FLORA SURVEY

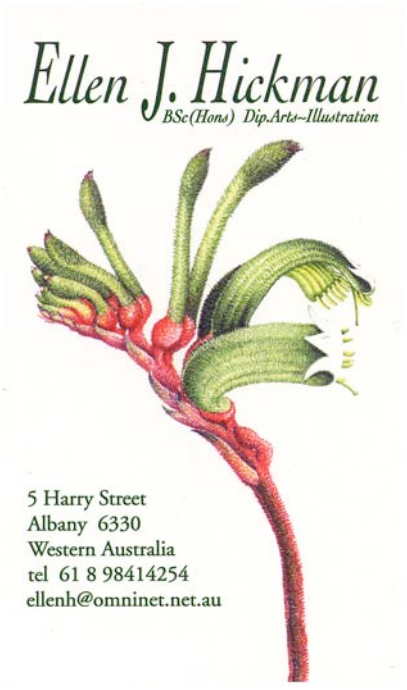
PORTION OF LOT 6382 STEEREDALE ROAD, HOPETOUN, W.A.

PROPOSED GRAVEL EXTRACTION SITES FOR HAMMERSLEY DRIVE UP-GRADE WORK

A report prepared for

Main Roads Western Australia
Chester Pass Road, ALBANY WA 6330

November 2009



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EXECUTIVE SUMMARY

Main Roads Western Australia is undertaking upgrade works to widen and seal Hamersley Drive in the Fitzgerald River National Park (Shire of Ravensthorpe) on behalf of the Department of Environment and Conservation (DEC).

The proposed upgrade work requires gravel extraction. Lot 6382, Steeredale Road north of Hopetoun was selected as an appropriate source for gravel extraction, and a vegetation and flora survey was conducted at three sites.

The vegetation of the proposed gravel extraction sites is open *Eucalyptus pleurocarpa* mallee heath and open *Banksia speciosa* shrubland, neither of which are classified as Threatened or Priority Ecological Communities.

Two species of Threatened Flora were located in association with these sites, *Acacia moirii* subsp. *dasycarpa* and *Banksia porrecta*, both Priority Four Flora species.

At the time of this survey the vegetation was considered to be healthy and in excellent condition. If the sites are used for gravel extraction then it is recommended that;

1. all machinery be cleaned prior to use on the sites, to limit the introduction of weeds and plant pathogens;
2. top soil is stock piled for use in restoration;
3. any soil or water introduced to the site during extraction and/or restoration should be obtained from disease-free sources;
4. only seed and plants sourced from local provenance should be used in restoration to limit future problems with plant genetics.

1. INTRODUCTION

Background

Main Roads Western Australia is undertaking upgrade works on Hamersley Drive in the Fitzgerald River National Park (Shire of Ravensthorpe) on behalf of the Department of Environment and Conservation (DEC). The works will involve widening and sealing of the existing road for tourism purposes, and will remain on its current horizontal alignment.

The proposed upgrade work requires gravel extraction. Since it was deemed there would not be sufficient gravel sources available within the Fitzgerald River National Park without opening new gravel pits, which is not desirable due to the sensitiveness of the area, other appropriate sources of gravel were sort outside the national park. Lot 6382, Steeredale Road north of Hopetoun was deemed appropriate and three proposed gravel extraction sites were identified.

Main Roads Western Australia requires flora surveys of the portions of Location 6382 identified for gravel extraction to provide an appropriate examination and description of the receiving environment to ensure that all aspects of biological/ecological significance are identified and recorded.

Study Area

Lot 6382 Steeredale Road is located within the Esperance Plains Region in the Shire of Ravensthorpe, approximately 3 kilometres north of Hopetoun townsite, and is bounded by the Hopetoun-Ravensthorpe Road to the east, and Steeredale Road to the North. The specific study sites are three areas of remnant native vegetation in the north west of the location (Fig 1.).

