EXCAVATION PLAN

LOT 901 (150) FLYNN DRIVE, NEERABUP

prepared by

Landvision

April 2014

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1.0 INTRODUCTION

The purpose of this report is to support an application for approval for an extractive industry license for the extraction of sand from Lot 901 Flynn Drive, Neerabup. The applicant is Carramar Sands.

Lot 901 is part of former Swan Location 2477 for which approval was given by the City of Wanneroo for sand extraction on January 31, 1996. It is 7 kilometres north east of Wanneroo and abuts a major urban expansion area at Neerabup (See Figure 1).

The approval was for Stages One, Two and Three depicted in an accompanying Excavation Management Plan prepared by Landvision in July 1995 (See Figure 2).

The subject land is zoned Industrial in the Metropolitan Region Scheme and is within the Neerabup Industrial Area Structure Plan area which covers approximately 1000 hectares (See Figure 3).

Excavation of former Swan Location 2477 has been carried out by Carramar Sands and has been ongoing since 1996. It has been confined to the western portion of the site. Location 2477 has been subsequently subdivided into 3 lots. The extraction on Lot 900 is complete and Lot 900 is being rehabilitated for industrial use. This application relates to Lot 901 and to which stage two and part of Stage 3 of the original application applies.

Part of Lot 901 has been used as a market garden. However water allocation limitations prevents a larger area being used for this purpose. The existing market garden is to be excluded from the excavation plan.

Lot 901 has been transposed onto the previous application. As can be seen Stage Two and part of Stage Three are contained in Lot 901. This application is for excavation within Lot 901 only, being an extension of the licence granted under the previous approval.

As part of the rehabilitation plan under the original approval, Carramar Sands is currently filling the excavation on Lot 900 with approved land fill in accordance with an approved management plan. The final finished surface levels are to be in accordance with Structure Plan No. 17 for the Neerabup Industrial Area.

All quarrying is required to be finished to design levels which allow for eventual industrial development over this area. Individual operators are responsible for ensuring that finished ground levels following extraction comply with the final surface contour plan.

The Structure Plan anticipates extraction to occur over much of the Structure Plan area and provides a final surface contour plan. On the subject land, the final contours range from 62m AHD at the northern boundary to 66m AHD at the southern boundary. These levels must be complied with at the completion of extraction.

The Structure Plan provides flexibility for an operator to consider alternative floor levels or greater extraction and allows for back filling to provide an economic return and thereby seek a variance to the levels shown.

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DATE: 2 December 2013
Job No. : 1671

