>Eucalyptus rudis</i> Woodlands	6
<i>Eucalyptus marginata</i> subsp. <i>marginata</i> Woodlands	6
<i>Eucalyptus gomphocephala</i> Woodlands	5
<i>Eucalyptus decipiens</i> Woodlands	1
<i>Kunzea ericifolia</i> subsp. <i>ericifolia</i> Shrublands	2
<i>Melaleuca</i> Woodlands	4
Closed Heath	3
Sedgeland	1
TOTAL	42

The vegetation communities recorded in the project area are defined below with the community descriptions based on Beard (1990). The species recorded in each community are summarised in Appendix B.

Eucalyptus rudis Woodlands

- R1: Disturbed Low Open Woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* over *Pteridium esculentum* and pastoral grasses.
- R2: Disturbed Low Open Woodland of *Eucalyptus rudis* - *Corymbia calophylla* over *Melaleuca preissiana*, *Melaleuca raphiophylla* and *Taxandria linearifolia* over pastoral grasses in association with watercourses.
- R3: Disturbed Low Open Woodland of *Eucalyptus rudis* - *Corymbia calophylla* over *Kunzea ericifolia* subsp. *ericifolia* over pastoral grasses.
- R4: Disturbed Low Open Woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* with pockets of *Corymbia calophylla* over pastoral grasses.
- R5: Disturbed Low Open Woodland of *Eucalyptus rudis* over *Melaleuca preissiana* with *Juncus pallidus* in depressions, over pasture grasses.
- R6: Woodland of *Eucalyptus rudis* – *Melaleuca raphiophylla* over *Melaleuca teretifolia* and *Astartea fascicularis* over *Lepidosperma longitudinale*.

Corymbia calophylla Woodlands

- C1: Disturbed Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* – *Melaleuca raphiophylla* over *Xanthorrhoea preissii*, *Viminaria juncea*, **Gladiolus caryophyllaceus* and pastoral grasses.
- C2: Disturbed Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* over *Kingia australis* and *Hypocalymma angustifolium* over pastoral grasses.
- C3: Low Woodland of *Corymbia calophylla* over *Xanthorrhoea preissii*, *Dasypogon bromeliifolius* and *Adenanthos meisneri*.
- C4: Disturbed Open Woodland of *Corymbia calophylla* - *Eucalyptus rudis* over *Agonis flexuosa* over pastoral grasses.
- C5: Disturbed Low Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* over *Taxandria linearifolia*, *Astartea fascicularis*, *Baumea articulata* and *Juncus pallidus* over pastoral grasses.
- C6: Disturbed Low Open Woodland of *Corymbia calophylla* - *Eucalyptus marginata* subsp. *marginata* - *Banksia menziesii* - *Allocasuarina fraseriana* over *Kunzea ericifolia* subsp. *ericifolia* over pasture grasses.
- C7: Disturbed Low Open Woodland of *Corymbia calophylla* - *Eucalyptus wandoo* over *Melaleuca preissiana* over pasture grasses.

Eucalyptus marginata subsp. marginata Woodlands

- M1: Disturbed Open Woodland of *Eucalyptus marginata* subsp. *marginata* over *Cartonema philydroides*.
- M2: Open Woodland of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* over *Kunzea ericifolia* subsp. *ericifolia*, *Pericalymma ellipticum* and *Acacia pulchella* var. *glaberrima* over Poaceae species.
- M3: Open Woodland of *Eucalyptus marginata* subsp. *marginata* - *Banksia ilicifolia* - *Banksia grandis* - *Banksia littoralis* and *Nuytsia floribunda* over *Kunzea ericifolia* subsp. *ericifolia*, *Acacia pulchella*, *Stirlingia latifolia*, *Xanthorrhoea preissii* and *Dasypogon bromeliifolius*.
- M4: Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia attenuata* and *Banksia grandis* over *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Aotus procumbens*, *Macrozamia riedlei*, *Dasypogon bromeliifolius* and *Bossiaea eriocarpa*.
- M5: Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia attenuata* - *Banksia grandis* and *Xylomelum occidentale* over *Kunzea ericifolia* subsp. *ericifolia*, *Hibbertia hypericoides*, *Daviesia incrassata* subsp. *incrassata*, *Brachyloma preissii*, *Persoonia saccata* and *Acacia willdenowiana*.

Eucalyptus gomphocephala Woodlands

- G1: Open Woodland of *Eucalyptus gomphocephala* - *Corymbia calophylla* over pasture species.
- G2: Open Woodland of *Eucalyptus gomphocephala* - *Allocasuarina fraseriana* over low mixed shrubs and herbs.
- G3: Open Woodland of *Eucalyptus gomphocephala* – *Eucalyptus marginata* subsp. *marginata*– *Banksia* species over low mixed shrubs and herbs.
- G4: Open Woodland of *Eucalyptus gomphocephala* over *Acacia saligna*, *Acacia rostellifera*, *Dryandra sessilis* var. *cygnorum* and low mixed shrubs.
- G5: Open Woodland of *Eucalyptus gomphocephala* over *Acacia* species and *Melaleuca raphiophylla* and low sedges and shrubs.

Eucalyptus decipiens Woodlands

- E1: Low Open Woodland of *Eucalyptus decipiens* - *Banksia littoralis* - *Acacia rostellifera* over *Dryandra sessilis* var. *cygnorum* and low mixed shrubs.

Banksia Woodlands

- B1: Disturbed Low Open Woodland of *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* - *Allocasuarina fraseriana* over low shrubs and pastoral grasses.
- B2: Disturbed Open Woodland of *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* - *Allocasuarina fraseriana* - *Xylomelum occidentale* over *Hibbertia hypericoides*, *Hibbertia huegelii* and *Hyalosperma cotula*.
- B3: Open Woodland of *Banksia attenuata* – *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia*, *Stirlingia latifolia*, *Calytrix fraseri*, *Adenanthos meisneri* and *Dasypogon bromeliifolius*.
- B4: Open Woodland of *Banksia attenuata* – *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia*, *Allocasuarina humilis*, *Stirlingia latifolia* and mixed shrubs.
- B5: Open Woodland of *Banksia attenuata* – *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia* with occasional *Nuytsia floribunda* and *Corymbia calophylla* over *Melaleuca thymoides*, *Calytrix fraseri*, *Acacia pulchella* var. *glaberrima* and mixed shrubs.
- B6: Open Woodland of *Banksia ilicifolia* - *Banksia attenuata* - *Agonis flexuosa* and *Eucalyptus marginata* subsp. *marginata* over dense *Kunzea ericifolia* subsp. *ericifolia* with *Bossiaea eriocarpa*, *Hibbertia hypericoides*, *Dasypogon bromeliifolius*, *Acacia pulchella* and *Patersonia occidentalis*.

Melaleuca Woodlands

- P1: Disturbed Open Woodland of scattered *Melaleuca preissiana* over *Juncus pallidus* and pastoral grasses.

- P2: Disturbed Low Open Woodland of *Melaleuca raphiophylla* - *Melaleuca preissiana* over *Astartea fascicularis* over pasture grasses and sedges.
- P3: Low Open Woodland of *Melaleuca preissiana* and occasional *Eucalyptus marginata* subsp. *marginata* and *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and *Calytrix* species over *Dasypogon bromeliifolius*.
- P4: Low Open Woodland of *Melaleuca preissiana* with either *Agonis flexuosa* or *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and *Calytrix* species over *Dasypogon bromeliifolius*.

Agonis flexuosa Woodlands and Forests

- F1: Open Forest of *Agonis flexuosa* – *Eucalyptus marginata* subsp. *marginata* over grasses.
- F2: Open Woodland of *Agonis flexuosa* with occasional *Banksia attenuata*, *Banksia ilicifolia* and *Nuytsia floribunda* over mixed shrubs.

Kunzea ericifolia subsp. ericifolia Shrublands

- K1: Disturbed Low Shrubland of *Kunzea ericifolia* subsp. *ericifolia* over *Regelia ciliata* over pastoral grasses.
- K2: Tall Shrubland of *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and mixed shrubs over *Meeboldina scariosa*, with occasional emergent *Eucalyptus marginata* subsp. *marginata*, *Banksia attenuata* and *Banksia ilicifolia*.

Closed Heath

- H1: Closed Heath of Myrtaceae species, including *Kunzea ericifolia* subsp. *ericifolia*, *Pericalymma ellipticum*, *Astartea fascicularis* and *Melaleuca* species over *Baumea* and *Meeboldina* species, with occasional emergent trees of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata*.
- H2: Closed Heath of *Pericalymma ellipticum* – *Hypocalymma angustifolium* shrubs over mixed sedges, with occasional emergent *Melaleuca preissiana*, *Nuytsia floribunda* and very occasional *Banksia littoralis* trees.
- H3: Closed Heath of *Astartea fascicularis* – *Calothamnus lateralis* and *Cassytha racemosa* over mixed sedges.

Sedgelands

- S1: Sedgelands of *Baumea*, *Meeboldina* and *Juncus* species over pastures in disturbed areas.

5.4 Significant Vegetation Communities

Vegetation communities B2, B4, B5, C5, H3 and M4 are regarded as Locally Significant due to the presence of *Acacia semitrullata* (P3), Community H2 is regarded as Locally Significant to the presence of *Acacia flagelliformis* (P4) and community H3 is regarded as Locally Significant due to the presence of *Boronia juncea* subsp. *juncea* (P1).

Vegetation Community C2 is regarded as 'Threatened Ecological Communities' (TEC's) as described by English and Blyth (1997, 1999) or under the EPBC Act (1999). Five areas of this community were located during the survey. These were centered at:

6411600 mN 397850 mE
 6406050 mN 397850 mE
 6404800 mN 397850 mE
 6400600 mN 397700 mE
 6400400 mN 397700 mN

The Threatened Ecological Community (C2 which is equivalent to 3a community as defined by Gibson *et al.* 1994 and recommended for listing by English and Blyth 1997 and 1999; this community is also listed at the Federal level under the EPBC Act 1999) occurred on five localized areas on the alignment. However the community was very degraded and in most cases only the occasional *Corymbia calophylla* or *Kingia australis* plants were present. Consequently these pockets were so disturbed and fragmented (small) that they were considered to be not sustainable, nor regarded as of any value. This community is listed pursuant to Schedule 2 of the Environmental Protection Biodiversity Conservation Act (1999). However in view of the degree of degradation, there should be no need for referral to Environment Australia.

Wetlands in the Wellesley area (near Kemerton) are considered to be significant because of the lack of remnant vegetation left on the Swan Coastal Plain and as it provides one of the few opportunities left to link native vegetation corridors (and associated wildlife corridors) from the coast to eastern areas of the Swan Coastal Plain. This area is under increasing pressure from industrial estates, the expansion of the Australind and Bunbury urban areas and from sand and mineral sand operations.

6. DISCUSSION

6.1 Flora

The flora and vegetation assessment undertaken on the Kwinana to Australind infrastructure corridor recorded 69 families, 195 genera and 326 plant taxa, including subspecies and varieties (Appendix A). The low number of taxa recorded during a survey of such relatively large size reflects the high degree of disturbance and the large area of cleared pasture, particularly in the southern portion. The major families recorded reflect the predominant types of vegetation communities recorded. In view of the seasonal conditions and particular period of drought, it is predicted that additional species would be recorded if further survey work were undertaken during other seasons or in more favourable rainfall periods.

No plant species listed as Declared Rare Flora under the Wildlife Conservation Act (1950) were located during the survey. No plant species listed as Vulnerable, Threatened, Endangered or Critically Endangered, under the EPBC Act (1999) were located during the survey. One Priority Four species (*Acacia flagelliformis*), One Priority Three species (*Acacia semitrullata*) and one Priority One species (*Boronia juncea* subsp. *juncea*) were located within the proposed corridor alignment. It is recommended that further fieldwork be undertaken in the specific areas and vegetation communities that support these species during the construction phase to determine any methods that can minimize disturbance to the native vegetation.

The construction staff operating in the area will need to be informed of the recorded locations of the populations of Priority Flora taxa found along the proposed pipeline infrastructure corridor. All operators will also need to be informed of the potential for individual plants likely to be found at additional locations, particularly where the route may alter from that assessed in the present survey.

A high number of weeds are found to occur within the proposed pipeline infrastructure corridors. The abundance of weeds far exceeds the diversity of weed species recorded. This is because a small number of introduced species are common pasture weeds and occur in dense numbers in grazing paddocks. A total of 77 introduced species were identified within the infrastructure corridor. Five of the recorded weed species, Arum Lily (*Zantedeschia aethiopica*), Blackberry (*Rubus fruticosus*), Cotton Bush (*Gomphocarpus fruticosus*), Paterson's Curse (*Echium plantagineum*) and Prickly Pear (*Opuntia* sp.) are listed as declared plants under Section 37 of the Agriculture and Related Resources Protection Act (1976). Declared Plants are weeds, which already are or have the potential to become pest weeds. Declared Plants are classed with a priority rating depending on the level or treatment they require for their control, which differs for each weed in different areas of the state. This priority ranking system should not be confused with the Priority status applied to native plant species under threat of extinction. The specific requirements for Declared Plant control and landholder obligations (WA Department of Agriculture, 2003) are summarized in Table 5.

Arum Lily (*Zantedeschia aethiopica*), Blackberry (*Rubus fruticosus*) and Cotton Bush (*Gomphocarpus fruticosus*) are listed by the WA Department of Agriculture as having P1 and P4 requirements for control. Paterson's Curse (*Echium plantagineum*) is listed as having P1 and P3 requirements.

Prickly Pear (*Opuntia* sp.) is listed as a Declared Plant and has requirements for control and landholder obligations in other areas of the state. However there are no requirements for control of the Prickly Pear in the area of this study.

One of the species located was found to be outside of its normal range of occurrence. *Marsdenia velutina* was recorded within communities G4 and G6. The WA Herbarium currently holds four specimens of *Marsdenia velutina* which each represent a separate population. The closest population of this species is located on Mabel Downs in the East Kimberley (approximately 2200km away), with the remaining three populations being located on the far north Kimberley coast, in the Kalumburu region. A population is considered to exhibit a range extension when it is located more than 100km away from previously recorded populations. This species is acting as an introduced species in this environment.

Within the project area, threats to flora conservation currently include the introduction of exotic plant species (weeds), grazing by domestic stock, feral animals and kangaroos, mining, associated infrastructure and vehicular activity, (not necessarily in the order of degree of threat). In terms of land management and potential impacts on natural resources, addressing these issues may have implications for future land use and nature conservation.

Table 5: Specific Requirements for Declared Plant control and landholder obligations (WA Department of Agriculture, 2003)

(Modified from the WA Department of Agriculture website <http://www.agric.wa.gov.au>)

Specific Requirements	Management Actions
<p>P1</p> <p>Prohibits movement</p>	<p>The movement of plants or their seeds is prohibited within the State.</p> <p>This prohibits the movement of contaminated machinery and produce including livestock and fodder.</p>
<p>P3</p> <p>Aims to control infestation by reducing area and/or density of infestation</p>	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:-</p> <ul style="list-style-type: none"> • Within 100 metres inside of the boundaries of the infestation. • within 50 metres of roads and highwater mark on waterways. • within 50 metres of sheds, stock yards and houses. <p>Treatment must be done prior to seed set each year.</p> <p>Of the remaining infested area:-</p> <ul style="list-style-type: none"> • Where plant density is 1-10 per hectare treat 100% of infestation. • Where plant density is 11-100 per hectare treat 50% of infestation. • Where plant density is 101-1000 per hectare treat 10% of infestation. <p>Properties with less than 2 hectares of infestation must treat the entire infestation.</p> <p>Additional areas may be ordered to be treated.</p>
<p>P4</p> <p>Aims to prevent infestation spreading beyond existing boundaries of infestation.</p>	<p>The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.</p> <p>Treat to destroy and prevent seed set all plants:-</p> <ul style="list-style-type: none"> • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses <p>Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation.</p> <p>Additional areas may be ordered to be treated.</p>

6.2 Vegetation

6.2.1 Communities and Disturbance

A total of forty two vegetation communities were located and mapped within the corridor alignments. The vegetation communities recorded along the Kwinana to Australind infrastructure corridor were not particularly diverse, despite the high number of communities recorded. The high number of communities recorded during this survey reflects the large area surveyed and to some degree the diversity of landforms within the survey area. Many of the vegetation communities differ only slightly from one another and the contrasts are more than likely due to a loss of structure and diversity due to degradation from intensive farming practises throughout much of the survey area, particularly in the southern portion.

The predominant plant communities were *Eucalyptus* Woodlands over various other tree and shrub species. There were also many *Melaleuca* Woodlands and *Banksia* Woodlands, while less common were *Agonis* Woodlands, *Kunzea* Shrublands, Heaths and Sedgeland. Pastures were also very common.

The condition of the vegetation throughout the survey area ranged from Very Good (3) to Degraded (5), in accordance with the condition scale, adapted from *Keighery* (1994) and used for the Perth Metropolitan area in Bush Forever publications (Department of Environmental Protection, 2000). Evidence of disturbance was largely associated with roads, railway lines, powerlines, existing pipeline corridors and variable grazing pressure associated beef and dairy farms, particularly in the southern portion. In most cases, communities described as “Disturbed” exist as fragments within or adjacent to Completely Degraded (6) pasture, containing only introduced pastoral grasses and being completely void of native species. Most of the communities not specifically defined as “Disturbed” should be regarded as being in Good (4) condition, with the exception of communities E1 and G1.

6.2.2 Significance of Vegetation

Seven of the communities recorded in the Kwinana to Australind infrastructure corridor survey area are regarded as significant. Vegetation communities are referred to as locally significant where the presence of priority flora species has been recorded, where they maintain a range extension of particular taxa from previously recorded locations, or where they are very restricted to one or two locations and/or occur as small isolated communities. In addition, communities that exhibit unusually high structural and species diversity are also of local significance.

Vegetation communities are referred to as Regionally Significant where they are limited to specific landform types, are uncommon or restricted community types within the regional context, or are recognized as a threatened ecological community or supports Declared Rare Flora.

Local Significance

Seven vegetation communities supported Priority Flora taxa (communities B2, B4, B5, C5, H2, H3 and M3). Three Priority Flora species have been located within the survey area (Department of Conservation and Land Management, 2001). In general, vegetation communities in which Priority Flora taxa have been recorded are Locally Significant. These should be avoided whenever possible during construction and operational activities.

Regional Significance

The Threatened Ecological Community (C2 which is equivalent to 3a community as defined by Gibson *et al.* 1994 and recommended for listing by English and Blyth 1997 and 1999; this community is also listed at the Federal level under the EPBC Act 1999) occurred on five localized areas on the alignment, however the community was very degraded and in most cases only the occasional *Corymbia calophylla* or *Kingia australis* plants were present.

Consequently the pockets of C2 community were so disturbed and fragmented (small) that these pockets were considered to be not sustainable and not regarded as of any value. This community is listed pursuant to Schedule 2 of the Environmental Protection Biodiversity Conservation Act (1999); however in view of the degree of degradation should not require referral to Environment Australia.

Therefore, none of the communities recorded along the Kwinana to Australind infrastructure corridor were defined as Regionally Significant due to the degree of disturbance in this community.

Degree of Land Clearing

Vegetation communities located in the agricultural areas should be considered both restricted and isolated as they occur in an environment predominantly cleared for primary production. For the most part, vegetation communities described occur as small isolated communities and are very restricted to one or two locations in the survey area.

Therefore, the majority of the vegetation along the routes (with the exception of a few key areas near Leda and Kemerton) has been largely disturbed by agricultural activities, weed invasions, urban expansion and existing infrastructure corridor developments that few sections of the proposed routes are significant in either a local or regional context.