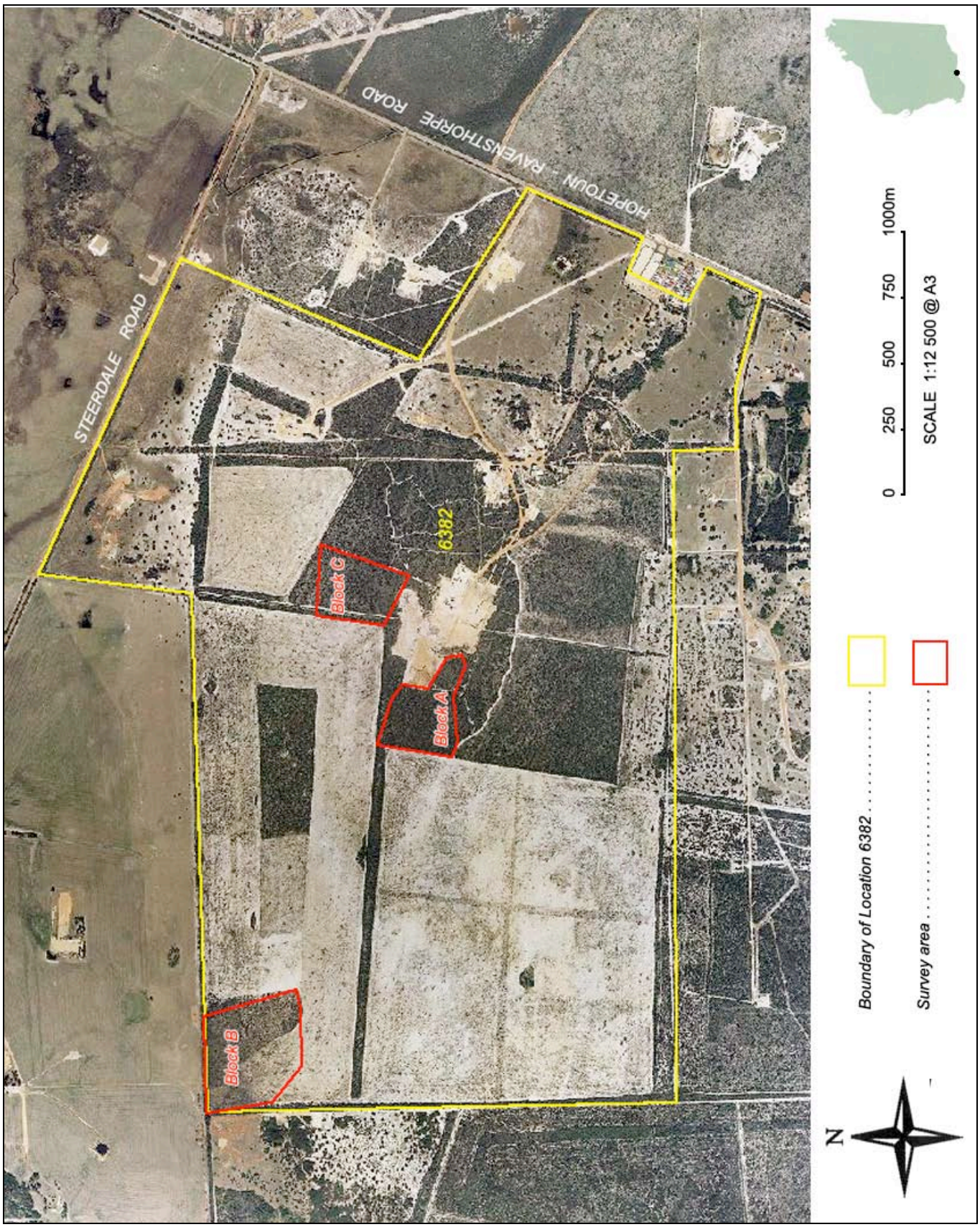

Fig 1. Location of proposed gravel extraction sites on Lot 6382, Steeredale Road, Hopetoun.

2. METHODS

Desktop

Previous reports and publications relevant to the area were reviewed.

A search of the Department of Environment and Conservation (DEC) Threatened Flora Database (DEFL), WA Herbarium database (WAHerb) and Declared Rare and Priority Flora Species List was undertaken.

Field Survey

A foot traverse of each of the three proposed gravel extraction areas was undertaken on 28th September, 2nd and 20th October 2009. The weather was cool to warm (15°C – 28°C max) and sunny or overcast with slight to moderate winds.

Any threatened flora located was marked as waypoints on a Garmin GPS 60 using the GDA94 datum.

Plant specimens were verified using the Albany and Ravensthorpe Regional Herbaria, nomenclature follows WAHERB.

Waypoints were downloaded from the GPS using DNR Garmin software. The waypoints were exported as text files to be imported into Excel to allow for sorting the data into individual files for each species.

3. DESKTOP ASSESSMENT

Physical Environment

Climate

The survey area is located within a region of warm to hot summers and cool, wet winters. The nearest weather station is Hopetoun North, for which the last 13 years of data is available (Table 1). Mean maximum temperature recorded at Hopetoun in the hottest month (February) is 26oC. Mean minimum temperature in the coldest months (July-August) is 8oC. The highest recorded temperature of 46 ^{o}C was recorded in January 1997, while the lowest of -0.3 ^{o}C was in July 2000. Frosts have been recorded by farmers in the catchment during winter and spring, but are usually rare on the coast.

The rainfall is typical of a Mediterranean climate with a pronounced winter maximum and a long dry summer. The mean annual rainfall on the coast is about 500 mm, but has been highly variable over the past 10 years with the maximum of 610 mm in 2001, followed by a very dry year in 2002 when only 274 mm fell. Sporadic heavy rainfall events can occur in summer as a result of cyclonic events in the north of the State - the highest monthly rainfall of 185 mm was recorded in January 2000.