LOCATION PLAN

LOT 901, FLYNN DRIVE, NEERABUP

FIGURE 1

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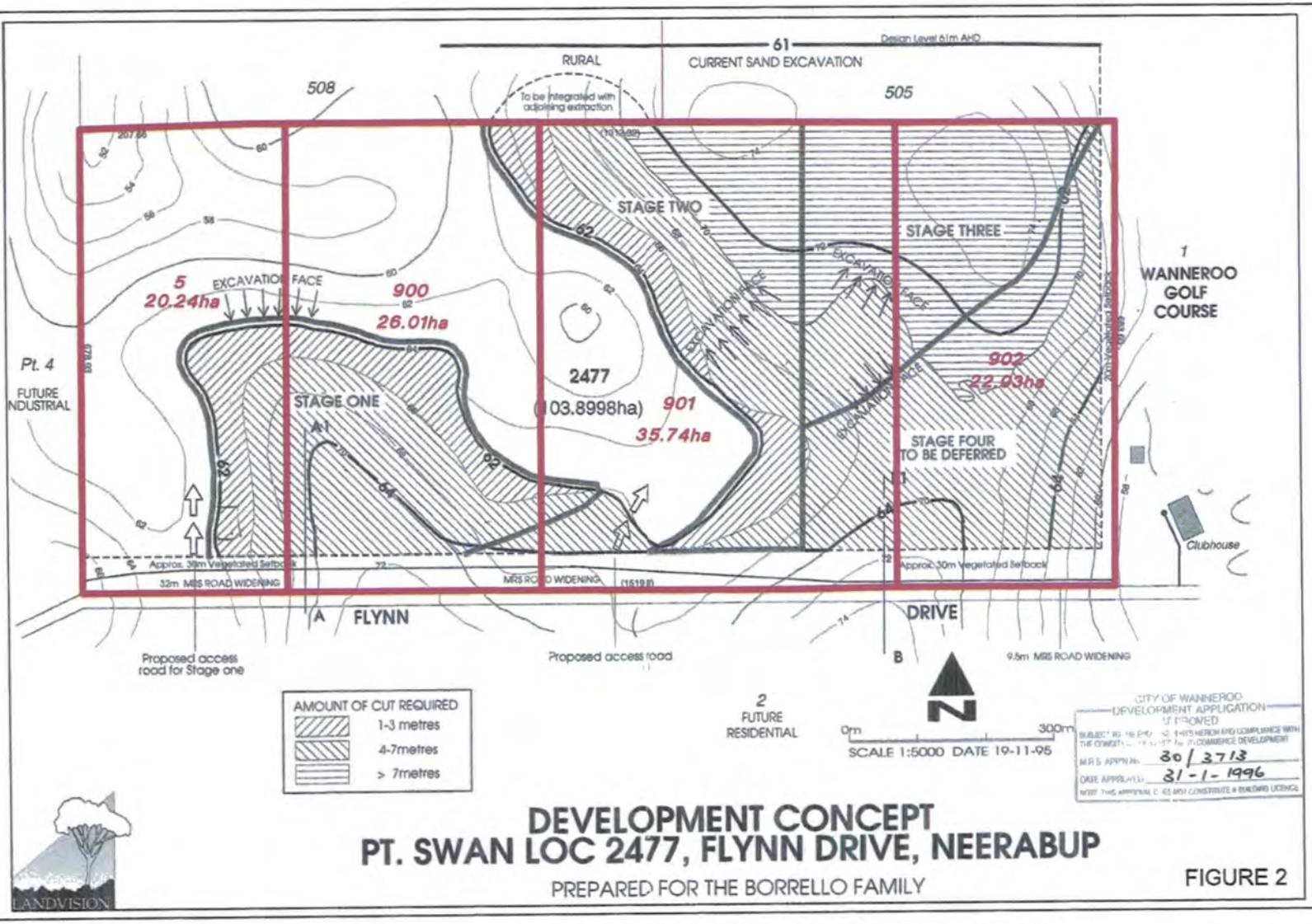

DEVELOPMENT CONCEPT
PT. SWAN LOC 2477, FLYNN DRIVE, NEERABUP

PREPARED FOR THE BORRELLO FAMILY

FIGURE 2

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APPROVED EXCAVATION MANAGEMENT PLAN

(Showing current cadastral boundaries)

LOT 901, FLYNN DRIVE, NEERABUP

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FIGURE 2

FILE: D:\Data\Planning\1671 flynn\1671 flynn-001.dgn

However, the depth of excavation needs to be at least 2.0 metres higher than the groundwater contours shown in the former Water and Rivers Commission Groundwater Atlas.

Connection to power, water and telephone are available to the site.

Lot 902 to the east of the subject land although within the structure plan area is excluded from industrial development, being a designated Bush Forever site (See Figure 3).

The broader area is a recognised quarrying area. A sand pit has been operating on adjoining land to the north as well as to the west, and limestone quarries have been operating two kilometres to the west for many years.

The land south of Flynn Drive is planned to be developed as urban land and Flynn Drive is planned to become a major traffic route with a widening possibly required from the subject land.

The Structure Plan for the Neerabup Industrial Area illustrates the road structure and land use precincts for its future industrial use following quarrying and rehabilitation. The subject land is in the 'General Industrial' precinct and is to be accessed from a proposed north - south road located to the west of the subject land and which intersects with Flynn Drive in the south and Pederick Road in the north (See Figure 3).

Two east – west roads and a service road parallel to Flynn Drive indicate a possible future subdivision layout for the site.