6.3 Plant Diseases

The fungal disease – *Phytophthora cinnamomi* has been confirmed on the low lying wetlands within the Kemerton area of the route alignment and consequently there is a need to take a precautionary approach to all of the vehicle movements along the route to ensure maximum vehicle hygiene is maintained at all times. This dieback has been present for some time and has led to the decline in several susceptible species including *Banksia littoralis* and *Banksia ilicifolia* in these low lying areas.

Therefore every effort should be made to maintain vehicle hygiene measures at all times.

7. RECOMMENDATIONS

The route has been revised on numerous occasions in localised areas so as to minimise the degree of clearing along the alignment. Therefore there is only minimal disturbance to remnant areas of native vegetation, particularly in the agricultural areas. The latter revisions and attempts to minimise the disturbance of native vegetation is in line with the Environmental Protection Authority (EPA) Position Statement No. 2 (Environmental Protection Authority 1999a) and Environmental Protection Authority (EPA) Bulletin 966 (Environmental Protection Authority 1999b).

The width of the clearing along the proposed infrastructure corridor should be kept to a minimum and prior to any earthworks a detailed inspection should be undertaken on the ground by a botanist and engineer to determine any methods that can minimize disturbance to the native vegetation.

Rehabilitation after construction should aim to return disturbed areas to their pre-production state, or better. The following points should be considered in the preparation of a rehabilitation program:

- the spread of invasive weeds and dieback (in less disturbed areas) be minimized by maintaining vehicle hygiene or other suitable means of control;
- any viable seed be collected for future rehabilitation work;
- unnecessary clearing of vegetation beyond that strictly required is avoided, particularly larger trees present through most of the survey area, which provide habitats of many forms and are an integral part of the ecosystem; and
- establishment program for the species through translocation trials or seed collection trials. The latter should be undertaken in consultation with experts in this field (eg. Kings Park Botanic Gardens or the Department of Conservation and Land Management).
- stockpiling of topsoil, log debris and leaf litter removed during clearing for future use in rehabilitation programs in the immediate area. If possible, stockpiled topsoil should be directly replaced on disturbed areas.

The impact of *Phytophthora cinnamomi* presents a major threat to the ecology and conservation of susceptible vegetation communities throughout Western Australia. The occurrence of *P. cinnamomi* is not specific to land tenure. Effective control of *P. cinnamomi* (i.e. detection, research and management, requires the combined efforts of the general public, industries and the federal, state and local government departments (Shearer 1990). With respect to the Kwinana to Australind infrastructure corridor, the key area of concern is in the low-lying swamp and wetland areas along the alignment and more specifically in the Kemerton area.

Tracks need to be rationalised and managed to allow access, yet minimize disturbance to developing and established vegetation. In particular, general access should be restricted, albeit denied in sensitive or problematic areas (e.g. restoration areas, weed eradication trials, location of endangered flora, weed infested areas, areas of high erosion). Tracks that are no longer required should be physically blocked off and rehabilitated.

Disturbance to the vegetation in the way of loss or fragmentation may adversely affect the long term viability, condition and diversity of vegetation occurring along certain areas of the infrastructure corridor. Increasing edge effects will invariably reduce the resilience of the vegetation communities to cope with disturbances (e.g. fire, weed invasion) in both the short and long term. Increased fragmentation and associated perimeter area ratios of bushland areas also incur greater management expense (pers. comm. E.M. Matiske, J. Quilty) to the landholders. It is therefore reiterated that disturbance is minimized wherever possible and consideration is given to edge effects and increasing fragmentation.

A management plan to reduce the impact of the future pipeline construction will need to address issues including erosion, rehabilitation, track use and access, soil hygiene, weed control strategies, remnant vegetation and fragmentation.

8. LIST OF PARTICIPANTS

The following personnel of Matiske Consulting Pty Ltd were involved in this project:

Principle Ecologist:

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10. REFERENCES

- Beard J.S. (1990)
Plant Life of Western Australia. Kangaroo Press, Kenthurst, New South Wales.
- Bureau of Meteorology (2001)
Climate Averages for specific sites. Publicly available data prepared by the Bureau of Meteorology, Commonwealth of Australia.
http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml
- Department of Agriculture (2003)
Declared Plants List. Publicly available list prepared by the Department of Agriculture, Western Australia.
- Department of Conservation and Land Management (2003)
Declared Rare and Priority Flora List. Publicly available list prepared by the Department of Conservation of Land Management, Western Australia.
- Department of Environmental Protection (2000)
Bush Forever – Volume 2.
Department of Environmental Protection, Perth.
- English, V and J. Blyth (1997)
Identifying and Conserving Threatened Ecological Communities (TECs) in the South West Botanical Province. ANCA National Reserves System Cooperative Program: Project Number N702.
- Environment Australia (2003)
National list of Threatened Species, Ecological Communities and Threatening Processes. Commonwealth of Australia.
<http://www.environment.gov.au/cgi-bin/forms/sprat/public/publicthreatenedlist.pl?wanted=flora>
- Environmental Protection Authority (1999a)
Environmental Protection of Native Vegetation in Western Australia. Position Statement No. 2. Environmental Protection Authority, Perth.
- Environmental Protection Authority (1999b)
Clearing of Native Vegetation – environmental advice on the issues arising from use of Section 38 to assess clearing proposals in the agricultural area, and implications for the other areas of Western Australia. Advice to the Minister for the Environment from the Environmental Protection Authority (EPA) under Section 16(j) of the *Environmental Protection Act 1986*. Environmental Protection Authority, Perth.
- English, V. and Blyth, J. (1997)
Identifying and conserving threatened ecological communities in the South West Botanical Province. National Parks and Wildlife and Department of Conservation of Land Management, 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 for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia, Perth, Western Australia.

Keighery, B.J. (1994)

Vegetation and Flora Report for System Six Proposed Reserve-M53.

Unpublished report for the Department of Environmental Protection, Perth, Western Australia.

Shearer, B.L. (1990)

Dieback of Native Plant Communities caused by Phytophthora species – A Major Factor affecting Land Use in South-Western Australia. In: *Land and Water Research News* **5**, pp. 15-26.

Western Australian Herbarium (2003)

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

<http://www.calm.wa.gov.au/science/florabase.html>

Western Australian Herbarium (2003)

Max –Western Australian Plant Census. Department of Conservation and Land Management.

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>
ZAMIACEAE	<i>Macrozamia riedlei</i>
PINACEAE	* <i>Pinus pinaster</i> * <i>Pinus sp.</i>
ARAUCARIACEAE	* <i>Araucaria heterophylla</i>
CUPRESSACEAE	<i>Actinostrobus pyramidalis</i> <i>Callitris sp.</i>
POACEAE	<i>Amhipogon laguroides</i> <i>Austrodanthonia occidentalis</i> <i>Austrostipa compressa</i> <i>Austrostipa sp.</i> * <i>Avena fatua</i> * <i>Avena sp.</i> * <i>Briza maxima</i> * <i>Briza minor</i> * <i>?Bromus sp.</i> * <i>Cynodon dactylon</i> * <i>Cynodon sp.</i> * <i>Ehrharta calycina</i> * <i>Ehrharta longiflora</i> * <i>Eragrostis curvula</i> * <i>Hordeum leporinum</i> * <i>Lagurus ovatus</i> * <i>Pennisetum clandestinum</i> * <i>Pennisetum macrourum</i> * <i>Pennisetum setaceum</i> * <i>Pentaschistis airoides</i> * <i>Phalaris aquatica</i> <i>Poaceae sp.</i>
CYPERACEAE	<i>Baumea juncea</i> * <i>Cyperus eragrostis</i> <i>Ficinia nodosa</i> <i>Gahnia trifida</i> <i>?Lepidosperma brunonianum</i> <i>Lepidosperma effusum</i> <i>Lepidosperma longitudinale</i>

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Note: * Denotes introduced taxa

Family	Species
CYPERACEAE (Continued)	<i>Lepidosperma squamatum</i> <i>Lepidosperma</i> sp. <i>Mesomelaena stygia</i> <i>Mesomelaena tetragona</i> <i>Schoenus curvifolius</i> <i>Schoenus</i> sp. ? <i>Schoenus</i> sp. <i>Tricostularia neesii</i> var. <i>neesii</i>
ARECACEAE	* <i>Washingtonia filifera</i>
ARACEAE	* <i>Zantedeschia aethiopica</i>
RESTIONACEAE	<i>Desmocladius asper</i> <i>Desmocladius fasciculatus</i> <i>Desmocladius flexuosus</i> <i>Hypolaena exsulca</i> <i>Lyginia barbata</i> <i>Lyginia imberbis</i> <i>Meeboldina coangustata</i> <i>Meeboldina roycei</i> (ms)
CENTROLEPIDACEAE	<i>Centrolepis drummondiana</i>
COMMELINACEAE	<i>Cartonema philydroides</i>
JUNCACEAE	* <i>Juncus acutus</i> <i>Juncus pallidus</i> <i>Juncus subsecundus</i> <i>Juncus</i> sp.
DASYPOGONACEAE	<i>Dasypogon bromeliifolius</i> <i>Kingia australis</i> <i>Lomandra caespitosa</i> <i>Lomandra hermaphrodita</i> <i>Lomandra nigricans</i> <i>Lomandra sericea</i> <i>Lomandra sonderi</i> <i>Lomandra</i> ? <i>suaveolens</i> <i>Lomandra</i> sp.

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Family	Species
XANTHORRHOEACEAE	<i>Xanthorrhoea gracilis</i> <i>Xanthorrhoea preissii</i>
PHORMIACEAE	<i>Dianella revoluta</i> var. <i>divaricata</i>
ANTHERICACEAE	<i>Corynotheca micrantha</i> <i>Dichopogon capillipes</i> <i>Johnsonia acaulis</i> <i>Johnsonia</i> sp. <i>Laxmannia squarrosa</i> <i>Thysanotus multiflorus</i> <i>Thysanotus patersonii</i> <i>Thysanotus thyrsoides</i> <i>Tricoryne elatior</i>
ASPHODELACEAE	* <i>Trachyandra divaricata</i>
COLCHIACEAE	<i>Burchardia umbellata</i>
HAEMODORACEAE	<i>Conostylis aculeata</i> subsp. <i>aculeata</i> <i>Conostylis aculeata</i> subsp. <i>preissii</i> <i>Conostylis juncea</i> ? <i>Conostylis</i> sp. <i>Haemodorum simplex</i> <i>Haemodorum spicatum</i> <i>Phlebocarya ciliata</i>
AGAVACEAE	* <i>Agave americana</i>
IRIDACEAE	* <i>Gladiolus caryophyllaceus</i> * <i>Gladiolus undulatus</i> <i>Patersonia occidentalis</i> * <i>Romulea rosea</i> * <i>Watsonia meriana</i> var. <i>bulbillifera</i> * <i>Watsonia</i> sp.
ORCHIDACEAE	<i>Cyrtostylis</i> sp. * <i>Disa bracteata</i> <i>Epiblema grandiflorum</i> var. <i>grandiflorum</i> <i>Eriochilus dilatatus</i> subsp. <i>dilatatus</i> (ms) <i>Leporella fimbriata</i> <i>Lyperanthus nigricans</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
ORCHIDACEAE (Continued)	<i>Microtis media</i> subsp. <i>media</i> <i>Oligochaetochilus vittatus</i> <i>Prasophyllum parvifolium</i> Orchidaceae sp. Orchidaceae sp. 2
CASUARINACEAE	<i>Allocasuarina fraseriana</i> <i>Allocasuarina humilis</i> <i>Casuarina obesa</i>
MORACEAE	* <i>Ficus marophylla</i>
PROTEACEAE	<i>Adenanthos meisneri</i> <i>Adenanthos obovatus</i> <i>Banksia attenuata</i> <i>Banksia grandis</i> <i>Banksia ilicifolia</i> <i>Banksia littoralis</i> <i>Banksia menziesii</i> <i>Conospermum triplinervium</i> <i>Dryandra lindleyana</i> <i>Dryandra sessilis</i> var. <i>cygnorum</i> <i>Grevillea crithmifolia</i> <i>Grevillea preissii</i> subsp. <i>preissii</i> <i>Grevillea vestita</i> subsp. <i>vestita</i> <i>Hakea varia</i> <i>Persoonia longifolia</i> <i>Persoonia saccata</i> <i>Petrophile linearis</i> ? <i>Petrophile serruriae</i> <i>Stirlingia latifolia</i> <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i> <i>Xylomelum occidentale</i>
LORANTHACEAE	<i>Nuytsia floribunda</i>
POLYGONACEAE	* <i>Acetosella vulgaris</i> <i>Muehlenbeckia adpressa</i> * <i>Rumex crispus</i> * <i>Rumex pulcher</i> * <i>Rumex</i> sp.

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Note: * Denotes introduced taxa

Family	Species
AMARANTHACEAE	<i>Ptilotus drummondii</i> var. <i>drummondii</i> <i>Ptilotus polystachyus</i>
AIZOACEAE	* <i>Carpobrotus edulis</i>
CARYOPHYLLACEAE	* <i>Petrorhagia dubia</i>
RANUNCULACEAE	<i>Clematis linearifolia</i> * <i>Ranunculus muricatus</i>
LAURACEAE	<i>Cassytha racemosa</i>
DROSERACEAE	<i>Drosera erythrorhiza</i> <i>Drosera menziesii</i> <i>Drosera pallida</i> <i>Drosera pulchella</i> <i>Drosera</i> sp. (climbing)
CRASSULACEAE	* <i>Crassula alata</i> var. <i>alata</i>
PITTOSPORACEAE	<i>Billardiera variifolia</i> Pittosporaceae sp.
ROSACE	* <i>Rubus fruticosus</i>
MIMOSACEAE	<i>Acacia alata</i> * <i>Acacia decurrens</i> <i>Acacia extensa</i> <i>Acacia flagelliformis</i> (P4) <i>Acacia huegelii</i> * <i>Acacia longifolia</i> * <i>Acacia podalyriifolia</i> <i>Acacia pulchella</i> <i>Acacia pulchella</i> var. <i>glaberrima</i> <i>Acacia rostelifera</i> <i>Acacia saligna</i> <i>Acacia semitrullata</i> (P3) <i>Acacia trigonophylla</i> <i>Acacia willdenowiana</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
PAPILIONACEAE	<i>Aotus gracillima</i>
	<i>Aotus procumbens</i>
	? <i>Aotus</i> sp.
	<i>Bossiaea eriocarpa</i>
	<i>Daviesia incrassata</i> subsp. <i>incrassata</i>
	<i>Daviesia physodes</i>
	<i>Dillwynia</i> sp. A Perth Flora (pn)
	<i>Euchilopsis linearis</i>
	<i>Gompholobium capitatum</i>
	<i>Gompholobium confertum</i>
	<i>Gompholobium scabrum</i>
	<i>Gompholobium tomentosum</i>
	<i>Gompholobium venustum</i>
	<i>Hardenbergia comptoniana</i>
	<i>Hovea trisperma</i>
	<i>Jacksonia furcellata</i>
	<i>Jacksonia horrida</i>
	<i>Jacksonia sternbergiana</i>
	<i>Kennedia prostrata</i>
	* <i>Lotus suaveolens</i>
	* <i>Lupinus cosentinii</i>
	* <i>Lupinus</i> sp.
	* <i>Medicago</i> ? <i>polymorpha</i>
	<i>Nemcia</i> ? <i>capitata</i>
	<i>Oxylobium lineare</i>
	<i>Templetonia retusa</i>
	* <i>Trifolium arvense</i>
* <i>Trifolium</i> sp.	
<i>Viminaria juncea</i>	
GERANIACEAE	* <i>Erodium botrys</i>
	<i>Geranium retrorsum</i>
	<i>Geranium</i> sp.
	* <i>Pelargonium capitatum</i>
OXALIDACEAE	* <i>Oxalis caprina</i>
RUTACEAE	<i>Boronia dichotoma</i>
	<i>Boronia juncea</i> subsp. <i>juncea</i> (P1)
	<i>Philotheca spicata</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
TREMANDRACEAE	<i>Platytheca galioides</i> <i>Tetratheca hirsuta</i>
POLYGALACEAE	<i>Comesperma calymega</i> <i>Comesperma confertum</i>
EUPHORBIACEAE	* <i>Euphorbia peplus</i> * <i>Euphorbia terracina</i> <i>Phyllanthus calycinus</i> <i>Poranthera drummondii</i> * <i>Ricinus communis</i>
ANACARDIACEAE	* <i>Schinus molle</i> * <i>Schinus terebinthifolia</i>
STERCULIACEAE	* <i>Brachychiton acerifolius</i> <i>Thomasia cognata</i>
DILLENIACEAE	<i>Hibbertia huegelii</i> <i>Hibbertia hypericoides</i> <i>Hibbertia racemosa</i> <i>Hibbertia stellaris</i> <i>Hibbertia subvaginata</i> <i>Hibbertia vaginata</i>
VIOLACEAE	<i>Hybanthus calycinus</i>
CACTACEAE	* <i>Opuntia stricta</i>
LYTHRACEAE	* <i>Lythrum hyssopifolia</i>
MYRTACEAE	<i>Agonis flexuosa</i> <i>Astartea fascicularis</i> <i>Astartea</i> sp. Brixton Road (pn) <i>Astartea</i> sp. Juniperina (pn) <i>Baeckea camphorosmae</i> <i>Calothamnus lateralis</i> <i>Calytrix flavescens</i> <i>Calytrix fraseri</i> <i>Corymbia calophylla</i> <i>Eucalyptus decipiens</i> * <i>Eucalyptus globulus</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
MYRTACEAE	<i>Eucalyptus gomphocephala</i>
(Continued)	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>
	<i>Eucalyptus rudis</i>
	<i>Eucalyptus wandoo</i>
	<i>Eucalyptus</i> sp.
	<i>Hypocalymma angustifolium</i>
	<i>Hypocalymma robustum</i>
	<i>Kunzea ericifolia</i> subsp. <i>ericifolia</i>
	<i>Kunzea glabrescens</i>
	<i>Melaleuca hamulosa</i>
	<i>Melaleuca huegelii</i>
	<i>Melaleuca incana</i> subsp. <i>incana</i>
	<i>Melaleuca lateritia</i>
	<i>Melaleuca nematophylla</i>
	<i>Melaleuca pauciflora</i>
	<i>Melaleuca preissiana</i>
	<i>Melaleuca raphiophylla</i>
	<i>Melaleuca systema</i>
	<i>Melaleuca teretifolia</i>
	<i>Melaleuca thymoides</i>
	<i>Melaleuca viminea</i> subsp. <i>viminea</i>
	<i>Pericalymma ellipticum</i>
	<i>Regelia ciliata</i>
	<i>Scholtzia involucrata</i>
	<i>Taxandria linearifolia</i> (ms)
HALORAGACEAE	<i>Gonocarpus paniculatus</i>
APIACEAE	<i>Daucus</i> sp.
	<i>Platysace filiformis</i>
	<i>Trachymene pilosa</i>
	<i>Trachymene</i> sp.
	<i>Xanthosia huegelii</i>
EPACRIDACEAE	<i>Astroloma pallidum</i>
	? <i>Astroloma</i> sp.
	<i>Brachyloma preissii</i>
	<i>Conostephium pendulum</i>
	<i>Leucopogon australis</i> subsp. <i>acutifolius</i> (ms)
	<i>Leucopogon conostephioides</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
EPACRIDACEAE (Continued)	<i>Leucopogon oxycedrus</i> <i>Leucopogon ?parviflorus</i> <i>Leucopogon polymorphus</i> <i>Leucopogon propinquus</i> <i>Leucopogon</i> sp. <i>Lysinema ciliatum</i>
PRIMULACEAE	* <i>Anagallis arvensis</i>
LOGANIACEAE	<i>Logania serpyllifolia</i> subsp. <i>angustifolia</i> <i>Phyllangium paradoxum</i>
GENTIANACEAE	* <i>Centaurium erythraea</i>
MENYANTHACEAE	<i>Villarsia albiflora</i>
ASCLEPIADACEAE	* <i>Asclepias</i> sp. * <i>Gomphocarpus fruiticosus</i> * <i>Marsdenia ?velutina</i>
BORAGINACEAE	* <i>Echium plantagineum</i>
LAMIACEAE	<i>Hemiandra pungens</i> * <i>Mentha pulegium</i> * <i>Mentha</i> sp.
SCROPHULARIACEAE	* <i>Parentucellia viscosa</i>
OROBANCHACEAE	* <i>Orobanche minor</i>
RUBIACEAE	<i>Opercularia hispidula</i> <i>Opercularia vaginata</i>
LOBELIACEAE	<i>Lobelia tenuior</i>
GOODENIACEAE	<i>Dampiera linearis</i> <i>Goodenia pulchella</i> subsp. Coastal Plain A (M. Hislop 634) (pn) ? <i>Lechenaultia floribunda</i> <i>Scaevola glandulifera</i>