Table 1: Climate data for Hopetoun North (BOM 2009)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature													
Maximum temperature													
Mean maximum temperature (^{o}C)	25.2	25.8	25	23.3	21.6	19.2	18.2	18.9	20.5	21.4	23.1	24.4	**22.2**
Minimum temperature													
Mean minimum temperature (^{o}C)	15.2	15.7	14.3	12.6	10.5	8.5	7.7	7.9	8.7	10	12.2	13.9	**11.4**
Rainfall													
Mean rainfall (mm)	48.6	18.1	29.3	44.5	36.8	49.5	66.3	54.1	49.1	39.5	37.4	24	**496.4**
Highest rainfall (mm)	185	72.4	69.4	138	78.4	106	126	127	109	70.4	97.2	54.6	**609.8**
Date	2000	1997	2006	2007	1999	2005	2001	2001	1996	2008	2008	2008	**2001**
Lowest rainfall (mm)	0	0.2	0	0	8.2	14.4	30	19.6	5.2	14.4	1.4	3.2	**274**
Date	1998	2008	2008	2008	2002	2002	1996	1996	2000	2006	2007	2006	**2002**
Mean number of days of rain	6.5	5.4	7.8	11.5	12.5	13.8	15	14.8	13.9	10.9	8.1	6.7	**126.9**

Geology and Soils

The survey area is located in the Esperance Plains Region that is formed predominantly of Eocene sediments with outcrops of granites and quartzite (Beard 1990). This region is generally a coastal plain, gently rising to 200m from almost sea level, dissected by quartzite ranges and granite domes. The project area lies to the east of East Mt Barren. The soils are described as sandy neutral yellow-mottled containing different levels of ironstone gravel in the surface sand, alternating with leached sands, and are underlain by a substrate of clay at depths of up to 1.5 m. Hard alkaline and neutral yellow- mottled soils occur in the valleys and support mallee vegetation (Beard 1981).

Previous Biological Surveys

Vegetation and flora surveys have been carried out by:

- Beard (1979, 1990) mapped the vegetation at 1:250 000 scale
- Craig (2005) surveyed north-eastern part of Loc 6382 for potential locations for the Hopetoun Waste Water Treatment Plant. That study recorded 46 vascular plant species, one of which was a Priority 2 taxon, *Andersonia macranthera*. This taxon has since been removed from the CALM Priority list (Department of Conservation and Land Management 2005).
- Woodman Environmental (2006) Flora and Vegetation Study as part of rezoning application. That study recorded 118 vascular plants, one of which was the Priority 2 taxon, *Caesia viscida.* It was found in the southern portion of the survey area. Prior to this location it was only recorded from Cape Arid east of Esperance and was poor represented in the herbarium collections.
- Hickman (2007) Follow-up Flora Survey to assess extent of *Caesia viscida* populations within Location 6382.

Vegetation Classification

The project area is located within the Esperance System of the Eyre Botanical District of the south West Province, and defined and mapped by Beard (1979, 1990).

The Esperance System extends eastwards of the Qualup System, rising from sea-level to a height of 180 metres. It is described as a plain incised by valleys of minor seasonally intermittent rivers. The surface of the plain contains numerous small depressions that form intermittent freshwater lakes or paperbark and yate swamps.

The predominant community is mallee-heath on lateritic soils. The mallees occurring comprise *Eucalyptus tetragona*, *E. tetraptera* and *E. incrassata*, with the predominant large shrubs including *Banksia baueri*, *Calothamnus quadrifidus*, *Dryandra longifolia* and *Lambertia inermis*. *Acacia*, *Hakea* and *Isopogon* spp. are typical of the medium shrub layer. The small shrubs and herbaceous plants that form the heath layer include *Andersonia parvifolia*, *Conospermum distichum*, *Darwinia diosmoides*, *Leschenaultia formosa*, *Petrophile phylicoides*, *Synaphea polymorpha* and *Verticordia chrysantha*

(Beard 1973).

Where the sand is greater than approximately 90 centimetres in depth, the vegetation changes from a *Eucalyptus tetragona* dominated mallee-heath to a scrub heath dominated by *Banksia speciosa*. Occurring as far east as the Oldfield River is *Banksia baxteri* and *B. coccinea*. *Lambertia inermis* becomes common and *Nuytsia floribunda* is present. Otherwise the florisitic composition appears to be similar to those comprising the mallee-heath (Beard 1973).

The mallee of the valley slopes is thought to be similar to that of the Qualup system where *Eucalyptus uncinata* and *E. redunca* are the dominant species. *Melaleuca* spp comprise the lower storey. *E. goniantha* appears to be associated with *E. redunca* in the Esperance system.

Woodland comprising patches of virtually pure stands of *E. occidentalis* occur in the valleys. There are no associated trees or shrubs in this woodland and there is very little ground cover.

Woodman Environmental identified and mapped four plant communities and two disturbances units within Location 6382 as part of their Flora and Vegetation Assessment in 2006, these are described below:

- **W**: Low Woodland of *Eucalyptus tetragona* and *Eucalyptus decurva* over *Xanthorrhoea platyphylla* and mixed shrubs on yellow sand with lateritic gravel
- **S**: Open Shrubland of *Banksia speciosa* and *Banksia coccinea* over *Melaleuca striata* and *Beaufortia empetrifolia* over a herb layer dominated by sedges on yellow sand
- **T**: Thicket of *Banksia speciosa* and *Eucalyptus* x *tetragona* over tall shrubs dominated by *Beaufortia empetrifolia*, *Melaleuca striata* and *Adenanthos cuneatus* on yellow or brown sand
- **H**: Heath dominated by *Beaufortia empetrifolia*, *Hibbertia mucronata*, *Melaleuca striata* and *Isopogon trilobus*, with emergent *Eucalyptus decurva*, on yellow sand over limestone

The proposed gravel extraction sites occur mostly within the **S** vegetation type extending into **H** vegetation type on the south boundary of Blocks A and the east boundary of Block C and into **W** vegetation type on the west boundary of Block B.