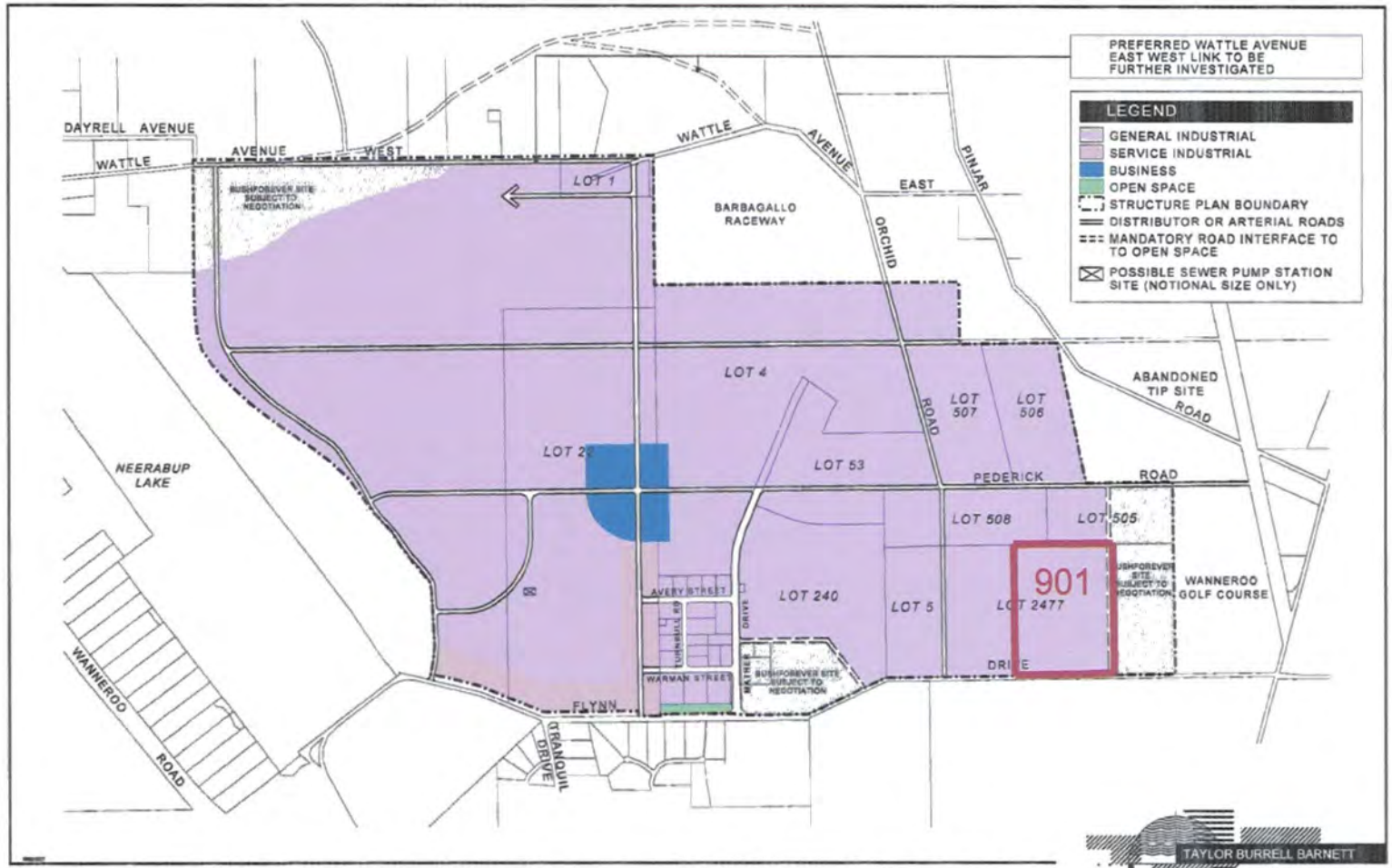
Importantly as the subject land is allocated to future industrial use, sand excavation will enable a final design surface to be created to suit industrial development. In this respect the surface can be modified to meet the structure plan for the area.

2.0 THE SAND RESOURCE

A report by the Western Australian Chamber of Commerce and Industry released in December 2007 entitled 'Basic Raw Materials Access and Availability 1996 – 2008', indicated that available sand reserves in the Northern Metropolitan Region were in short supply.

A high proportion of northern metropolitan supply comes from a single source - State Forest 65.The other major reserve in the northern metropolitan area was Landsdale, much of which has now been developed or is being developed for urban and industrial purposes. Lot 901 has now become an important source of quality sand.

On Lot 901, yellow quartz sand has been shown through the drilling of a water bore to extend to depths of up to 35 metres. A shallow layer of leached white sand covers parts of the surface. Sand of this type is often used for fill sand, however brickie's sand is available at depth when the clay content increases slightly. Lot 901, Flynn Drive is ideally located to augment supplies particular for the North West Corridor.



NEERABUP INDUSTRIAL AREA
ZONING AND LOCAL STRUCTURE PLAN

PLAN 1

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PROPOSED EXCAVATION SITE

(In the context of the)
NEERABUP INDUSTRIAL AREA STRUCTURE PLAN
LOT 901, FLYNN DRIVE, NEERABUP

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FIGURE 3

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Soils

The following description of the site is taken from the 1995 Extraction Management Plan.