**APPENDIX A : VASCULAR PLANT SPECIES RECORDED ON PROPOSED KWINANA
TO AUSTRALIND PIPELINE, OCTOBER 2002 - OCTOBER 2003**

Note: * Denotes introduced taxa

Family	Species
STYLIDIACEAE	<i>Levenhookia stipitata</i>
	<i>Stylidium brunonianum</i>
	<i>Stylidium brunonianum</i> subsp. <i>brunonianum</i>
	<i>Stylidium calcaratum</i>
	<i>Stylidium ?carnosum</i>
	<i>Stylidium divaricatum</i>
	<i>Stylidium junceum</i>
	<i>Stylidium piliferum</i> subsp. <i>piliferum</i>
	<i>Stylidium schoenoides</i>
ASTERACEAE	* <i>Arctotheca calendula</i>
	<i>Asteridea pulverulenta</i>
	* <i>Cirsium vulgare</i>
	* <i>Conyza</i> sp.
	<i>Cotula coronopifolia</i>
	<i>Hyalosperma cotula</i>
	* <i>Hypochaeris glabra</i>
	<i>Lagenophora huegelii</i>
	<i>Podolepis lessonii</i>
	<i>Senecio</i> sp.
	<i>Siloxerus humifusus</i>
	* <i>Sonchus oleraceus</i>
* <i>Ursinia anthemoides</i>	

Eucalyptus rudis Woodlands

- R1:** Disturbed Low Open Woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* over *Pteridium esculentum* and pastoral grasses.
- R2:** Disturbed Low Open Woodland of *Eucalyptus rudis* - *Corymbia calophylla* over *Melaleuca preissiana*, *Melaleuca raphiophylla* and *Taxandria linearifolia* over pastoral grasses in association with watercourses.
- R3:** Disturbed Low Open Woodland of *Eucalyptus rudis* - *Corymbia calophylla* over *Kunzea ericifolia* subsp. *ericifolia* over pastoral grasses.
- R4:** Disturbed Low Open Woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* with pockets of *Corymbia calophylla* over pastoral grasses.
- R5:** Disturbed Low Open Woodland of *Eucalyptus rudis* over *Melaleuca preissiana* with *Juncus pallidus* in depressions, over pasture grasses.
- R6:** Woodland of *Eucalyptus rudis* *Melaleuca raphiophylla* over *Melaleuca teretifolia* and *Astartea fascicularis* over *Lepidosperma longitudinale*.

Corymbia calophylla Woodlands

- C1:** Disturbed Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* *Melaleuca raphiophylla* over *Xanthorrhoea preissii*, *Viminaria juncea*, **Gladiolus caryophyllaceus* and pastoral grasses.
- C2:** Disturbed Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* over *Kingia australis* and *Hypocalymma angustifolium* over pastoral grasses.
- C3:** Low Woodland of *Corymbia calophylla* over *Xanthorrhoea preissii*, *Dasyopogon bromeliifolius* and *Adenanthos meisneri*.
- C4:** Disturbed Open Woodland of *Corymbia calophylla* - *Eucalyptus rudis* over *Agonis flexuosa* over pastoral grasses.
- C5:** Disturbed Low Open Woodland of *Corymbia calophylla* - *Melaleuca preissiana* over *Taxandria linearifolia*, *Astartea fascicularis*, *Baumea articulata* and *Juncus pallidus* over pastoral grasses.
- C6:** Disturbed Low Open Woodland of *Corymbia calophylla* - *Eucalyptus marginata* subsp. *marginata* - *Banksia menziesii* - *Allocasuarina fraseriana* over *Kunzea ericifolia* subsp. *ericifolia* over pasture grasses.
- C7:** Disturbed Low Open Woodland of *Corymbia calophylla* - *Eucalyptus wandoo* over *Melaleuca preissiana* over pasture grasses.

Eucalyptus marginata subsp. marginata Woodlands

- M1:** Disturbed Open Woodland of *Eucalyptus marginata* subsp. *marginata* over *Cartonema phylloides*.
- M2:** Open Woodland of *Eucalyptus marginata* subsp. *marginata* *Corymbia calophylla* over *Kunzea ericifolia* subsp. *ericifolia*, *Pericalymma ellipticum* and *Acacia pulchella* var. *glaberrima* over Poaceae species.
- M3:** Open Woodland of *Eucalyptus marginata* subsp. *marginata* - *Banksia ilicifolia* - *Banksia grandis* - *Banksia littoralis* and *Nuytsia floribunda* over *Kunzea ericifolia* subsp. *ericifolia*, *Acacia pulchella*, *Stirlingia latifolia*, *Xanthorrhoea preissii* and *Dasyopogon bromeliifolius*.
- M4:** Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia attenuata* and *Banksia grandis* over *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Aotus procumbens*, *Macrozamia riedlei*, *Dasyopogon bromeliifolius* and *Bossiaea eriocarpa*.
- M5:** Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia attenuata* - *Banksia grandis* and *Xylomelum occidentale* over *Kunzea ericifolia* subsp. *ericifolia*, *Hibbertia hypericoides*, *Daviesia incrassata* subsp. *incrassata*, *Brachyloma preissii*, *Persoonia saccata* and *Acacia willdenowiana*.

Eucalyptus gomphocephala Woodlands

- G1:** Open Woodland of *Eucalyptus gomphocephala* - *Corymbia calophylla* over pasture species.
- G2:** Open Woodland of *Eucalyptus gomphocephala* - *Allocasuarina fraseriana* over low mixed shrubs and herbs.
- G3:** Open Woodland of *Eucalyptus gomphocephala* *Eucalyptus marginata* subsp. *marginata* *Banksia* species over low mixed shrubs and herbs.
- G4:** Open Woodland of *Eucalyptus gomphocephala* over *Acacia saligna*, *Acacia rostellifera*, *Dryandra sessilis* var. *cygnorum* and low mixed shrubs.
- G5:** Open Woodland of *Eucalyptus gomphocephala* over *Acacia* species and *Melaleuca raphiophylla* and low sedges and shrubs.

Eucalyptus decipiens Woodlands

- E1:** Low Open Woodland of *Eucalyptus decipiens* - *Banksia littoralis* - *Acacia rostellifera* over *Dryandra sessilis* var. *cygnorum* and low mixed shrubs.

Banksia Woodlands

- B1:** Disturbed Low Open Woodland of *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* - *Allocasuarina fraseriana* over low shrubs and pastoral grasses.
- B2:** Disturbed Open Woodland of *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* - *Allocasuarina fraseriana* - *Xylomelum occidentale* over *Hibbertia hypericoides*, *Hibbertia huegelii* and *Hyalosperma cotula*.
- B3:** Open Woodland of *Banksia attenuata* *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia*, *Stirlingia latifolia*, *Calytrix fraseri*, *Adenanthos meisneri* and *Dasyopogon bromeliifolius*.
- B4:** Open Woodland of *Banksia attenuata* *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia*, *Allocasuarina humilis*, *Stirlingia latifolia* and mixed shrubs.
- B5:** Open Woodland of *Banksia attenuata* *Banksia ilicifolia* - *Eucalyptus marginata* subsp. *marginata* over *Kunzea ericifolia* subsp. *ericifolia* with occasional *Nuytsia floribunda* and *Corymbia calophylla* over *Melaleuca thymoides*, *Calytrix fraseri*, *Acacia pulchella* var. *glaberrima* and mixed shrubs.
- B6:** Open Woodland of *Banksia ilicifolia* - *Banksia attenuata* - *Agonis flexuosa* and *Eucalyptus marginata* subsp. *marginata* over dense *Kunzea ericifolia* subsp. *ericifolia* with *Bossiaea eriocarpa*, *Hibbertia hypericoides*, *Dasyopogon bromeliifolius*, *Acacia pulchella* and *Patersonia occidentalis*.

Melaleuca Woodlands

- P1:** Disturbed Open Woodland of scattered *Melaleuca preissiana* over *Juncus pallidus* and pastoral grasses.
- P2:** Disturbed Low Open Woodland of *Melaleuca raphiophylla* - *Melaleuca preissiana* over *Astartea fascicularis* over pasture grasses and sedges.
- P3:** Low Open Woodland of *Melaleuca preissiana* and occasional *Eucalyptus marginata* subsp. *marginata* and *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and *Calytrix* species over *Dasyopogon bromeliifolius*.
- P4:** Low Open Woodland of *Melaleuca preissiana* with either *Agonis flexuosa* or *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and *Calytrix* species over *Dasyopogon bromeliifolius*.

Agonis flexuosa Woodlands and Forests

- F1:** Open Forest of *Agonis flexuosa* *Eucalyptus marginata* subsp. *marginata* over grasses.
- F2:** Open Woodland of *Agonis flexuosa* with occasional *Banksia attenuata*, *Banksia ilicifolia* and *Nuytsia floribunda* over mixed shrubs.

Kunzea ericifolia subsp. ericifolia Shrublands

- K1:** Disturbed Low Shrubland of *Kunzea ericifolia* subsp. *ericifolia* over *Regelia ciliata* over pastoral grasses.
- K2:** Tall Shrubland of *Kunzea ericifolia* subsp. *ericifolia* over *Hypocalymma angustifolium* and mixed shrubs over *Meeboldina scariosa*, with occasional emergent *Eucalyptus marginata* subsp. *marginata*, *Banksia attenuata* and *Banksia ilicifolia*.

Closed Heath

- H1:** Closed Heath of Myrtaceae species, including *Kunzea ericifolia* subsp. *ericifolia*, *Pericalymma ellipticum*, *Astartea fascicularis* and *Melaleuca* species over *Baumea* and *Meeboldina* species, with occasional emergent trees of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata*.
- H2:** Closed Heath of *Pericalymma ellipticum* *Hypocalymma angustifolium* shrubs over mixed sedges, with occasional emergent *Melaleuca preissiana*, *Nuytsia floribunda* and very occasional *Banksia littoralis* trees.
- H3:** Closed Heath of *Astartea fascicularis* *Calothamnus lateralis* and *Cassytha racemosa* over mixed sedges.

Sedgeland

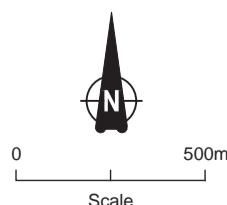
- S1:** Sedgelands of *Baumea*, *Meeboldina* and *Juncus* species over pastures in disturbed areas.

Disturbed Areas

- D:** Disturbed, drains, plantations, pasture, roads and buildings.
- (d):** Partially disturbed, eg. M3(d) partially disturbed M3.

Notes:

This map to be read in conjunction with Mattiske Consulting Pty Ltd report Numberd DRD0301/101/03



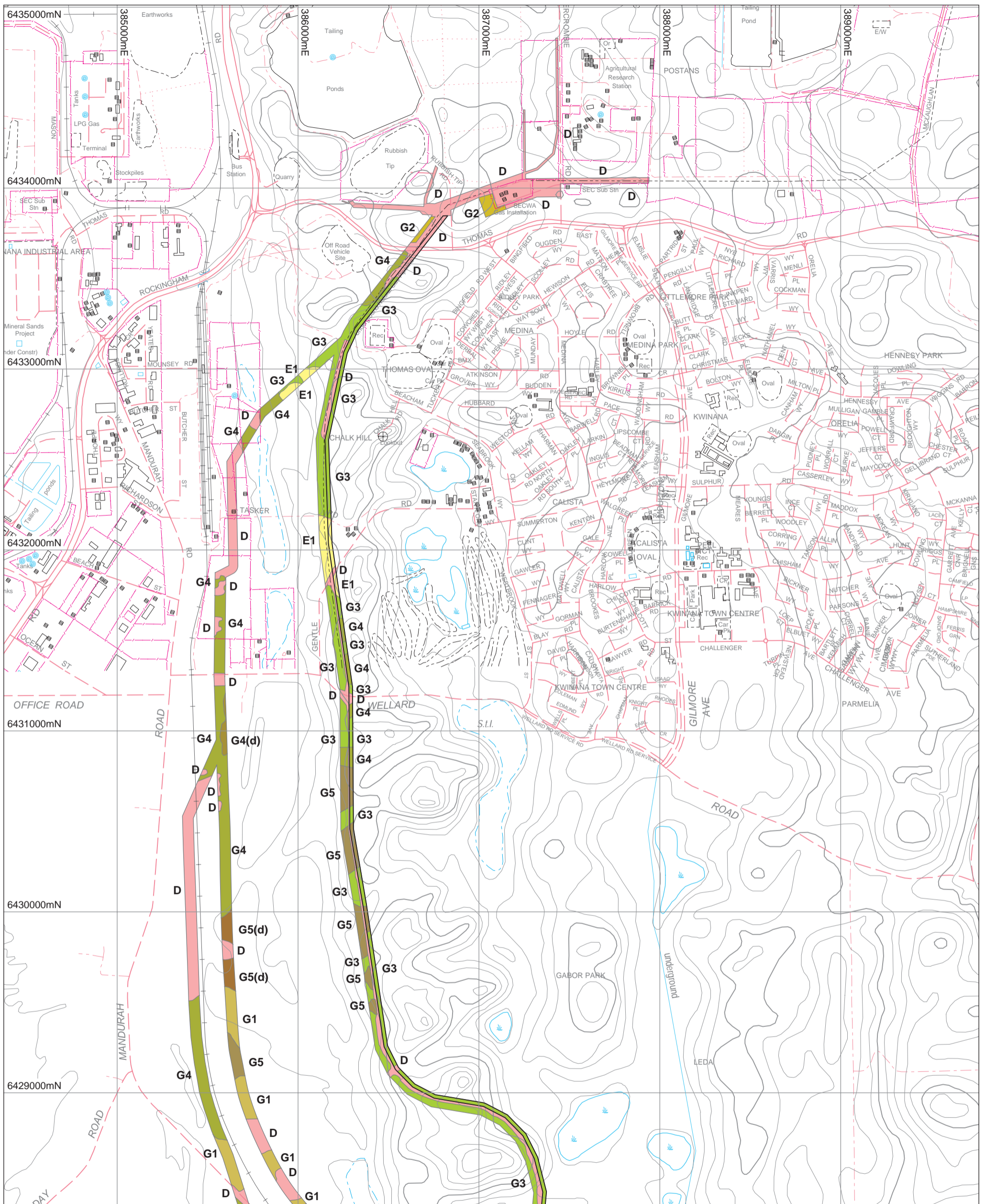
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**KWINANA TO AUSTRALIND
GAS PIPELINE CORRIDOR
Figure 1
VEGETATION**

Author: E. M. Mattiske

November 2003



Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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0 500m
 Scale

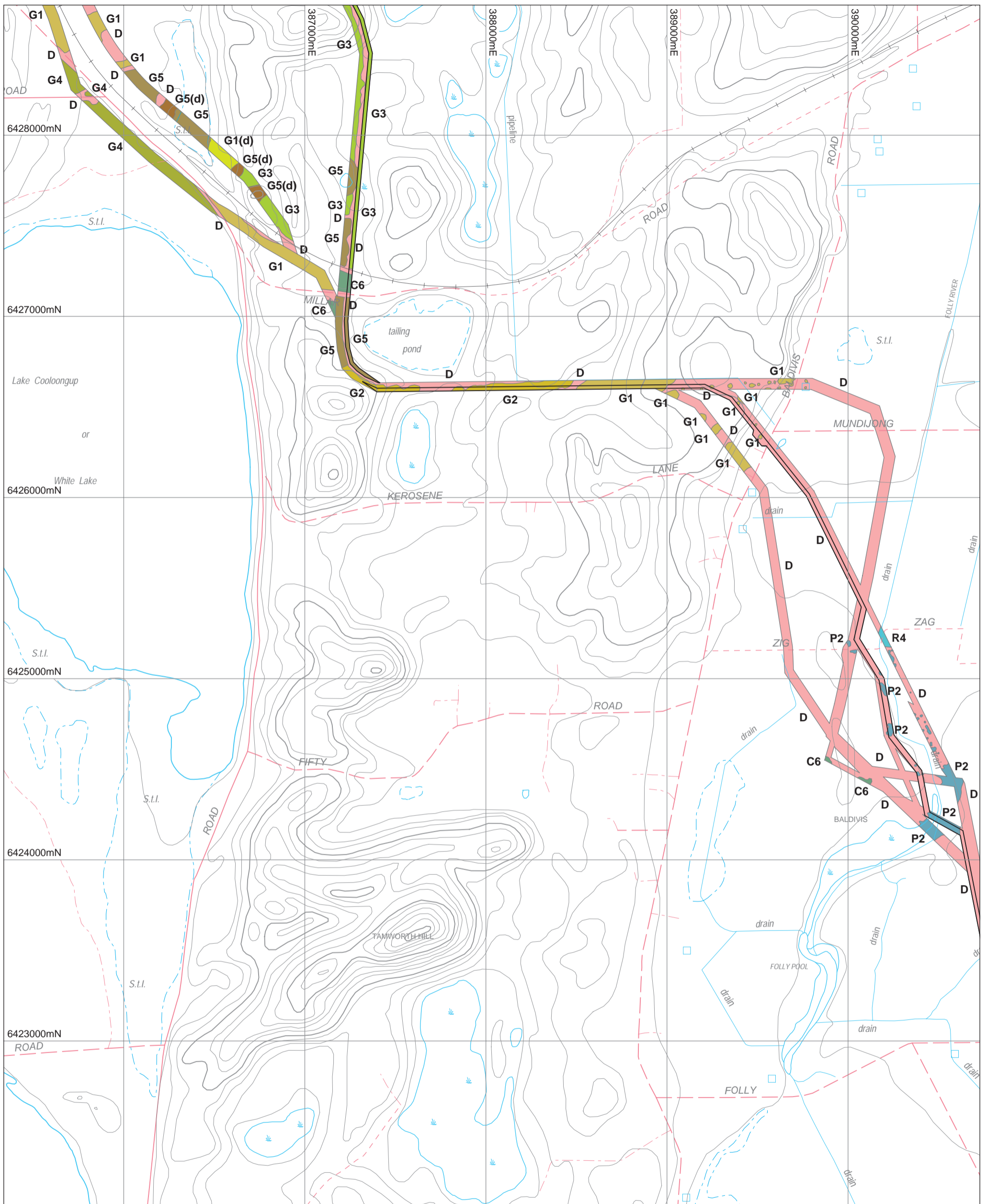
Bowman Bishaw Gorham
 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 2
 VEGETATION**