Threatened Ecological Communities

The search of DEC's Threatened Ecological Communities database found no known occurrences of threatened ecological communities in the study area (M. Hunter, pers.comm.). However, there are occurrences of the following ecological communities within approximately 5 km of the survey area:

- The 'Vulnerable' threatened ecological community – 'Thumb Peak - Mid-Mount

Barren - Woolburnup Hill (Central Barren Ranges) *Eucalyptus acies* mallee heath'

- The 'Priority 1' ecological community – 'Very open mallee over *Melaleuca* sp. Kundip (GF Craig 6020) dense heath'.

Declared Rare and Priority Flora

The WAHERB and DEFL searches found 20 species of threatened flora in the vicinity of the survey area, with one species of Declared Rare Flora. Table 2 below contains a list of these species with their associated conservation codes (see Appendix 1 for definitions).

Table 2: Threatened Flora from near Location 6382 Steeredale Road, Hopetoun.

Species Name	DEC Conservation Code
Acacia aemula subsp. *aemula*	P4
Acacia empelioclada	P4
Acacia moirii subsp. *dasycarpa*	P4
Andersonia carinata	P2
Antherocercis fasciculata	P4
Calochilus pruinosus	P2
Cryptandra craigiae	P1
Dampiera sericantha	P3
Dodonaea hexandra	P1
Eucalyptus famelica	P3
Eucalyptus oleosa subsp. *corvina*	P3
Eucalyptus x *stoataptera*	P2
Hibbertia hamata	P3
Jacksonia compressa	P4
Lechenaultia acutiloba	P3
Mitreola minima	P3
Spyridium montanum	P2
Spyridium oligocephalum	P3
Thysanotus brachiatus	P2
Verticordia pityrhops	R
Verticordia vicinella	P4

4. FIELD INVESTIGATIONS

Vegetation

The majority of the survey area is in open mallee heath of *Eucalyptus pleurocarpa* and *E.decurva* (Fig 2.) or open shrubland of *Banksia speciosa* (Fig 3.).

Fig 2. Open mallee of *Eucalyptus pleurocarpa* and *E.decurva*

Fig 3. Open shrubland of *Banksia speciosa*

The survey identified a total of 144 vascular plants species across the survey area. These species are listed in Appendix 2 and their presence in each of the three proposed gravel extraction sites are recorded in Appendix 3.

Threatened Ecological Communities

No Threatened or Priority Ecological Communities were found during this field survey.

Threatened Flora

Two species of threatened flora were identified during this survey. A summary of each is given below and details of GPS locations are listed in Appendix 4.

***Acacia moirii subsp. dasycarpa* (P4)**

This species is Priority Four Flora species. One plant was located in Block A and 354 plants were located in Block B.

This is an erect spreading shrub 0.15 – 0.6 m high which is densely hairy, has yellow flowers from May to August followed by hairy pods. It is widespread on sandplain from Hammersley Inlet to Munglinup. It occurs on grey, yellow or gravelly sand, sandy clay or loam, rocky loam or quartzite. It is most common after disturbance such as fire. It is recommended for removal from the threatened flora list.

***Banksia porrecta* (P4)**

This species is a Priority Four Flora species. One plant was located in Block B.

This is a prostrate, sprawling, mat-forming shrub 0.2 to 0.35 m high and 0.6 to 4 m wide. It has white, cream flowers from July to August. It occurs on white/grey sand, or sandy loam near Manjimup in the west to east of Ravensthorpe and north to Hyden.

Vegetation Condition

The vegetation was generally in excellent condition with no weed species recorded. Block A and C have not been cleared. Block B vegetation has been cleared and sown to pasture in the past however it has not been maintained and the native vegetation is regenerating well.

A concurrent survey to assess the presence of dieback and other plant pathogens was conducted by Malcom Grant.

5. CONCLUSION & RECOMMENDATIONS

The vegetation of the proposed gravel extraction sites surveyed on Location 6382 Steeredale Road, Hopetoun, is open *Eucalyptus pleurocarpa* mallee heath and open *Banksia speciosa* shrubland, neither of which are classified as Threatened or Priority Ecological Communities.

The Ten Clearing Principles as outlined in Schedule 5 of the Environmental Protection Act 1986 are that native vegetation should not be cleared if;

1. it comprises a high level of biological diversity;
2. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
3. it includes, or is necessary for the continued existence of, rare flora;
4. it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;
5. it is growing in, or in association with, an environment associated with a watercourse or wetland;
7. the clearing of the vegetation is likely to cause appreciable land degradation;
8. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
9. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water;
10. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The only principle limiting the proposed gravel extraction is that the survey areas comprise vegetation that has a high level of biological diversity.

Two species of Threatened Flora were located in association with these sites, *Acacia moirii* subsp. *dasycarpa* and *Banksia porrecta*, both Priority Four Flora species.