The site is covered by Spearwood Sands and is underlain at depth by Tamala Limestone as revealed by Water Authority of Western Australia Bore SW 35.

The Spearwood Sands are thought to have originated by being blown from weathering Tamala Limestone which is widespread along the coastal area of Western Australia. The age of limestone is late Pleistocene and the Spearwood Dunes are thus assumed to be younger.

Soils in the area are shallow, yellow brown, loamy sands. They are generally classified as the Spearwood soils; Uc1.23 (Northcote) and are part of the Karrakatta association. Soil depths are very deep with the surface sand to form a podsol with bleached white – grey surface sand. Humus colours the surface sand grey.

Hydrology

The area has no surface drainage because of the permeable and porous nature of sand. Drainage is to the water table which comes to the surface as the Neerabup Lake wetlands, 4.5kms to the west and Little Coogee Swamps, 1.5km to the east. Groundwater flow is from the Little Coogee System with a general ground water flow to the west at depth. Groundwater occurs at 40m AHD – 44m AHD.

The site is a proclaimed groundwater management area and is proposed to be a proclaimed Priority 3 Underground Water Pollution Control Area. It lies just west of the Wanneroo Underground Water Pollution Control and Public Water Supply Area. Production bores occur 5.5 km to the east within the Wanneroo Priority 1 UWPCA.

A licensed bore is located on Lot 901 with an allocation for 53 kl/annum and will be used for washing and settling dust.

Land Use

Part of the land has been utilised as a market garden for 13 years, with the remaining land being uncleared Banksia Woodland.

Surrounding land uses include sand excavation, inert landfilling, limestone quarrying to the west, undeveloped bushland and motorsport to the north and a golf course to the east. Further west is the mixed use/industrial/warehousing/commercial area of Mather Road and Warman Street.

Access

Flynn Drive is a planned major through road linking Wanneroo Road with Bullsbrook to the east. Its future alignment and elevation in all likelihood will be modified from the current alignment and elevation, to suit greater volumes of traffic. It makes economic and planning sense to utilise sand from the site while at the same time modifying the land surface to conform with the requirements of Flynn Drive and the proposed industrial site.

3.0 ENVIRONMENTAL ASSESSMENT

Flora and Vegetation

ATA Environmental 2006 Survey

The flora and vegetation of the site was surveyed in September 2006 as part of a wider survey of the Neerabup Industrial Area (ATA Environmental 2007). The survey identified three vegetation types on the site as follows:

EmLW *Eucalyptus marginata* (Jarrah) Low Woodland with scattered *Banksia attenuata, Banksia menziesii* and *Allocasuarina fraseriana* over *Xanthorrhoea preissii* Low Open Shrubland

EmTOW *Eucalyptus marginata* (Jarrah) Woodland to Tall Woodland with scattered *Banksia attenuata* and *Banksia menziesii* over *Xanthorrhoea preissii* and *Hibbertia hypericoides* Low Open Heath

AcCTS *Adenanthos cygnorum* (Woolly Bush) Closed Tall Scrub with scattered *Allocasuarina fraseriana, Nuytsia floribunda, Eucalyptus todtiana* and *Banksia grandis* trees over *Hibbertia hypericoides* and *Xanthorrhoea preissii* Low Open Shrubland.

The condition of the Jarrah vegetation on the site recorded by ATA Environmental was Very Good to Excellent. The Woolly Bush vegetation in the south-east corner was rated as Good to Very Good.

ATA Environmental (2007) considered that the vegetation on the site was most likely to be representative of the following Floristic Community Types:

FCT 21a – Central *Banksia attenuata – Eucalyptus marginata* woodlands
FCT23a – Central *Banksia attenuata – Banksia menziesii* woodlands; and
FCT 28 – Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* woodlands

None of the Floristic Community Types is a Threatened or Priority Ecological Community.

The flora survey recorded 139 species (127 native) in the whole NIA area, none of which was listed as a Threatened (Declared Rare) or Priority listed flora species.

Current Situation

A site assessment by Dr Paul van der Moezel of PGV Environmental was undertaken on 14 February 2014. The assessment revealed that the vegetation on the site had been highly modified since the 2006 ATA Environmental survey. According to the historic aerial photos progressive clearing of the native vegetation started in early 2010 and was largely completed by April 2012.