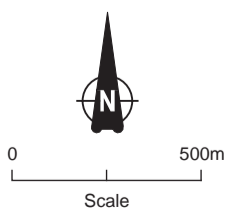
Author: E. M. Mattiske

November 2003



Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
 This map to be read in conjunction with Mattiske Consulting Pty Ltd
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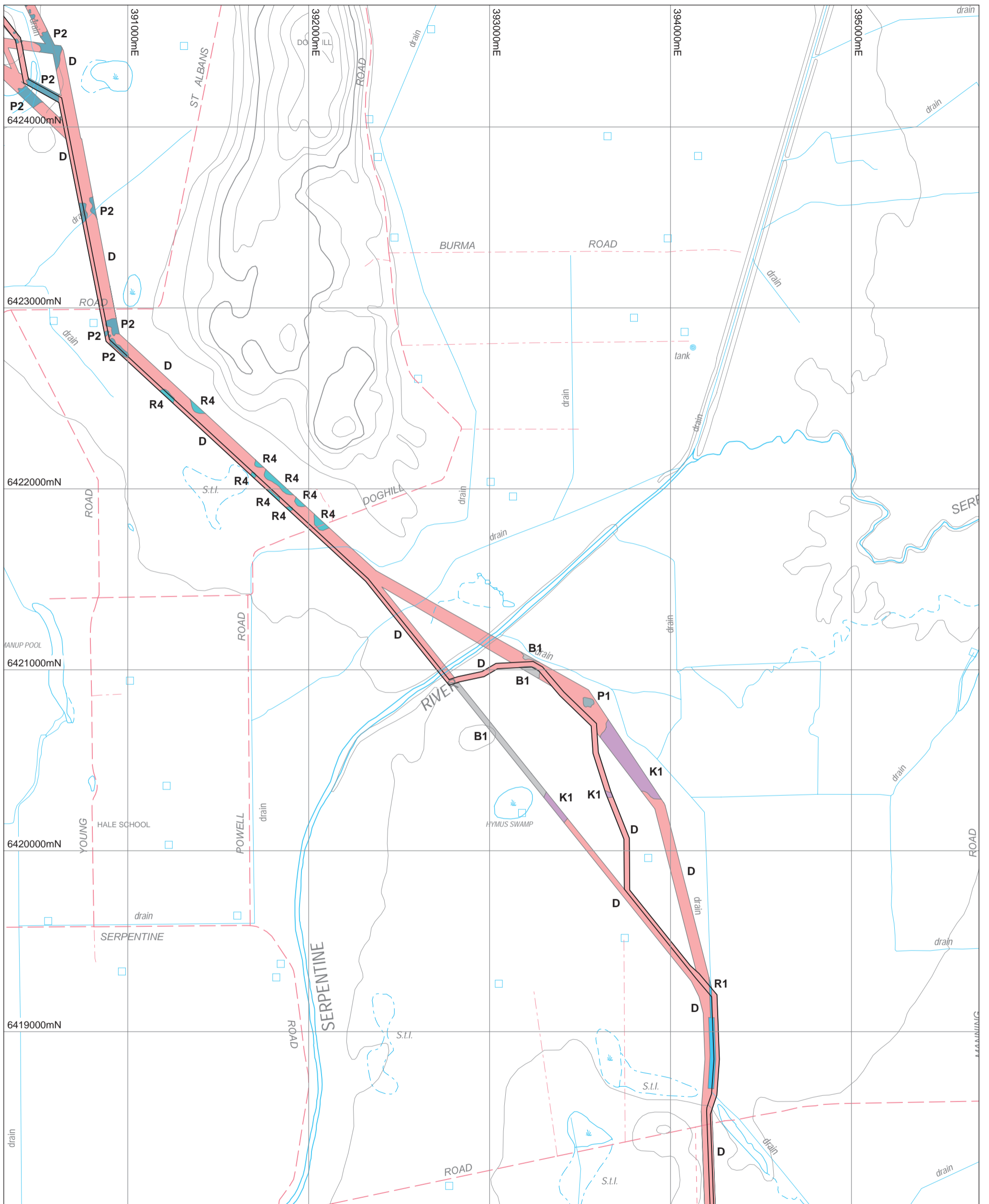
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 3
 VEGETATION**

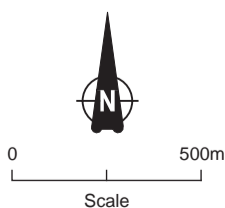
Author: E. M. Mattiske

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Notes:

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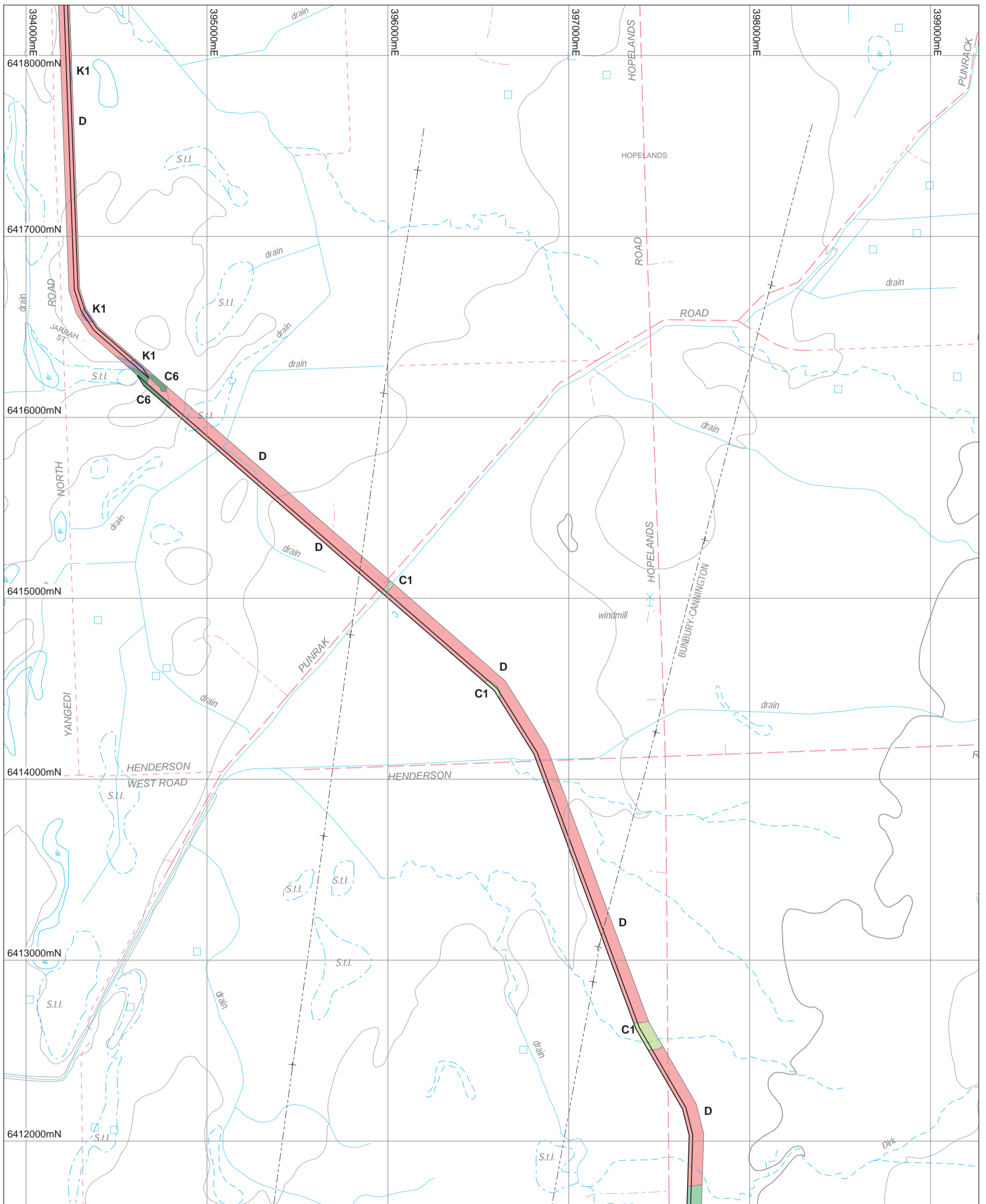
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 4
 VEGETATION**

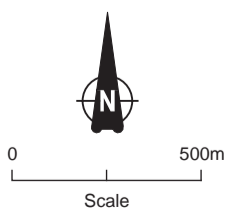
Author: E. M. Mattiske

November 2003



Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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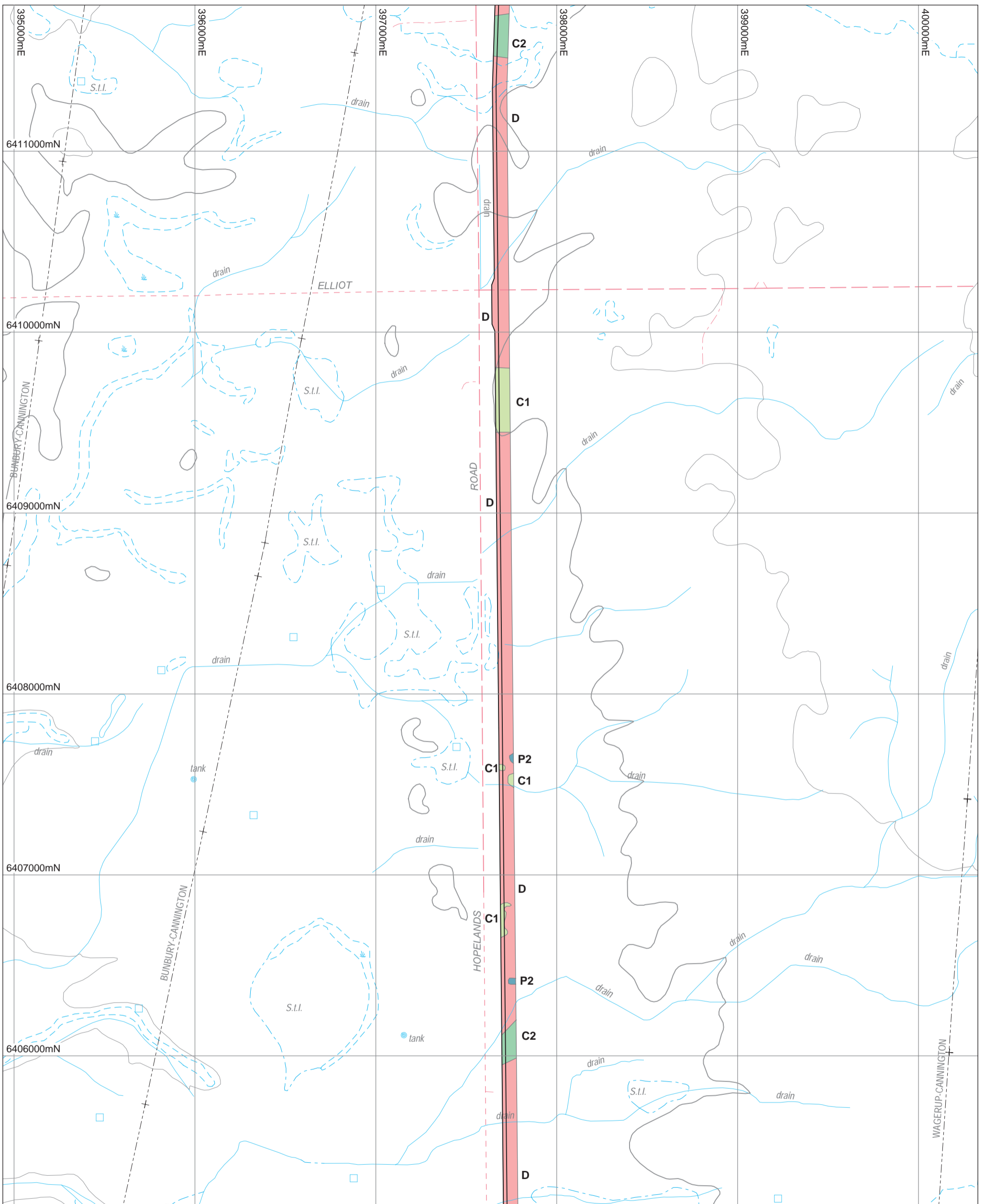
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 5
 VEGETATION**

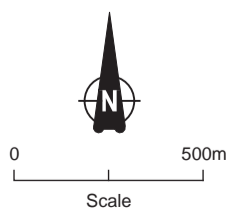
Author: E. M. Mattiske

November 2003



Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
 This map to be read in conjunction with Mattiske Consulting Pty Ltd
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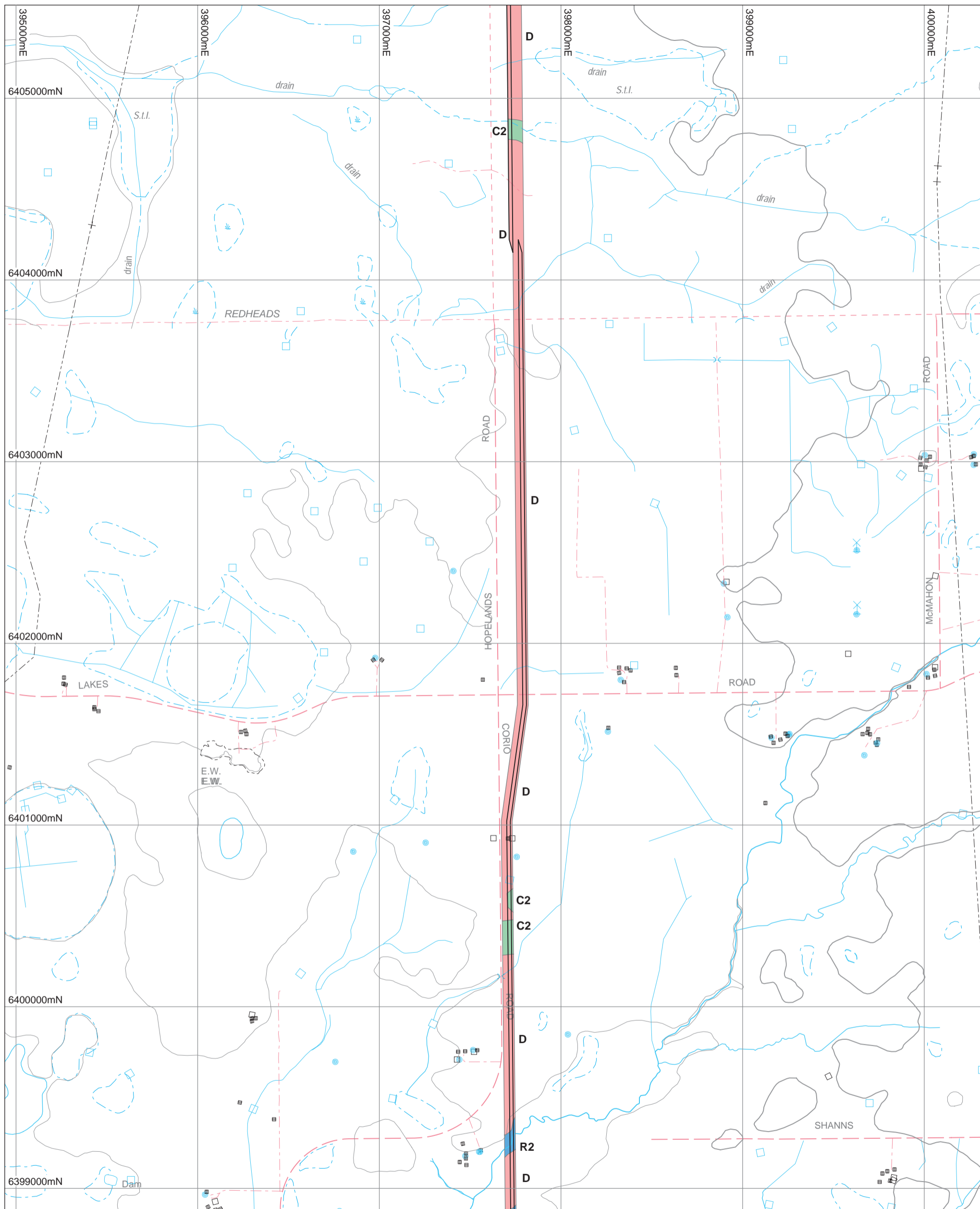
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 6
 VEGETATION**

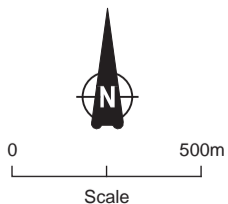
Author: E. M. Mattiske

November 2003



Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
 This map to be read in conjunction with Mattiske Consulting Pty Ltd
 report Numberd DRD0301/101/03



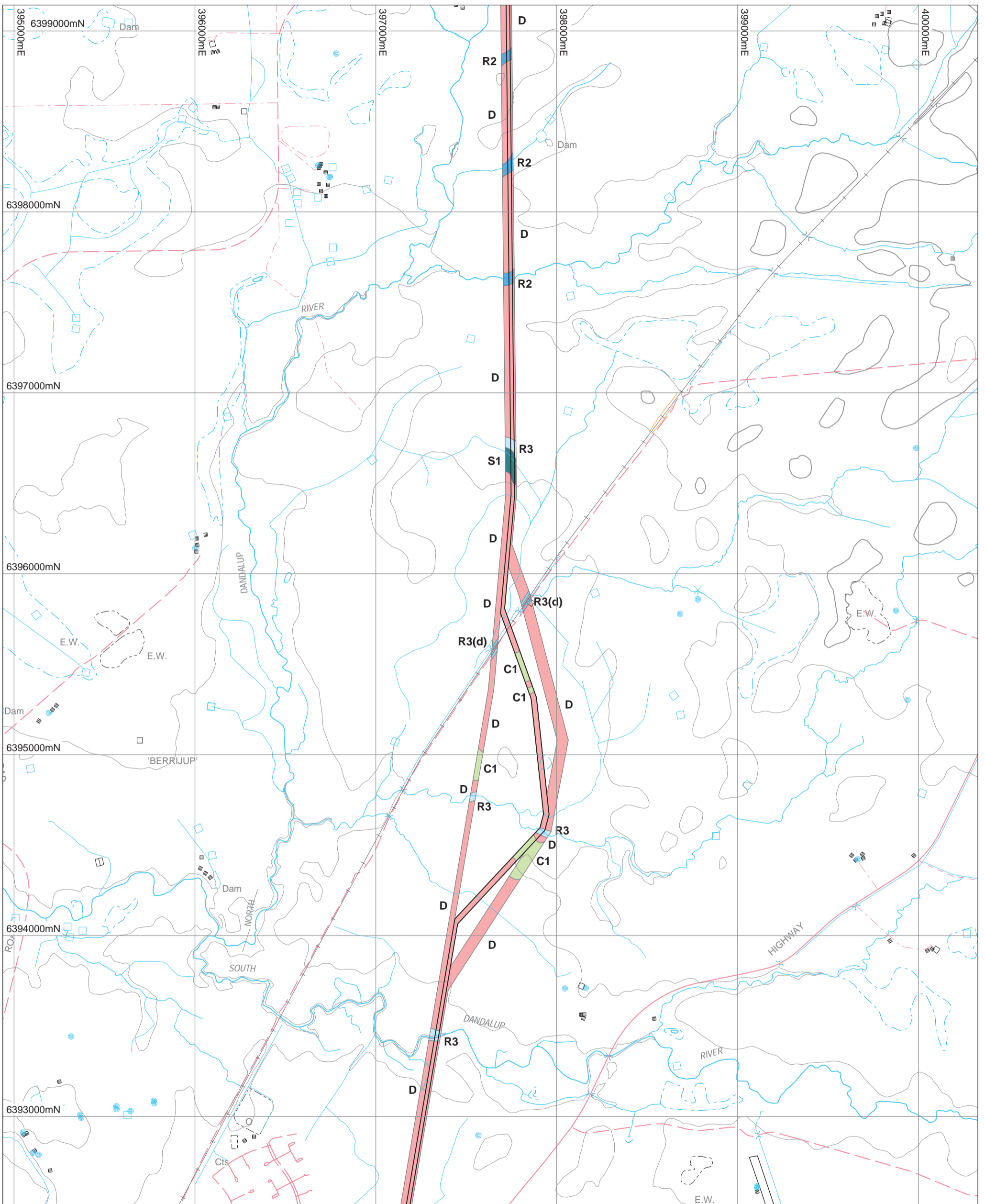
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 7
 VEGETATION**