DEC ranks plant taxa considered to be threatened under a series of conservation codes, depending on their degree of threat (see Appendix 1). Taxa listed as Declared Rare Flora require permission from the Minister responsible for the Wildlife Conservation Act 1950, if any portion of the plant is to be, or likely to be, disturbed. As Priority Flora does not require permission from the Minister, application for clearance permits will not be required for the proposed extraction of gravel from these sites.

At the time of this survey the vegetation was considered to be healthy and in excellent condition. If the sites are used for gravel extraction then it is recommended that;

1. all machinery should be cleaned prior to use on the sites, to limit the introduction of weeds and plant pathogens;
2. top soil is stock piled for use in restoration;
3. any soil or water introduced to the site during extraction and/or restoration should be obtained from disease-free sources;
4. only seeds and plants sourced from local provenance should be used in restoration to limit future problems with plant genetics.

6. REFERENCES

Atkins KJ (2008) *Declared Rare and Priority Flora list for Western Australia*. Department of Environment and Conservation. August 2008.

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EPA (2004) *Guidance for the assessment of environmental factors (in accordance with the Environmental Protection Act 1986). Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia. No. 51*. Environmental Protection Authority, June 2004.

Hickman EJ (2007) *Follow-up Flora Survey – Portion of Lot 6382 Steeredale Road, Hopetoun, WA*. Unpublished report prepared for Krystal Park Estate Pty Ltd.

Woodman Environmental Consulting (2006) *Krystal Park Estate Pty Ltd Lot 6382 Steeredale Road – Flora and Vegetation Assessment*.

APPENDIX 1: Department of Environment and Conservation's declared rare and priority flora list

Rare flora legislation and guidelines for gazettal

The State Conservation Strategy, Wildlife Conservation Act,1950, and Conservation and Land Management Act 1984 provide the guidelines and legislative basis for the conservation of the State's indigenous plant and animal species. Under the Wildlife Conservation Act, the Department of Environment and Conservation (DEC) is responsible for the protection of flora and fauna of all lands and waters throughout the State. Section 23F of the Act gives the Minister responsible for the Act statutory responsibility for the protection of those classes of flora declared to be rare.

The Wildlife Conservation Act (1950-1985) protects all classes of indigenous flora throughout the State. Protected flora includes:

Spermatophyta – flowering plants, conifers and cycads
Pteridophyta – ferns and fern allies
Bryophyta – mosses and liverworts
Thallophyta – algae, fungi and lichens

Section 23F of the Act provides special protection to those taxa (species, subspecies, varieties) considered by the Minister to be:

- in danger of extinction – the taxon is in serious risk of disappearing from the wild state within one or two decades if present land use and other factors continue to operate;

- rare – less than a few thousand adult plants of the taxon existing in the wild;

- in need of Special Protection – the taxon is not presently in danger of extinction but is at risk over a longer period through continued depletion, or occurs largely on sites likely to experience changes in land use which could threaten its survival in the wild;

  or

- presumed Extinct – taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.

This is achieved by declaring them to bee 'rare' by notice published in the Government Gazette. DEC's Policy Statement No.9 discusses the legislation relating to Declared Rare Flora and outlines the criteria for gazettal.

Under the provisions of Section 23F, the 'taking' of Declared Rare Flora is prohibited by any person on any category of land throughout the State without the written consent of the Minister. A breach of the Act is liable to a penalty of up to $10 000. The legislation refers only to wild growing populations and applies equally the Government officers and private citizens on Crown or private land.

To 'take' in relation to any flora includes 'to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means'. This includes not only direct destruction or injury by human hand or machine but also such activities as allowing grazing stock, introducing pathogens, altering water tables so as to inundate or deprive the flora of adequate soil moisture, allowing air pollutants to harm foliage, and burning.

The schedule published in the Government Gazette is revised annually to accommodate additions and deletions to the Declared Rare Flora. To qualify for gazettal, plants must satisfy certain requirements as defined in Policy Statement No.9, namely:

- the taxon (species, subspecies, variety) must be well-defined, readily identifiable and represented by a voucher specimen in the State or National Herbarium. It need not be formally described under conventions in the International Code of Botanical Nomenclature, but such a description is preferred and should be undertaken as soon as possible after listing on the schedule;
- the taxon must have been thoroughly searched for in the most likely habitats in the wild by competent botanists during the past five years;

- the searches have established that the plant in the wild is either rare, endangered or deemed to be threatened and in need of special protection.

Plants may be deleted from the Rare Flora schedule where:

- recent botanical survey has shown that the taxon is no longer rare, endangered or in need of special protection;
- the taxon is shown to be a hybrib;
- the taxon is no longer in danger of extinction because it has been adequately protected by reservation of land on which it occurs or because population numbers have increased beyond the danger point.

DEC's Priority Species List

DEC maintains a priority species list to determine the need for survey of plants of uncertain conservation status. The list comprises some 1000+ taxa that are poorly known and in need of high priority survey or are adequately surveyed but in need of monitoring. The poorly known taxa are possibly at risk but do not meet the survey requirements for gazettal as Declared Rare Flora (DRF), as outlined in Policy Statement No.9. Only those plants considered to be threatened on the basis of thorough survey or presumed extinct can be included on the DRF schedule.