A small amount of intact native vegetation occurs in the south-west corner of the lot. The vegetation consists of a Jarrah/Sheoak (*Allocasuarina fraseriana*)/*Nuytsia floribunda* Low

Woodland with some *Banksia menziesii* and Woolly Bush trees over *Hibbertia hypericoides/Desmocladus flexuosus* Heathland (Plate 1). The condition of this area was rated as Very Good.

Plate 1 Vegetation in the south-west corner

Some clumps of stunted Jarrah trees have been retained around the carpark and site office near Flynn Drive (Plate 2) as well as around the mulching facility in the north-west corner.

Plate 2. Clumps of Jarrah near around the entry road and site office

The north-east quarter of the site contains a mix of cleared land, areas with native shrubs and no trees, previously cleared areas with some regeneration of native shrubs, and small clumps of remnant trees and understorey (Plate 3).

The few mature trees remaining in this area are mostly *Banksia attenuata* and some *B. menziesii.* No *Banksia* seedlings were observed in the area. Some Jarrah saplings are regrowing from the cleared stumps (Plate 4). The areas containing understorey species only contains common species *Xanthorrhoea preissii, Stirlingia latifolia, Alexgeorgea nitens,*

Haemodorum spicatum, and *Banksia dallanyei.* Common weed species include *Ehrharta longiflora* (Veldtgrass), *Briza maxima* (Blowfly Grass) and *Carpobrotus edulis* (Pigface). Overall the condition of the vegetation in the north-east quarter is considered Degraded according to the definition of vegetation condition in Bush Forever (Government of WA, 2000) where the vegetation structure has been severely impacted by disturbance. Loss of tree canopy is considered a severe impact on vegetation structure.

Plate 3 Cleared area with some native shrubs

Plate 4 Regenerating Jarrah

The highly disturbed condition of the vegetation in the north-east quarter is too degraded to assign a Floristic Community Type. As a result, the vegetation on the site is not considered to be either a Threatened or Priority Ecological Community.

No conservation significant flora species are expected to occur on the site as none were recorded during the 2006 ATA Environmental survey on the site or in the broader Neerabup Industrial Area and the site has been significantly impacted by clearing.

Fauna

ATA Environmental 2006 Survey

A Level 2 fauna survey was conducted for the broader Neerabup Industrial Area (NIA) in 2006 by ATA Environmental and included Lot 901 (previously part of Lot 2477).

The fauna survey identified five habitat types in the whole NIA study area. Of those, two occurred on the site in 2006: Jarrah and Banksia Woodland over mixed Low Shrubland; and Woolly Bush dominated Closed Tall Scrub.

The fauna survey recorded three conservation significant species in the NIA: Carnaby's Black Cockatoo, Peregrine Falcon and the Rainbow Bee-eater. Of these three species, two (Carnaby's Black Cockatoo and Rainbow Bee-eater) are listed on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Carnaby's Black Cockatoos were recorded on several occasions feeding on Banksia trees. No roosting or breeding was recorded during the survey. The Banksia woodland habitat present on the site in 2006 would have provided foraging habitat for Carnaby's Black Cockatoo.

The Peregrine Falcon was recorded during the survey and was considered likely to be an infrequent visitor to the area.

The Rainbow Bee-eater was recorded on multiple occasions during the 2006 survey but no nests were observed. ATA Environmental concluded that the site represented a small fraction of the habitat for this species and other similar habitat existed nearby.

Current Situation

A site assessment was undertaken by PGV Environmental on 14 February 2014 to determine the significance of the site for any conservation significant fauna. The assessment revealed that very little of the site contains intact native vegetation. Only a small section in the south-west corner contains woodland habitat in very good condition. Elsewhere the site contains scattered Jarrah trees, small pockets of Banksia trees, large areas of shrubs without trees and completely cleared areas.

The most likely conservation significant fauna species to utilise the site as habitat according to the 2006 fauna survey conducted by ATA Environmental is Carnaby's Black Cockatoo. The site currently contains limited foraging habitat for Carnaby's Black Cockatoo in the small pockets of Banksia trees remaining in the north-east quarter. Jarrah trees are a secondary source of foraging habitat. All remnant trees were examined for signs of foraging. No evidence of foraging on Banksia cones or Jarrah nuts was observed.

No evidence of overnight roosting on the few remaining Jarrah trees was recorded.