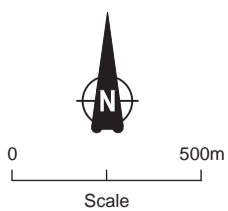
Author: E. M. Mattiske

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Notes:

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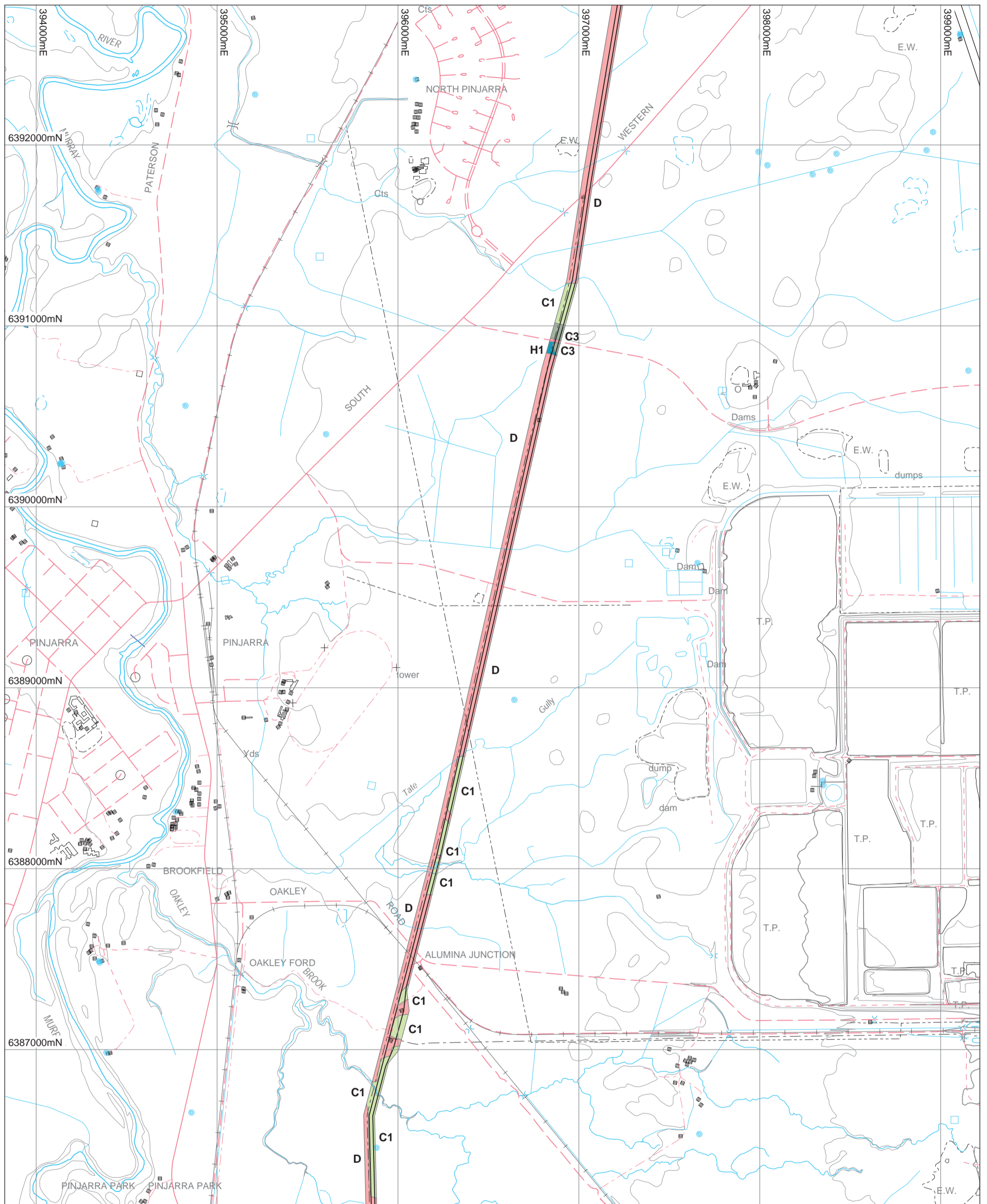
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 8
 VEGETATION**

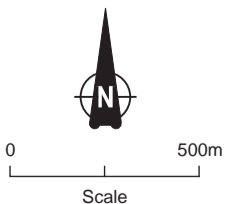
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
 This map to be read in conjunction with Mattiske Consulting Pty Ltd
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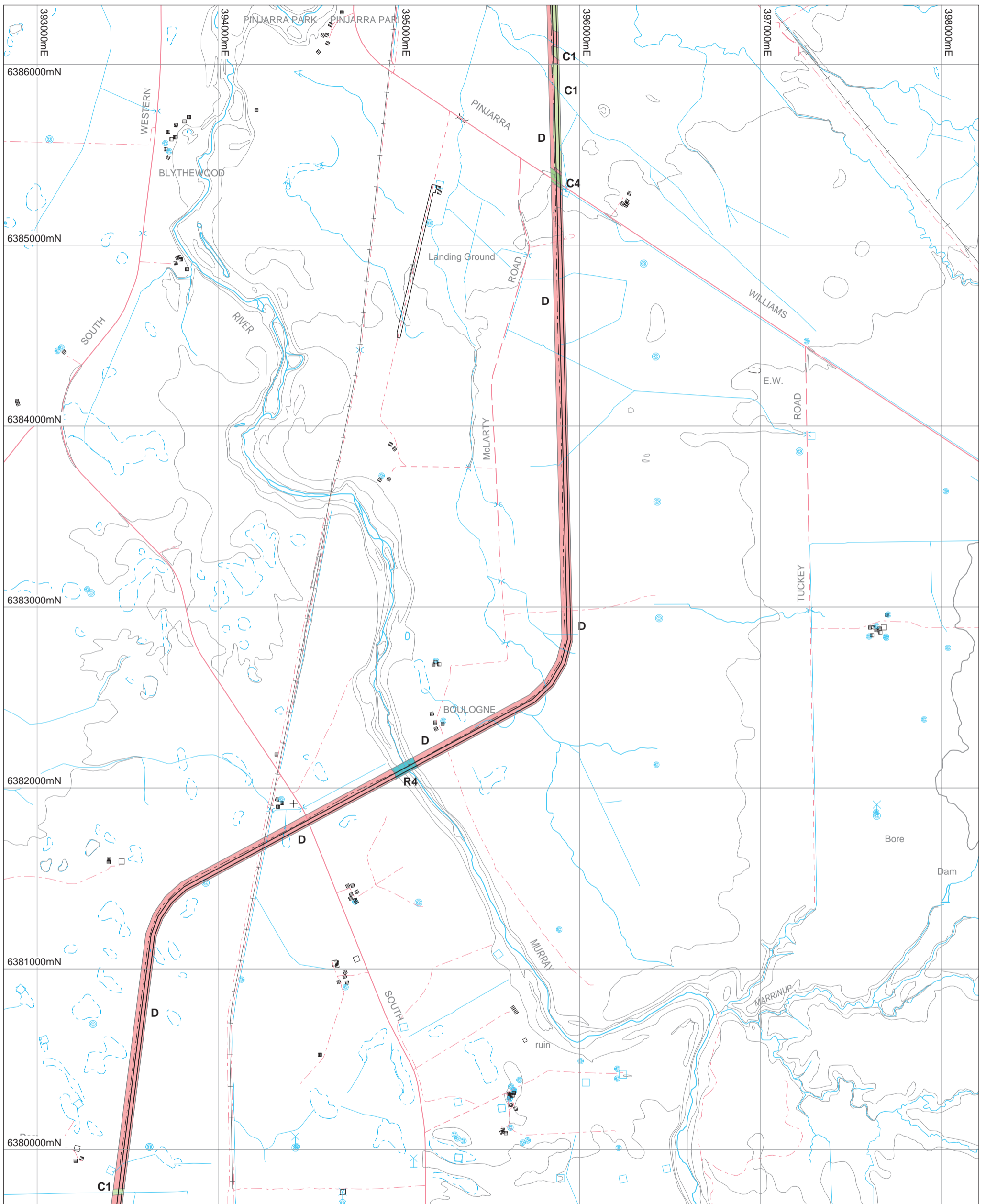
Bowman Bishaw Gorham
 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 9
 VEGETATION**

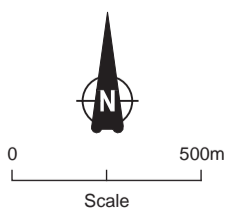
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
 This map to be read in conjunction with Mattiske Consulting Pty Ltd
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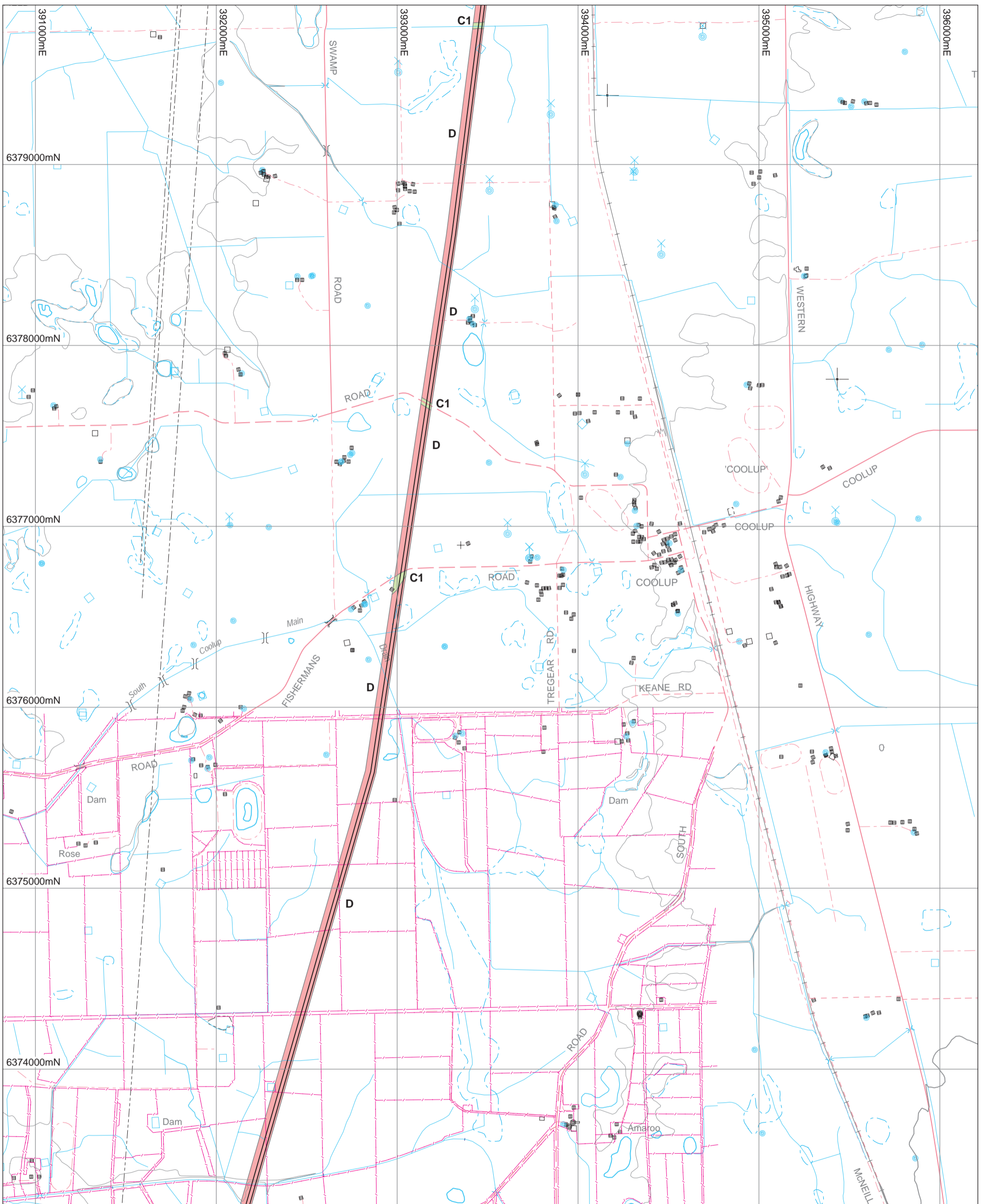
Bowman Bishaw Gorham
 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 10
 VEGETATION**

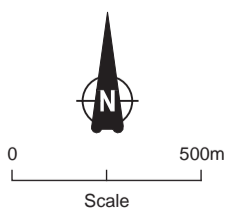
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
Horizontal Datum: GDA94(Zone 50)
This map to be read in conjunction with Mattiske Consulting Pty Ltd
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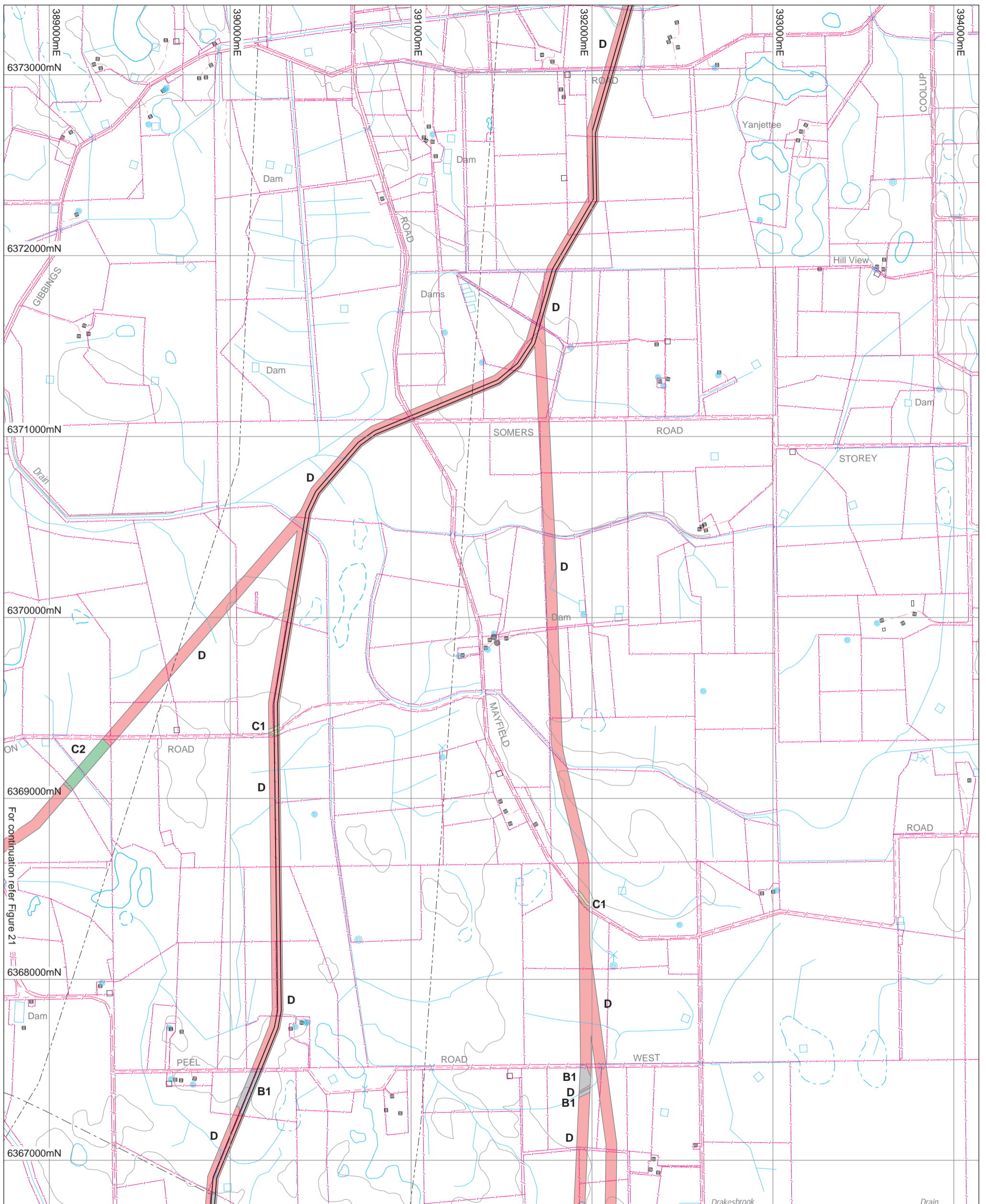
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Environmental Management Consultants



**KWINANA TO AUSTRALIND
GAS PIPELINE CORRIDOR
Figure 11
VEGETATION**

Author: E. M. Mattiske

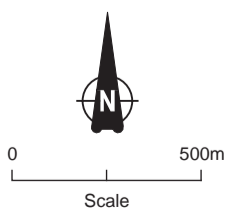
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For continuation refer Figure 21

Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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 report Numberd DRD0301/101/03



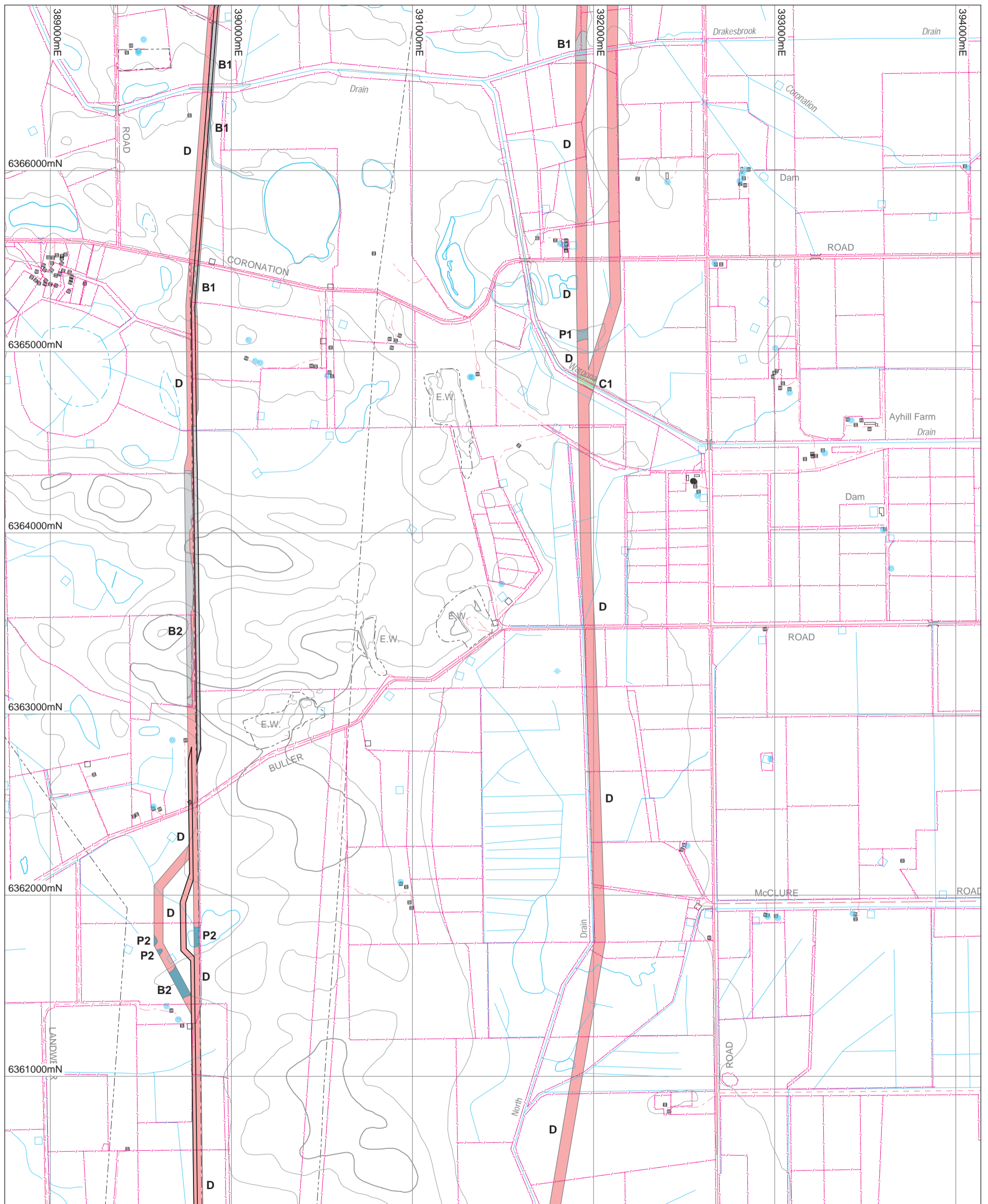
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 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 12
 VEGETATION**