The priority flora list is divided into the following categories according to the degree of threat.

Priority One (P1) – Poorly Known Taxa

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, e.g. road verges, urban areas, farmland, active mining leases, etc., or plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two (P2) – Poorly Known Taxa

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 are in urgent need of further survey.

Priority Three (P3) – Poorly Known Taxa

Taxa which are known from several 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 are in need of further survey.

Priority Four (P4) – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

APPENDIX 2: Vascular Plant Species Recorded within Survey Area 2009

Family	Species Name
Aizoaceae	*Carpobrotus modestus*
Anthericaceae	*Agrostocrinum scabrum*
	Johnsonia acaulis
	Laxmannia brachyphylla
Asteraceae	*Olearia ciliata*
Boraginaceae	*Halgania anagalloides var. Southern (A.E. Orchard 1609)*
Casuarinaceae	*Allocasuarina humilis*
	Allocasuarina thuyoides
Cyperaceae	*Caustis dioica*
	Cyathochaeta avenacea
	Gahnia ancistrophylla
	Lepidosperma sp. Mt Burdett (M.A. Burgman & C. Layman MAB 3287)
	Lepidosperma sp. Halleys
	Mesomelaena stygia
	Mesomelaena tetragona
	Schoenus caespititius
	Schoenus curvifolius
	Schoenus obtusifolius
	Schoenus pleiostemoneus
	Schoenus subbarbatus
	Tricostularia neesii
Dasypogonaceae	*Calectasia grandiflora*
Dilleniaceae	*Hibbertia acerosa*
	Hibbertia lineata
	Hibbertia mucronata
	Hibbertia racemosa
	Hibbertia racemosa
	Hibbertia recurvifolia
	Hibbertia rupicola
Droseraceae	*Drosera erythrorhiza*
	Drosera paleacea subsp. trichocaulis
Epacridaceae	*Acrotriche cordata*
	Andersonia macranthera
	Andersonia parvifolia
	Astroloma prostratum
	Leucopogon conchifolius
	Leucopogon conchifolius
	Leucopogon conostephioides
	Leucopogon crassifolius
	Leucopogon obtusatus
	Lysinema ciliatum
	Oligarrhena micrantha
Euphorbiaceae	*Stachystemon polyandrus*
Goodeniaceae	*Dampiera fasciculata*
	Dampiera linearis
	Goodenia incana
	Lechenaultia formosa
	Lechenaultia heteromera

Family	Species Name
Haemodoraceae	*Anigozanthos humilis*
	Anigozanthos rufus
	Conostylis serrulata
	Conostylis vaginata
Iridaceae	*Patersonia lanata*
	Patersonia pygmaea
Lamiaceae	*Microcorys barbata*
Loranthaceae	*Nuytsia floribunda*
Mimosaceae	*Acacia crassiuscula*
	Acacia cyclops
	Acacia moirii subsp. dasycarpa
	Acacia rostellifera
	Acacia subcaerulea
	Acacia varia var. parviflora
Myrtaceae	*Baeckea pachyphylla*
	Beaufortia micrantha
	Calothamnus gracilis
	Calytrix decandra
	Calytrix leschenaultii
	Chamelaucium megalopetalum
	Conothamnus aureus
	Darwinia sp. Ravensthorpe (G.J. Keighery 8030)
	Darwinia vestita
	Eucalyptus decurva
	Eucalyptus falcata
	Eucalyptus pleurocarpa
	Leptospermum spinescens
	Melaleuca striata
	Melaleuca subtrigona
	Melaleuca thymoides
	Melaleuca tuberculata var. macrophylla
	Taxandria spathulata
	Verticordia roei subsp. roei
Orchidaceae	*Caladenia longicauda*
	Thelymitra campanulata
Papilionaceae	*Chorizema aciculare*
	Daviesia incrassata subsp. reversifolia
	Daviesia retrorsa
	Daviesia teretifolia
	Eutaxia neurocalyx subsp. leptophylla ms
	Gastrolobium spinosum
	Gompholobium knightianum
	Gompholobium scabrum
	Kennedia nigricans
	Sphaerolobium daviesioides
	Templetonia retusa
Phormiaceae	*Dianella revoluta*
Pittosporaceae	*Billardiera heterophylla*
Poaceae	*Amphipogon turbinatus*
	Neurachne alopecuroidea

Family	Species Name
Polygalaceae	*Comesperma virgatum*
Polygonaceae	*Muehlenbeckia adpressa*
Proteaceae	*Adenanthos cuneatus*
	Adenanthos flavidiflorus
	Banksia baxteri
	Banksia coccinea
	Banksia obovata
	Banksia porrecta
	Banksia pteridifolia
	Banksia pulchella
	Banksia repens
	Banksia speciosa
	Conospermum distichum
	Conospermum teretifolium
	Franklandia fucifolia
	Grevillea coccinea
	Grevillea nudiflora
	Hakea corymbosa
	Hakea ferruginea
	Hakea obliqua
	Hakea trifurcata
	Isopogon polycephalus
	Isopogon teretifolius subsp. teretifolius
	Isopogon trilobus
	Lambertia inermis
	Lambertia inermis
	Lambertia inermis
	Lambertia inermis
	Persoonia teretifolia
	Petrophile seminuda
	Petrophile teretifolia
	Stirlingia anethifolia
	Synaphea oligantha
Restionaceae	*Anarthria gracilis*
	Anarthria prolifera
	Anarthria scabra
	Chordifex crispatus
	Harperia lateriflora
	Hypolaena exsulca
	Lepidobolus chaetocephalus
	Lyginia barbata
Rhamnaceae	*Cryptandra pungens*
	Stenanthemum notiale subsp. notiale
Rubiaceae	*Opercularia vaginata*
Rutaceae	*Boronia crassifolia*
	Boronia ramosa subsp. anethifolia
Stylidiaceae	*Stylidium crassifolium*
	Stylidium piliferum
	Stylidium pilosum
	Stylidium schoenoides
Xanthorrhoeaceae	*Xanthorrhoea platyphylla*

APPENDIX 3: Vascular Plant Species Recorded within each Proposed Gravel Extraction Block.

Species Name	Block A	Block B	Block C
Acacia crassiuscula		*	
Acacia cyclops		*	
Acacia moirii subsp. dasycarpa	*	*	
Acacia rostellifera		*	
Acacia subcaerulea		*	*
Acacia varia var. parviflora	*	*	
Acrotriche cordata		*	
Adenanthos cuneatus	*	*	*
Adenanthos flavidiflorus		*	
Agrostocrinum scabrum		*	
Allocasuarina humilis	*	*	*
Allocasuarina thuyoides		*	*
Amphipogon turbinatus	*	*	*
Anarthria gracilis	*	*	
Anarthria prolifera	*		
Anarthria scabra	*	*	*
Andersonia macranthera	*		*
Andersonia parvifolia		*	*
Anigozanthos humilis		*	
Anigozanthos rufus	*		*
Astroloma prostratum		*	
Baeckea pachyphylla		*	
Banksia baxteri	*		
Banksia coccinea	*		*
Banksia obovata	*	*	*
Banksia porrecta		*	
Banksia pteridifolia		*	
Banksia pulchella	*		*
Banksia repens	*	*	
Banksia speciosa	*	*	*
Beaufortia micrantha	*	*	*
Billardiera heterophylla		*	
Boronia crassifolia	*	*	
Boronia ramosa subsp. anethifolia	*		*
Caladenia longicauda	*	*	
Calectasia grandiflora	*		*
Calothamnus gracilis	*	*	*
Calytrix decandra	*	*	*
Calytrix leschenaultii	*	*	*
Carpobrotus modestus		*	
Caustis dioica	*	*	*
Chamelaucium megalopetalum	*		*
Chordifex crispatus	*	*	*
Chorizema aciculare		*	
Comesperma virgatum		*	
Conospermum distichum	*	*	*
Conospermum teretifolium	*		*
Conostylis serrulata	*		*
Conostylis vaginata	*	*	*

Species Name	Block A	Block B	Block C
Conothamnus aureus	*	*	*
Cryptandra pungens		*	
Cyathochaeta avenacea		*	*
Dampiera fasciculata		*	
Dampiera linearis	*	*	*
Darwinia sp. Ravensthorpe (G.J. Keighery 8030)		*	
Darwinia vestita	*	*	*
Daviesia incrassata subsp. reversifolia	*	*	*
Daviesia retrorsa			*
Daviesia teretifolia		*	
Dianella revoluta		*	
Drosera erythrorhiza	*		*
Drosera paleacea subsp. trichocaulis	*		*
Eucalyptus decurva	*	*	*
Eucalyptus falcata		*	
Eucalyptus pleurocarpa	*	*	*
Eutaxia neurocalyx subsp. leptophylla ms	*	*	*
Franklandia fucifolia			*
Gahnia ancistrophylla		*	
Gastrolobium spinosum		*	
Gompholobium knightianum	*	*	*
Gompholobium scabrum			*
Goodenia incana		*	
Grevillea coccinea		*	
Grevillea nudiflora		*	
Hakea corymbosa	*		*
Hakea ferruginea	*		
Hakea obliqua	*		*
Hakea trifurcata	*		*
Halgania anagalloides var. Southern (A.E. Orchard 1609)		*	
Harperia lateriflora	*	*	
Hibbertia acerosa		*	
Hibbertia lineata	*		
Hibbertia mucronata	*	*	*
Hibbertia racemosa		*	
Hibbertia recurvifolia	*		*
Hibbertia rupicola	*	*	*
Hypolaena exsulca	*	*	*
Isopogon polycephalus	*	*	*
Isopogon teretifolius subsp. teretifolius		*	
Isopogon trilobus	*	*	*
Johnsonia acaulis	*	*	*
Kennedia nigricans		*	
Lambertia inermis	*	*	*
Laxmannia brachyphylla	*	*	*
Lechenaultia formosa		*	
Lechenaultia heteromera	*	*	*
Lepidobolus chaetocephalus	*	*	*
Lepidosperma sp.		*	
Lepidosperma sp. Mt Burdett (M.A. Burgman & C. Layman MAB 3287)		*	