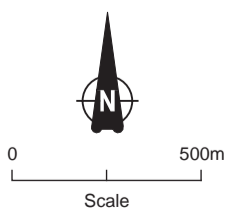
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
Horizontal Datum: GDA94(Zone 50)
This map to be read in conjunction with Mattiske Consulting Pty Ltd
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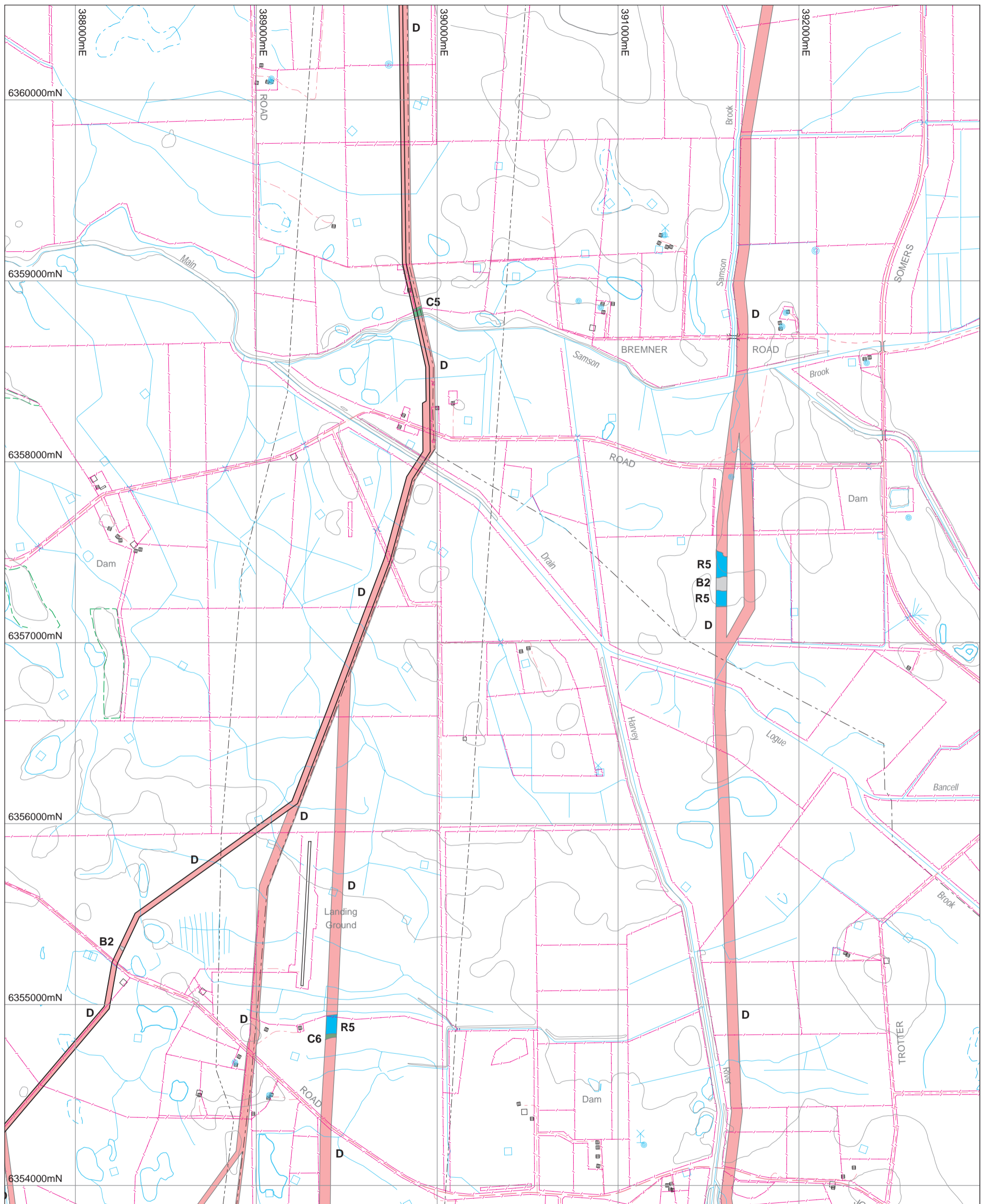
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**KWINANA TO AUSTRALIND
GAS PIPELINE CORRIDOR
Figure 13
VEGETATION**

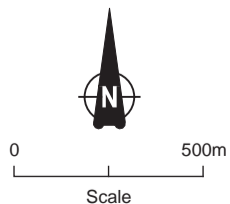
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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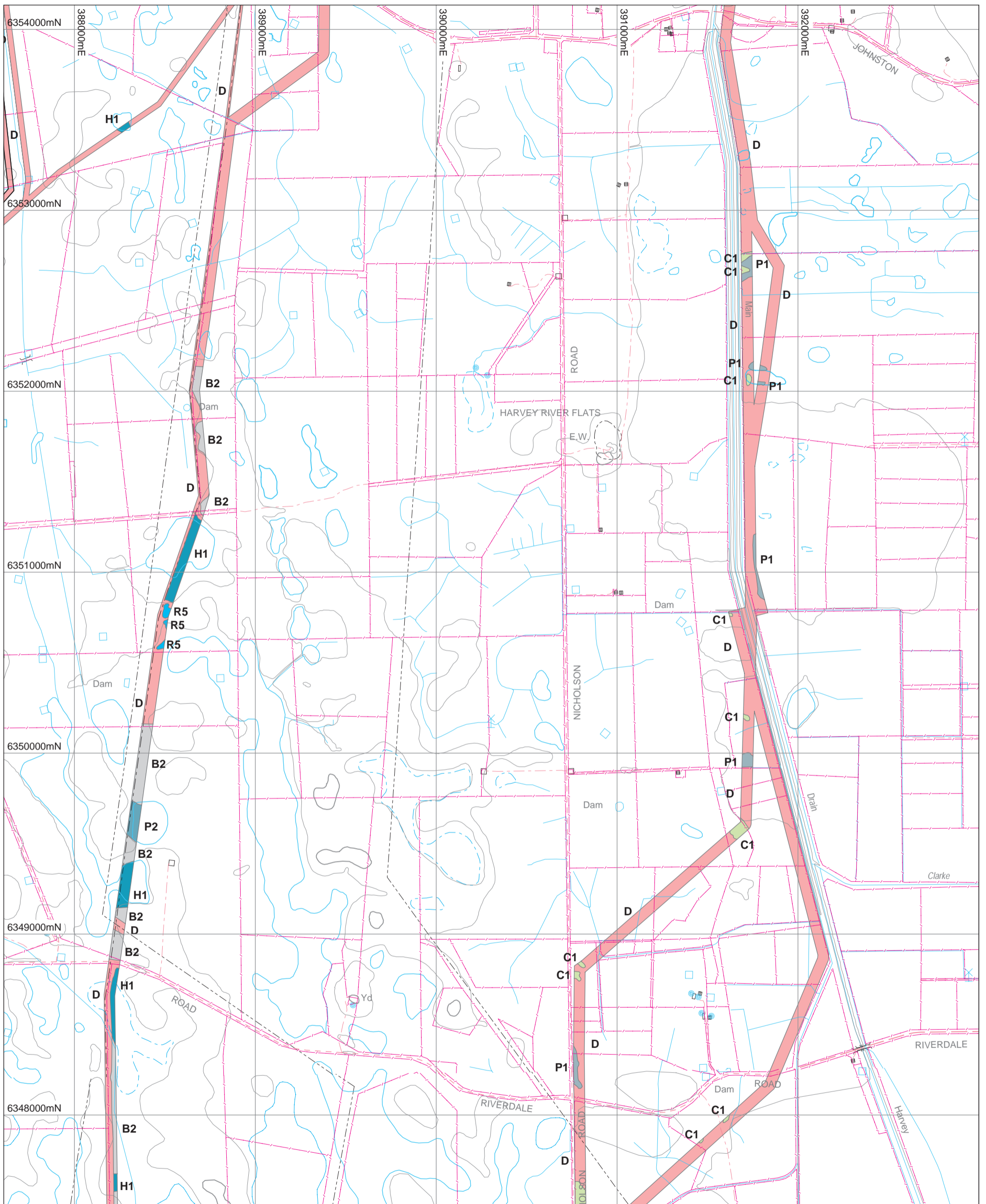
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 14
 VEGETATION**

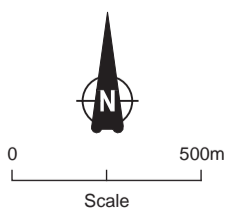
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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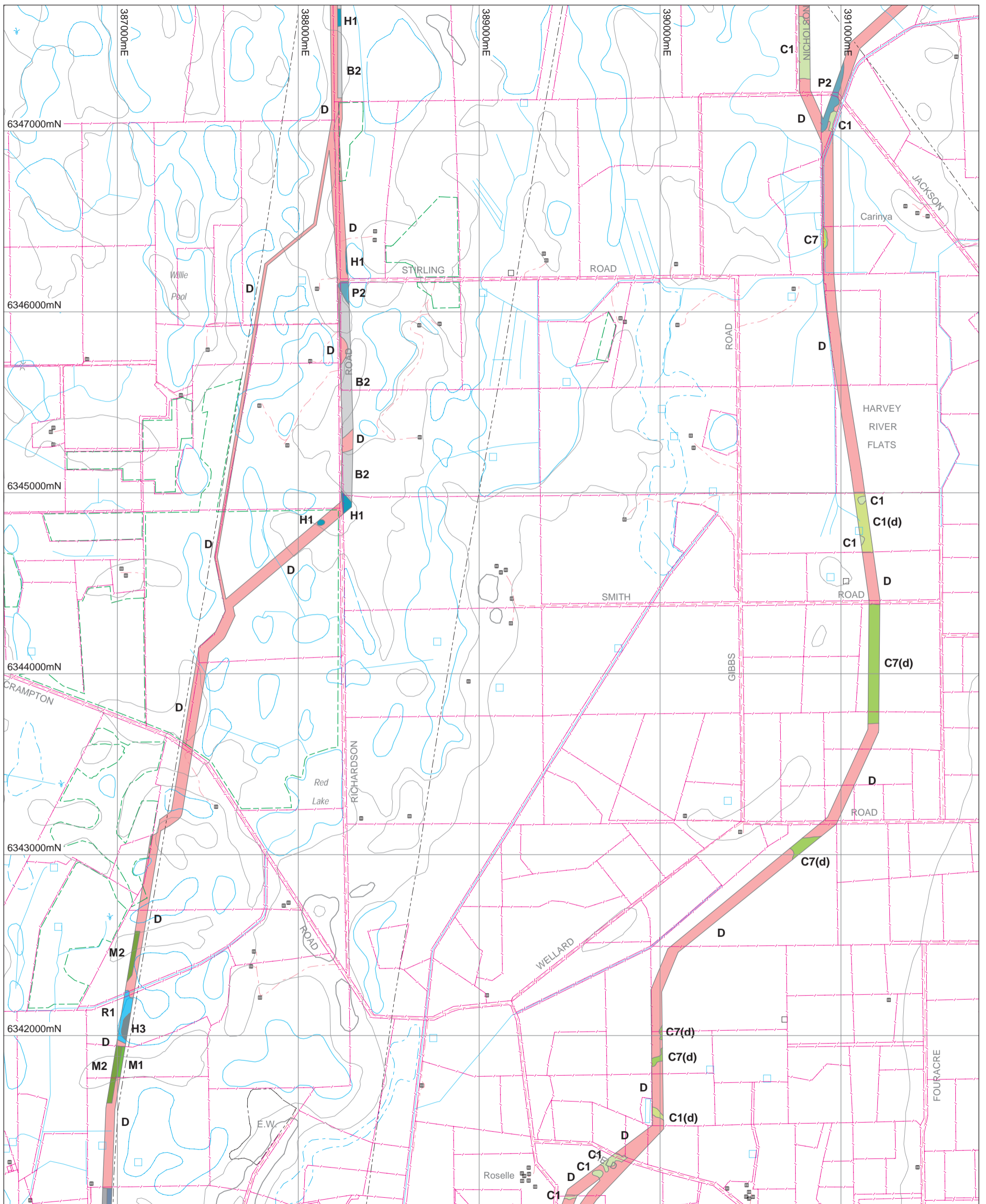
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 15
 VEGETATION**

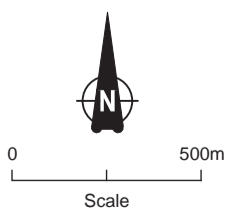
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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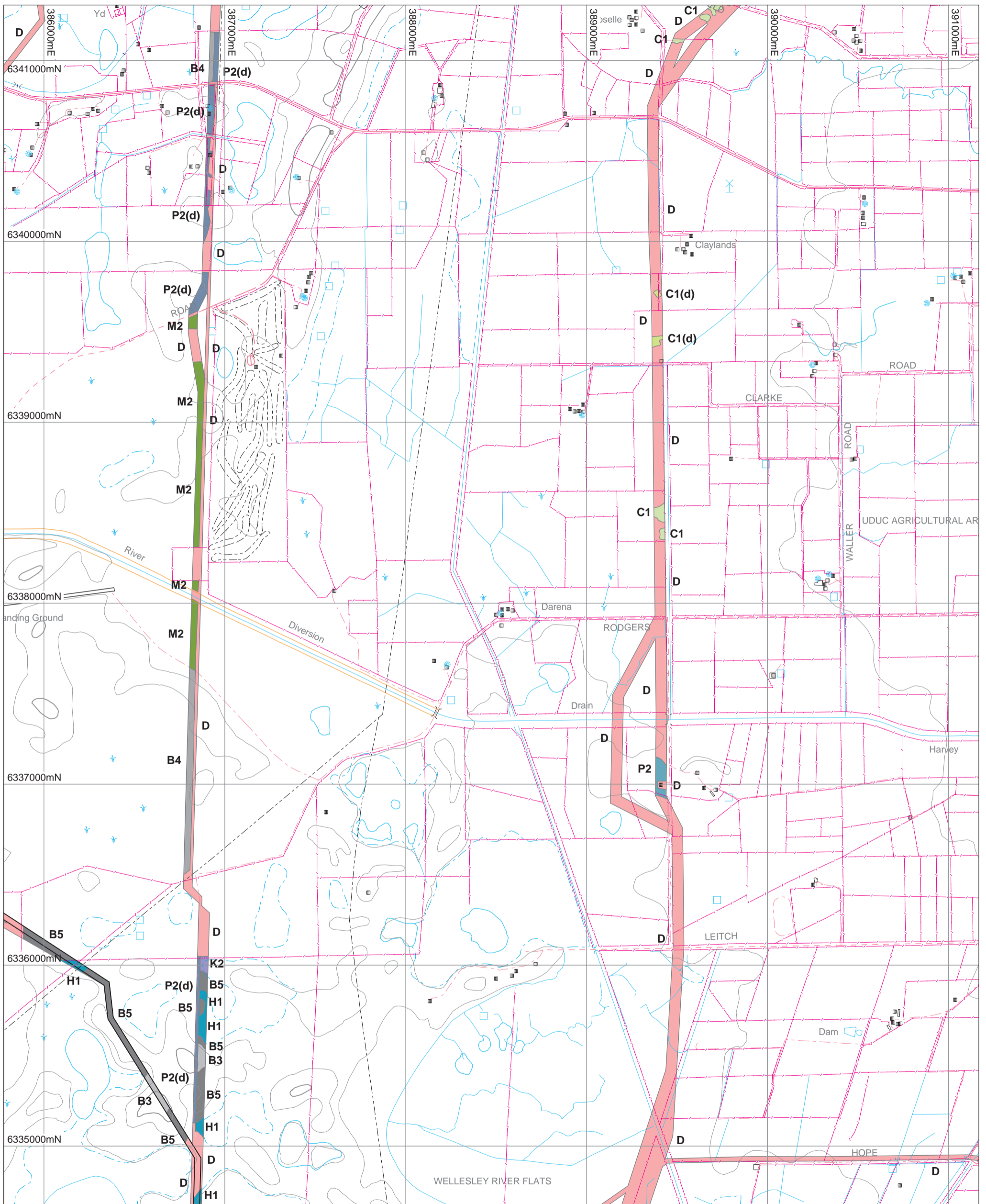
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 16
 VEGETATION**