Species Name	Block A	Block B	Block C
Leptospermum spinescens	*	*	*
Leucopogon conchifolius	*		*
Leucopogon conostephioides	*		
Leucopogon crassifolius	*	*	*
Leucopogon obtusatus		*	
Lyginia barbata	*	*	*
Lysinema ciliatum	*	*	*
Melaleuca striata	*	*	*
Melaleuca subtrigona			*
Melaleuca thymoides	*	*	*
Melaleuca tuberculata var. macrophylla	*	*	
Mesomelaena stygia	*	*	*
Mesomelaena tetragona	*	*	*
Microcorys barbata	*		
Muehlenbeckia adpressa		*	
Neurachne alopecuroidea		*	
Nuytsia floribunda	*	*	*
Olearia ciliata		*	
Oligarrhena micrantha	*	*	*
Opercularia vaginata		*	
Patersonia lanata	*	*	*
Patersonia pygmaea		*	
Persoonia teretifolia		*	
Petrophile seminuda		*	
Petrophile teretifolia	*		*
Schoenus caespititius	*	*	
Schoenus curvifolius			*
Schoenus obtusifolius	*		
Schoenus pleiostemoneus	*	*	*
Schoenus subbarbatus			*
Sphaerolobium daviesioides	*	*	
Stachystemon polyandrus	*	*	*
Stenanthemum notiale subsp. notiale		*	
Stirlingia anethifolia	*	*	*
Stylidium crassifolium			*
Stylidium piliferum		*	
Stylidium pilosum	*		
Stylidium schoenoides		*	*
Synaphea oligantha	*	*	*
Taxandria spathulata	*	*	*
Templetonia retusa		*	
Thelymitra campanulata	*		*
Tricostularia neesii			*
Verticordia roei subsp. roei	*		
Xanthorrhoea platyphylla	*	*	

APPENDIX 4: Threatened flora locations

Acacia moirii subsp *dasycarpa* (P4)

Waypoint	Latitude	Longitude	Date	Alt	Plant count
16	-33.90844353	120.1180097	29-Sep-09	53	1
1	-33.90172468	120.102235	2-Oct-09	16	8
2	-33.90171203	120.1022605	2-Oct-09	17	4
3	-33.90170675	120.1023786	2-Oct-09	15	2
4	-33.90164279	120.1024982	2-Oct-09	15	1
5	-33.9016878	120.1025383	2-Oct-09	16	10
6	-33.90171127	120.1027111	2-Oct-09	17	14
7	-33.90176643	120.102919	2-Oct-09	18	16
8	-33.90178939	120.1030413	2-Oct-09	22	4
9	-33.90179451	120.1032281	2-Oct-09	18	12
10	-33.90172888	120.1035155	2-Oct-09	19	7
11	-33.90169015	120.1036399	2-Oct-09	18	12
12	-33.90170725	120.1038563	2-Oct-09	17	12
13	-33.90176819	120.104262	2-Oct-09	16	5
14	-33.90179191	120.1044349	2-Oct-09	21	9
15	-33.90174857	120.104592	2-Oct-09	15	14
16	-33.90193373	120.1059486	2-Oct-09	20	7
17	-33.90204437	120.106033	2-Oct-09	23	1
21	-33.90253019	120.1054691	2-Oct-09	23	17
22	-33.90253144	120.1051261	2-Oct-09	23	3
23	-33.90257654	120.104737	2-Oct-09	23	10
24	-33.90262499	120.1046078	2-Oct-09	23	17
25	-33.90258182	120.1044491	2-Oct-09	23	7
26	-33.90258249	120.1043087	2-Oct-09	23	18
27	-33.90258995	120.1040535	2-Oct-09	23	2
31	-33.90273211	120.1027048	2-Oct-09	19	5
32	-33.90277837	120.1024556	2-Oct-09	19	3
33	-33.90279195	120.1023758	2-Oct-09	18	5
34	-33.90283487	120.1021595	2-Oct-09	17	8
35	-33.90275331	120.1019415	2-Oct-09	17	3
36	-33.90348036	120.1023843	2-Oct-09	17	10
37	-33.9033558	120.1027948	2-Oct-09	21	13
38	-33.90328305	120.1030121	2-Oct-09	22	18
41	-33.90310703	120.1040997	2-Oct-09	22	6
43	-33.90316243	120.1051818	2-Oct-09	25	3
44	-33.90319252	120.10544	2-Oct-09	24	2
45	-33.90322739	120.1062527	2-Oct-09	27	10
46	-33.90432928	120.1060053	2-Oct-09	29	5
48	-33.90418972	120.1051826	2-Oct-09	28	12
51	-33.90420103	120.1044546	2-Oct-09	27	3
52	-33.90416021	120.1039341	2-Oct-09	24	2
53	-33.90400934	120.1033734	2-Oct-09	22	4
55	-33.90399207	120.102954	2-Oct-09	21	12
56	-33.90401948	120.1025751	2-Oct-09	20	10
57	-33.90402636	120.1021505	2-Oct-09	19	8
					355

Banksia porrecta (P4)

Waypoint	Latitude	Longitude	Date	Alt	Plant count
27	-33.90258995	120.1040535	2-Oct-09	23	1
					1