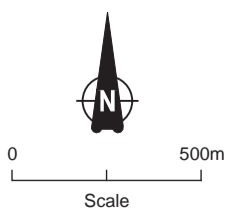
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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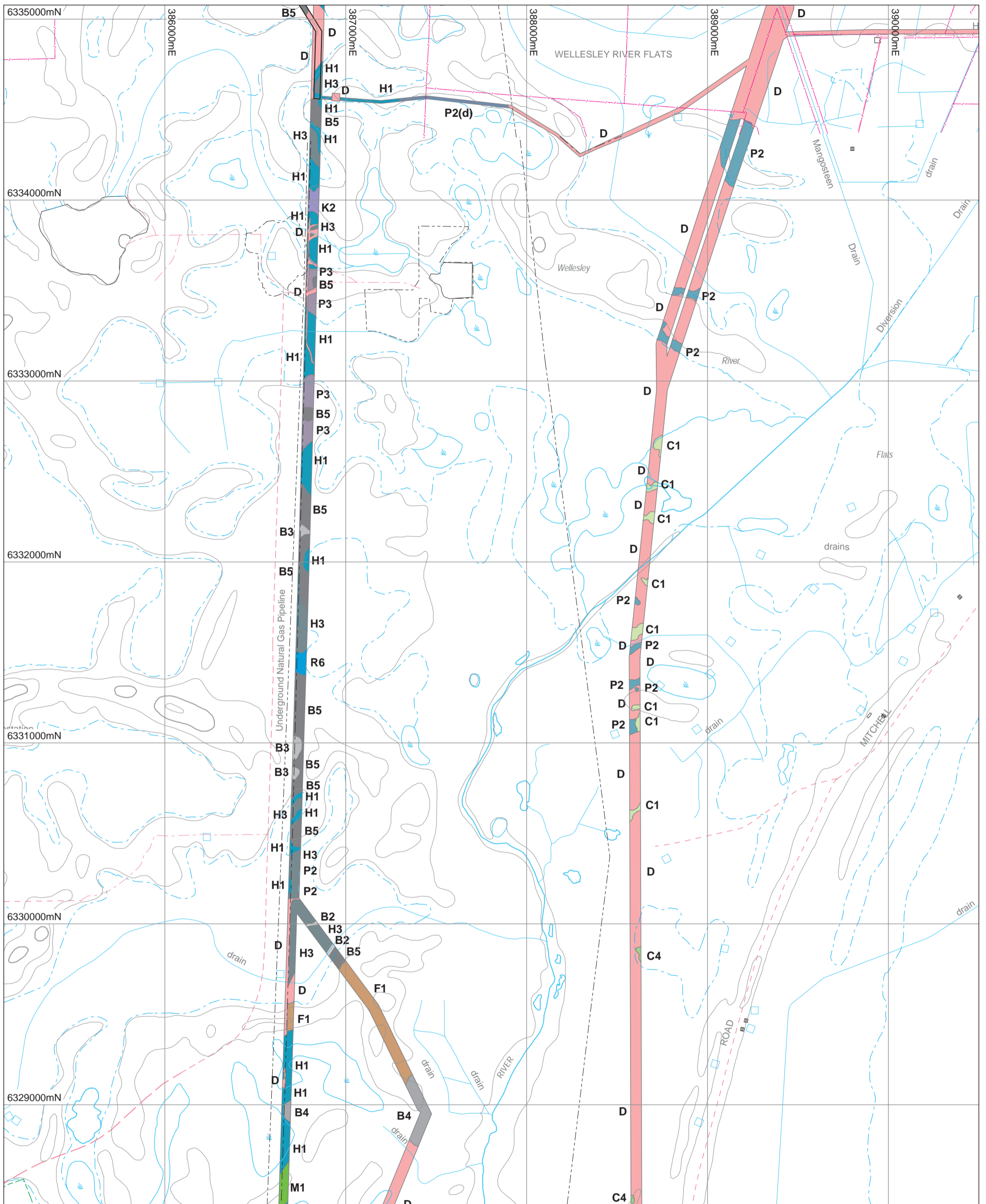
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 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 17
 VEGETATION**

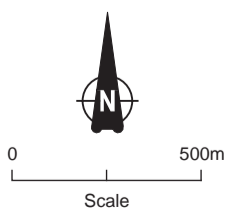
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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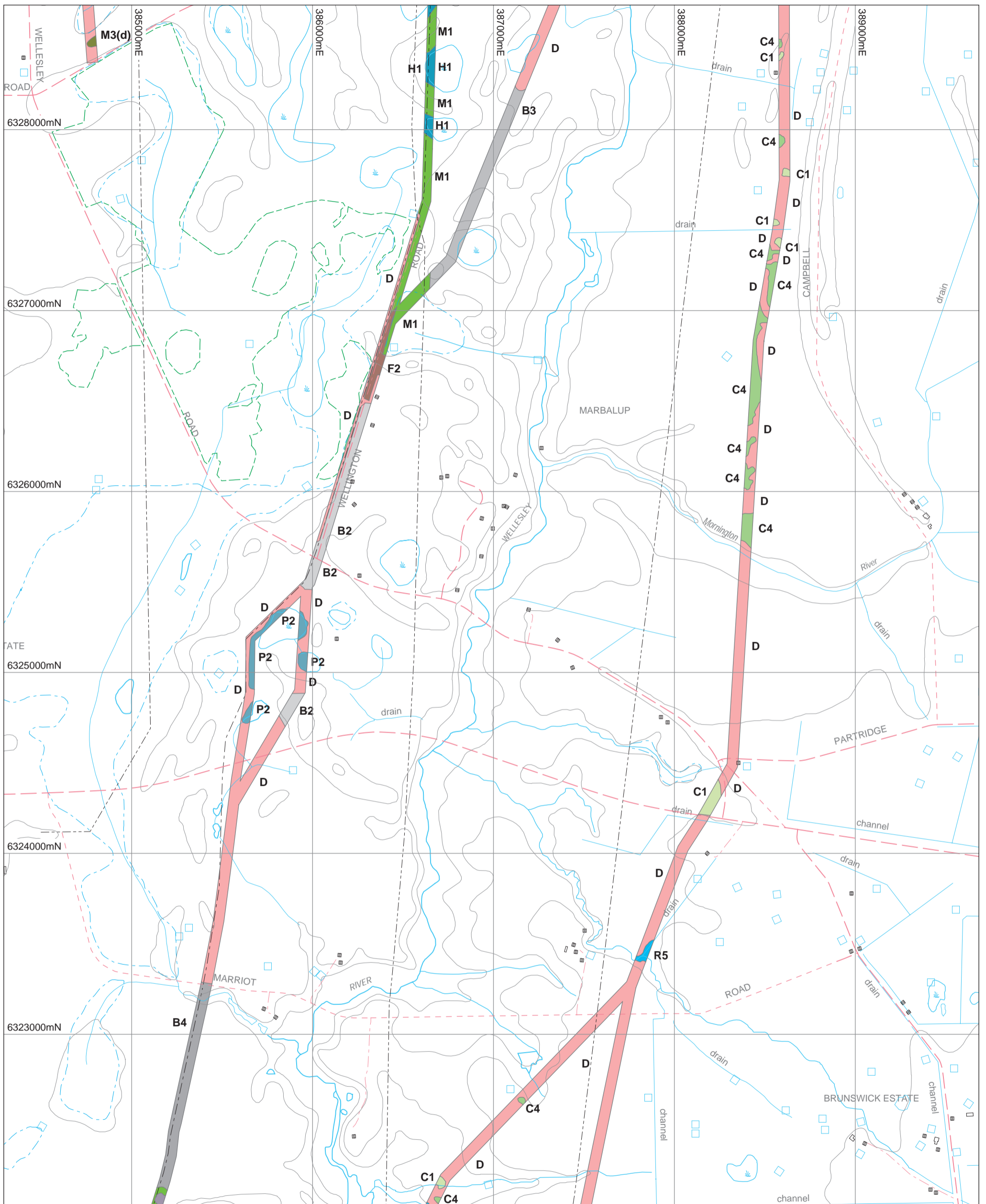
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 18
 VEGETATION**

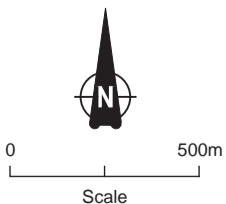
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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 report Numberd DRD0301/101/03



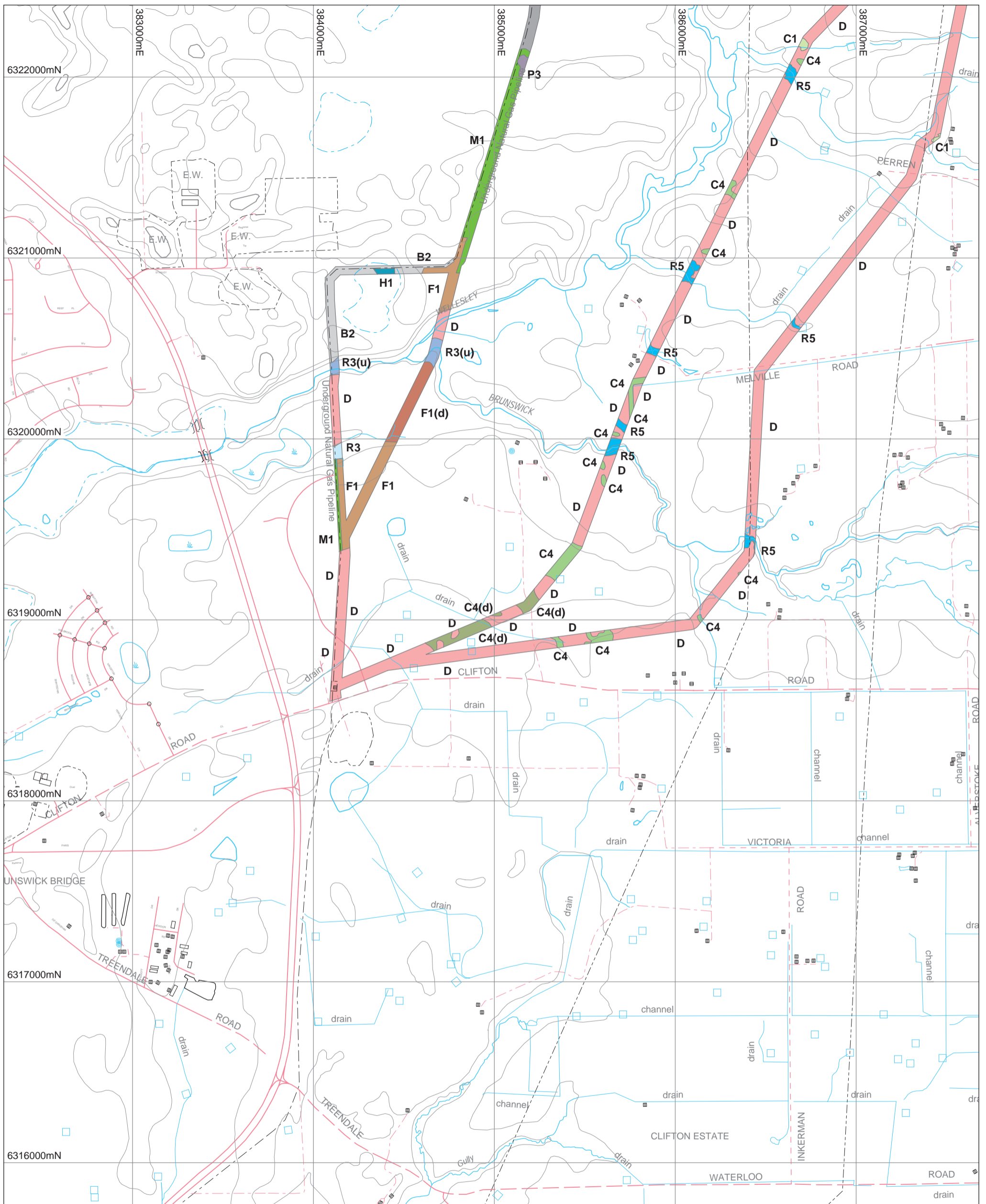
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 19
 VEGETATION**

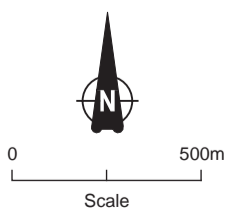
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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 report Numberd DRD0301/101/03



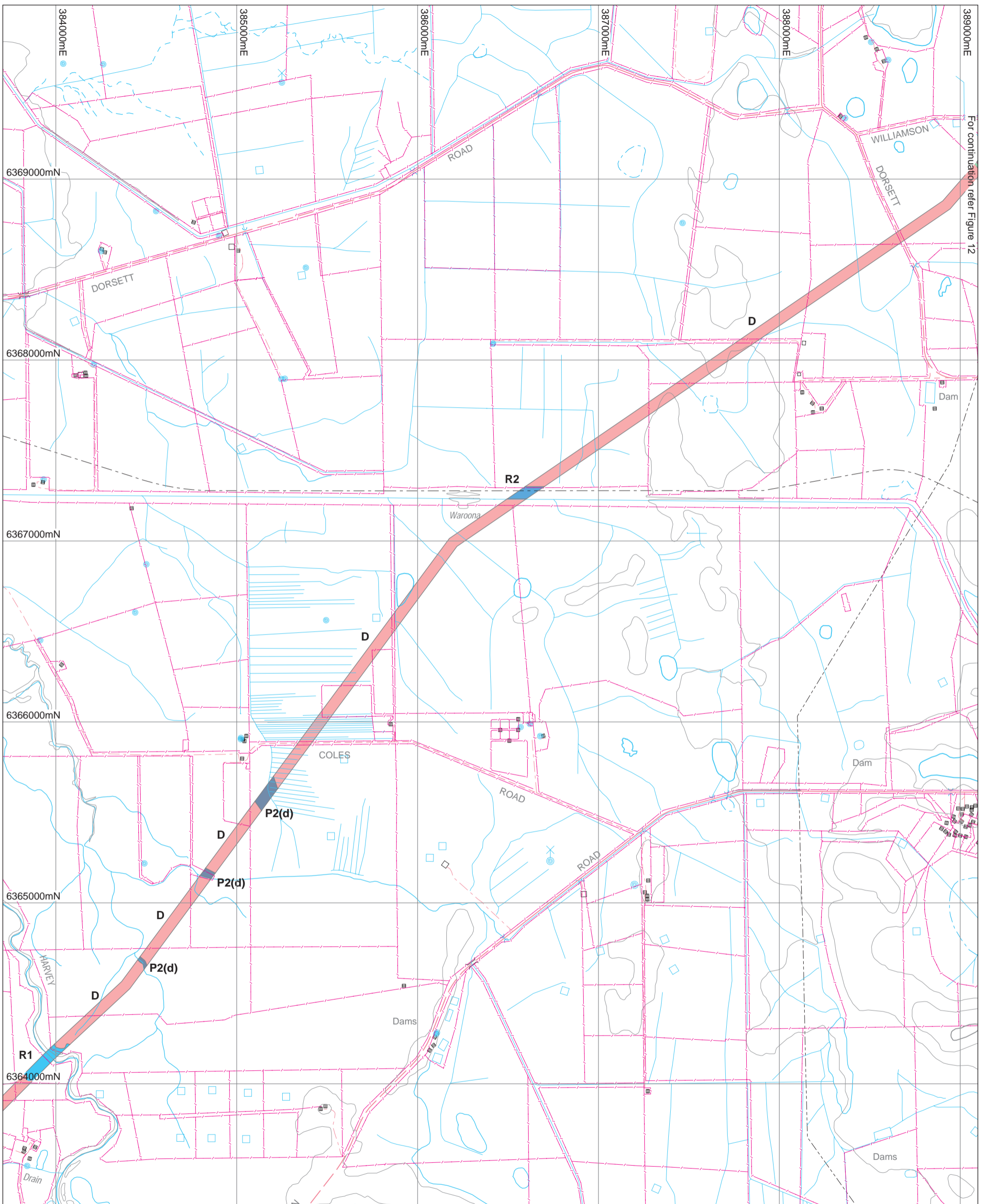
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 20
 VEGETATION**

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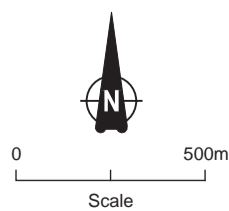
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For continuation refer Figure 12

Notes:

For detailed legend refer figure numbered 1
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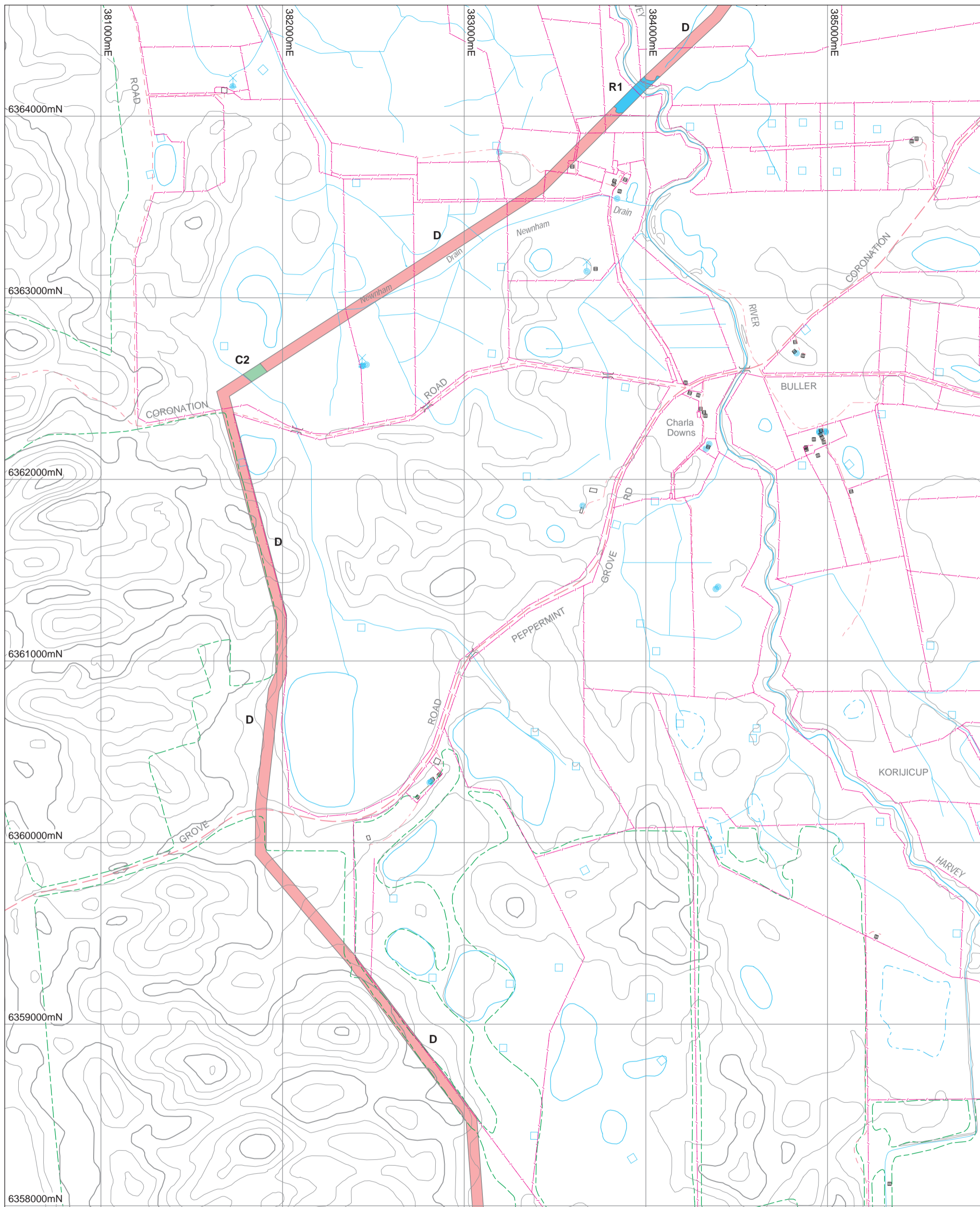
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Environmental Management Consultants



**KWINANA TO AUSTRALIND
GAS PIPELINE CORRIDOR
Figure 21
VEGETATION**

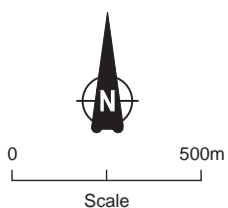
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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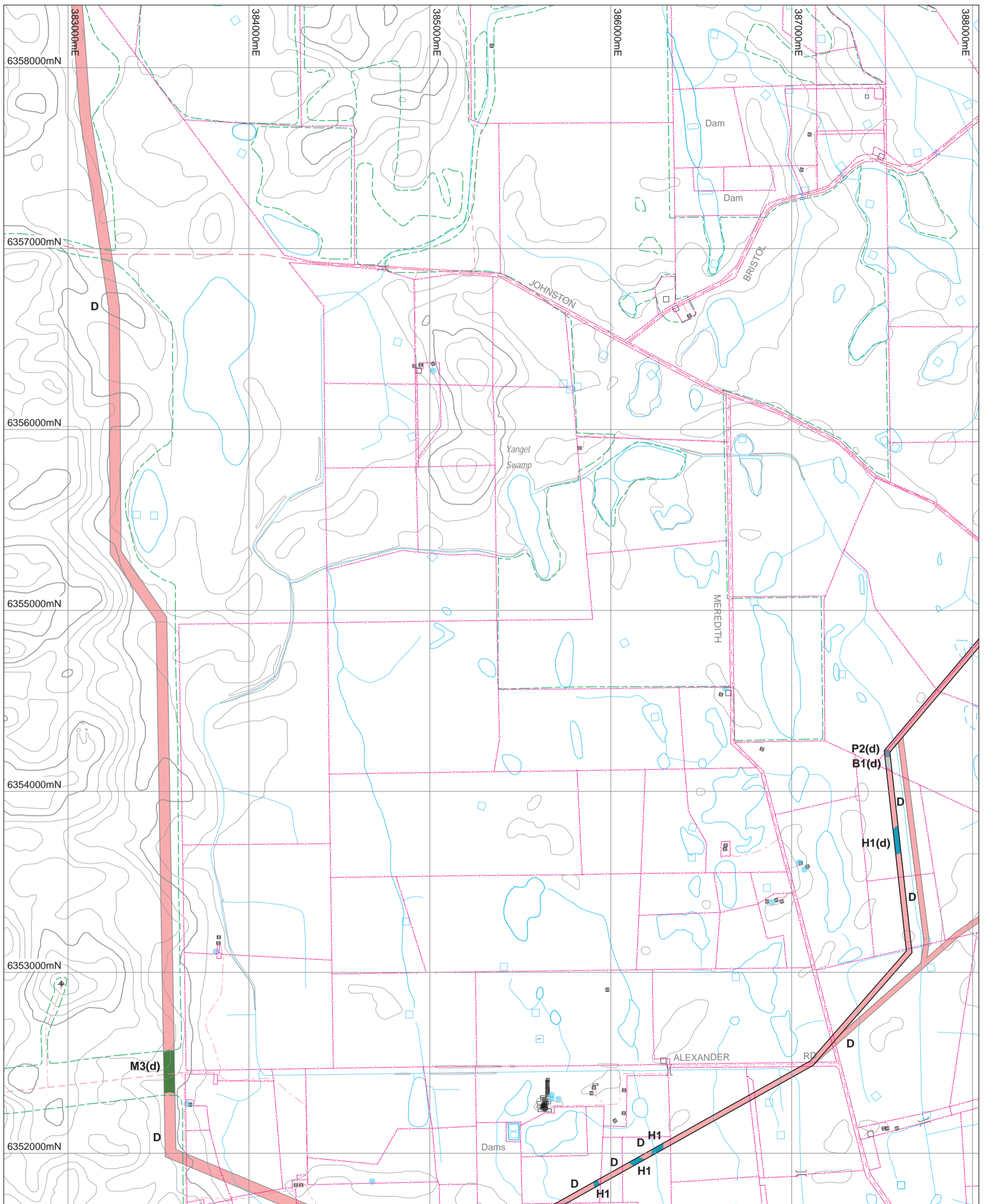
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**KWINANA TO AUSTRALIND
GAS PIPELINE CORRIDOR
Figure 22
VEGETATION**

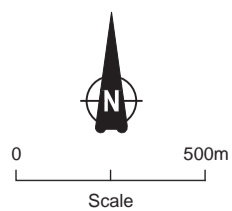
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
 Horizontal Datum: GDA94(Zone 50)
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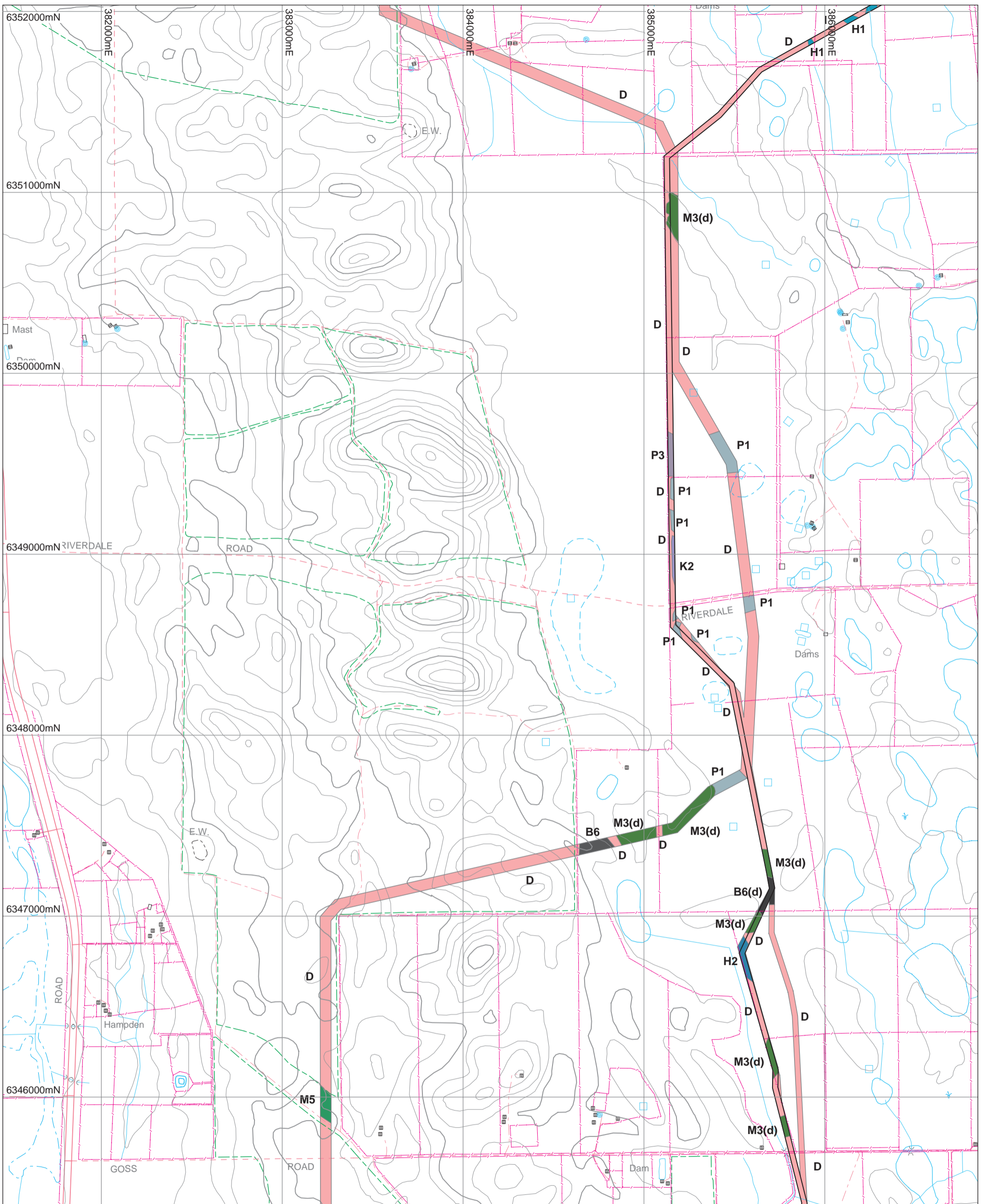
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 23
 VEGETATION**

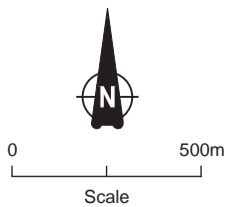
Author: E. M. Mattiske

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Notes:

For detailed legend refer figure numbered 1
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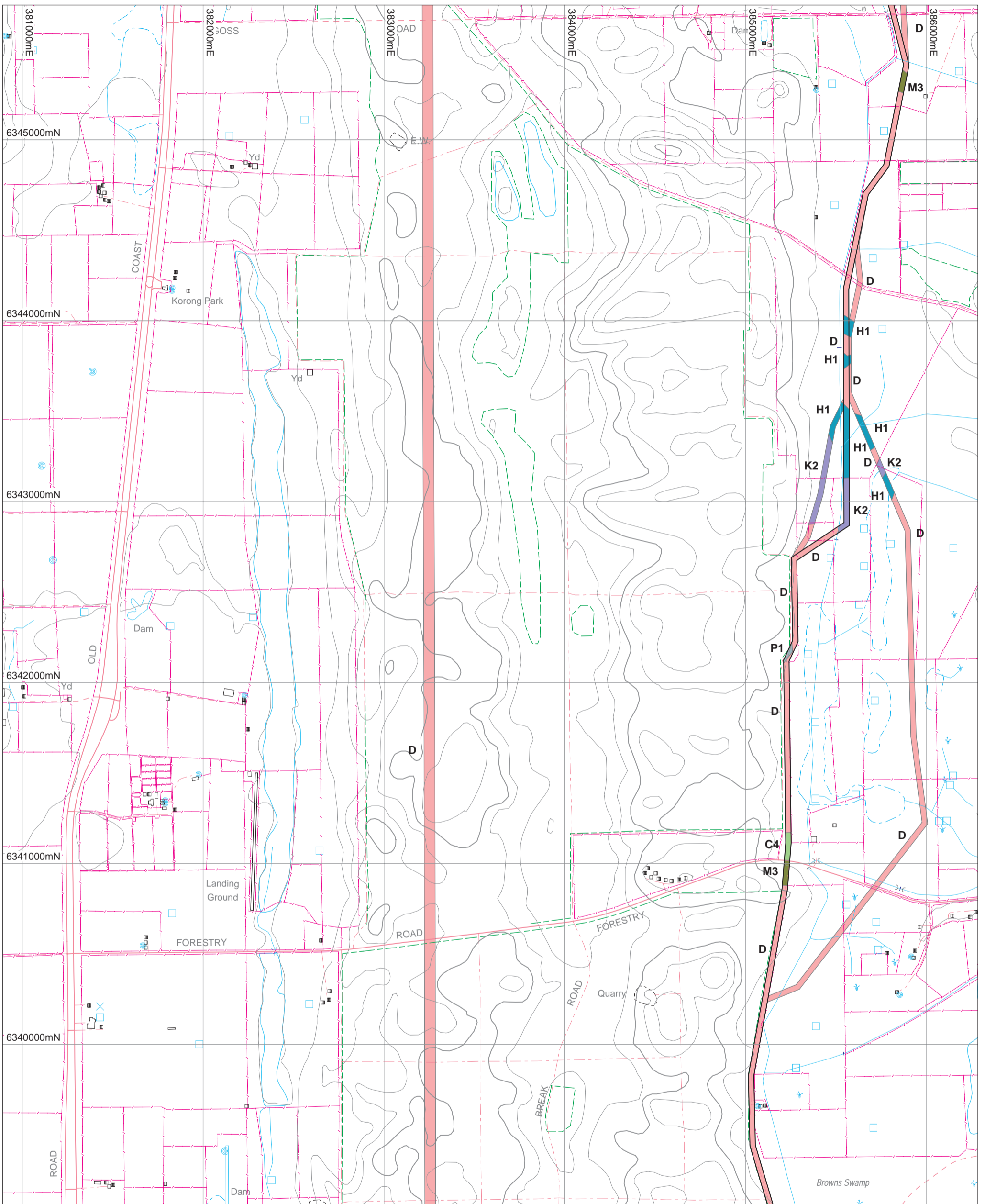
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 24
 VEGETATION**

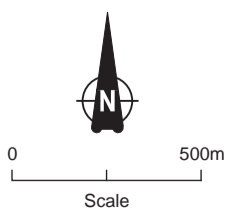
Author: E. M. Mattiske

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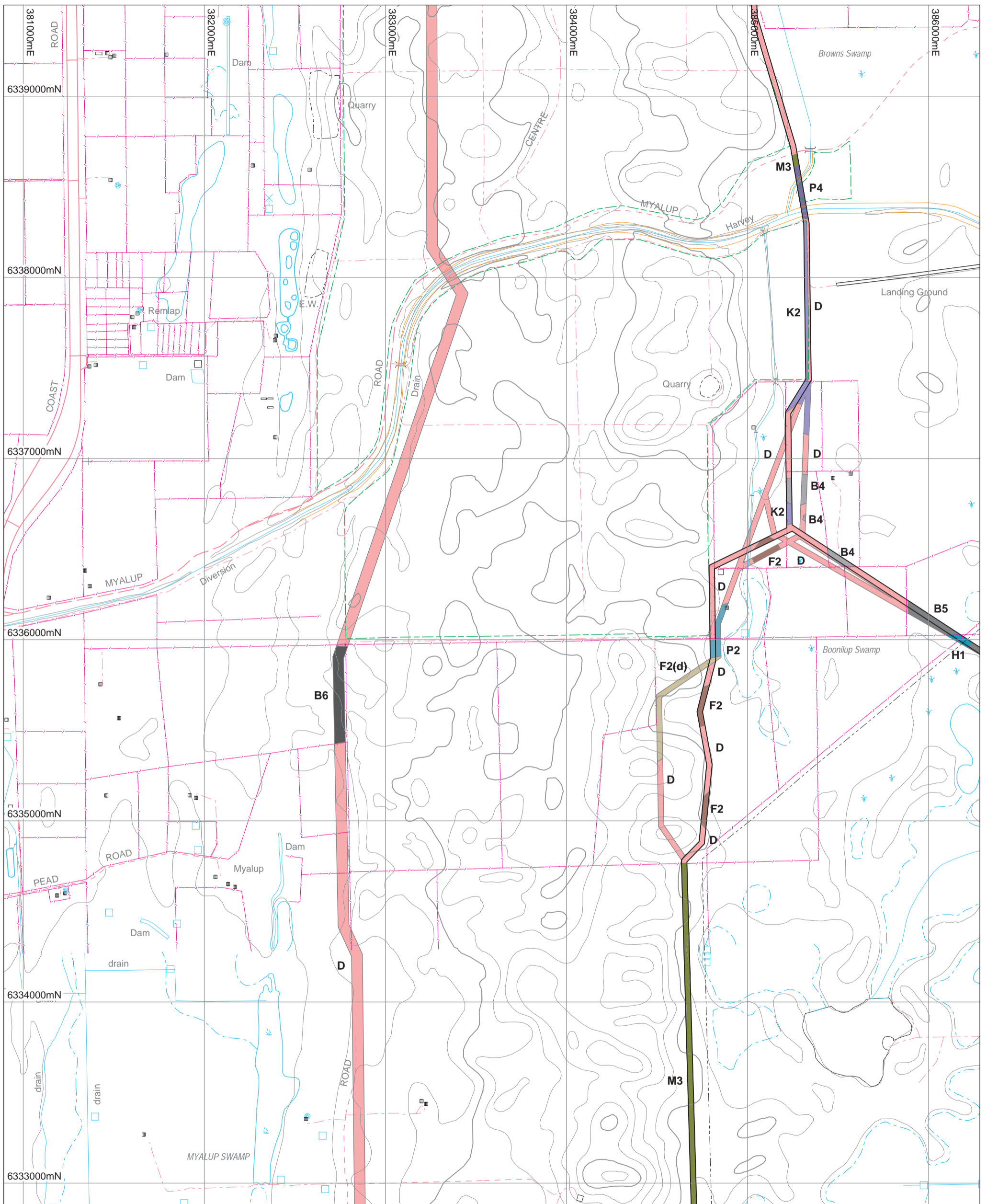
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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 25
 VEGETATION**

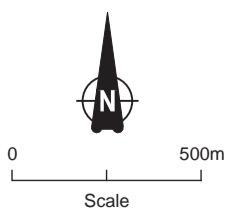
Author: E. M. Mattiske

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Notes:

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 Horizontal Datum: GDA94(Zone 50)
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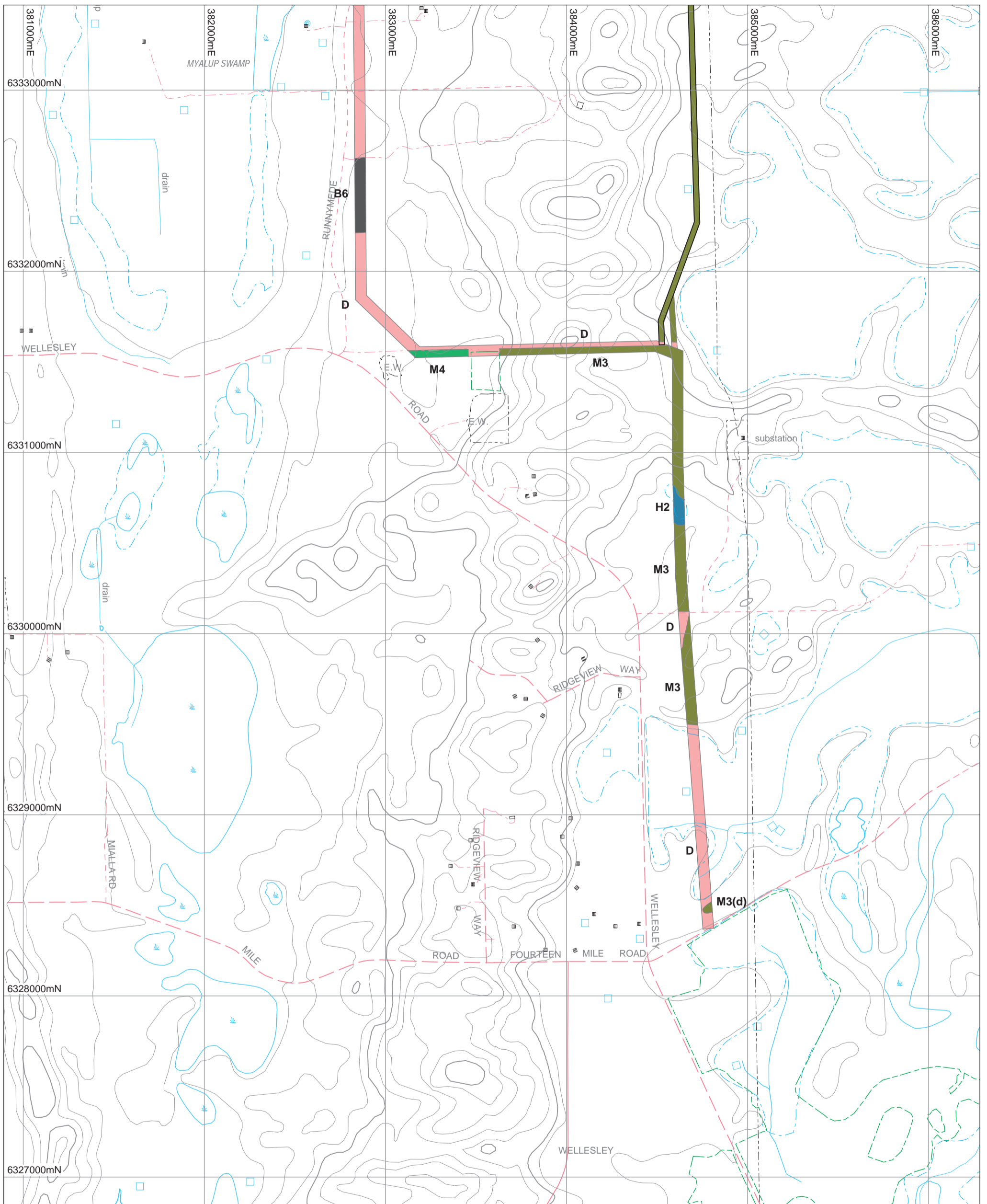
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 Environmental Management Consultants



**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 26
 VEGETATION**

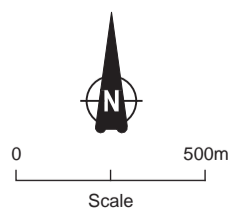
Author: E. M. Mattiske

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**KWINANA TO AUSTRALIND
 GAS PIPELINE CORRIDOR
 Figure 27
 VEGETATION**

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