Jarrah trees with a diameter of greater than 500mm at breast height are considered by the *EPBC Act Referral Guidelines for three Threatened Black Cockatoo Species* (2012) as breeding habitat even if they do not contain hollows. The site assessment recorded seven Jarrah trees with a diameter greater than 500mm (Table 1 and Attachment 1). None of the trees contained any hollows.

Table 1 Jarrah Trees with Diameter Greater than 500mm

Tree Number	Height	Diameter (mm)	Hollows	Location
1	8	500 x 2	No	386727 6493837
2	6	1000	No	386780 6493844
3	7	550	No	386938 6494415
4	7	600 x 2	No	386939 6494424
5	9	800	Small hollows	386880 6494446
6	8	650	No	386874 6494367
7	7	600	No	386927 6494338

The Black Cockatoo Referral Guidelines state that the clearing of more than 1ha of quality foraging habitat could have a significant impact on Black Cockatoos and therefore a referral under the EPBC Act is highly recommended. In addition, the Referral Guidelines state that clearing more than one breeding habitat tree could also lead to a significant impact.

PGV Environmental consider that the isolated Banksia trees on the site would not constitute quality foraging habitat and, while not calculated, the area is highly likely to be far less than 1ha. There are no regenerating Banksia seedlings, therefore there is very little chance that the site would regenerate to a high quality Banksia woodland. Clearing the remaining Banksia trees on the site is unlikely to have a significant impact on Carnaby's Black Cockatoos.

PGV Environmental considers that clearing seven semi-mature Jarrah trees with a diameter greater than 500mm, and containing no hollows, would not have a significant impact on Carnaby's Black Cockatoos.

Environmental Management

Tree Retention

The Jarrah trees and small area of intact native vegetation at the entrance to the current site adjacent to Flynn Drive are located close to Flynn Drive and may not impact on the future sand quarry footprint. If possible these trees and vegetation should be retained in the expansion of the sand mine and any future development after mining. The five larger Jarrah trees located close to the northern boundary are not likely to be able to be retained given the proposed finished floor level and batter slope to the adjoining lot.

Topsoil Stripping and Seed Collection

While the north-east quarter of the site has had most of the native trees removed over time, large areas containing a wide variety of native understorey species remain. Where possible the topsoil from this area should be collected and used in the rehabilitation of completed mining operations elsewhere on the site or Lot 900 to the west. Topsoil should either be transferred directly after stripping or stored for a short period, preferably less than 3 months, if it is to be used for rehabilitation purposes.

Any weeds that arise from the spread topsoil will need to be controlled.

If there are areas of completed mining operation on Lots 900 or 901 that require rehabilitation then collection of seed from the understorey species and few remaining trees on the site should be considered. The collected seed would be directly seeded into the rehabilitation areas in winter.

Fauna

No specific fauna management measures are proposed for the quarry extension. Clearing the vegetation in the north-east quarter from west to east will allow the ground-dwelling fauna to move into the adjacent very good quality vegetation in the Bush Forever site.

4.0 THE PROPOSED EXCAVATION

Figure 4 indicates the current extent of the excavation for Stage One and the natural surface on Lot 901 together with the finished design levels designated for Lot 901 in Structure Plan No. 17 for the Neerabup Industrial Area.

The site grades from 50m AHD at the western boundary as a result of excavation of Lot 900, to 68m AHD at the south east corner and 74 m AHD at the north east corner.

It is proposed that excavation will commence at the western boundary extending the current excavation eastwards towards Lot 902.

This accords with Stage 2 and Part of Stage 3 approved in 1996.

Access to Flynn Drive will continue from the existing access point on Lot 900.

As can be seen from Figure 4 a finished floor level of 42m AHD is consistent with previous excavation and is more than 2 metres above the maximum ground water level in this area.

It is proposed to excavate to this level for the majority of Lot 901 before filling up to a designated final design level.

The main excavation area will be filled with approved recycled material as is currently occurring on Lot 900 and then be covered by 2 metres of clean fill stockpiled from the excavated areas. These operations have received environmental approval from the former DEC.

Other activities are planned for the site and are subject to a separate application for planning approval. Specifically planning approval is being sought for green waste composting/mulching and waste recycling (concrete, clay, asphalt & limestone only for storage on site and for re-sale as a recycled product). The location of these in relation to the proposed excavation are indicated in Figure 4.

As the recycling and green waste/mulching operations occur on the same site, some joint management can occur.

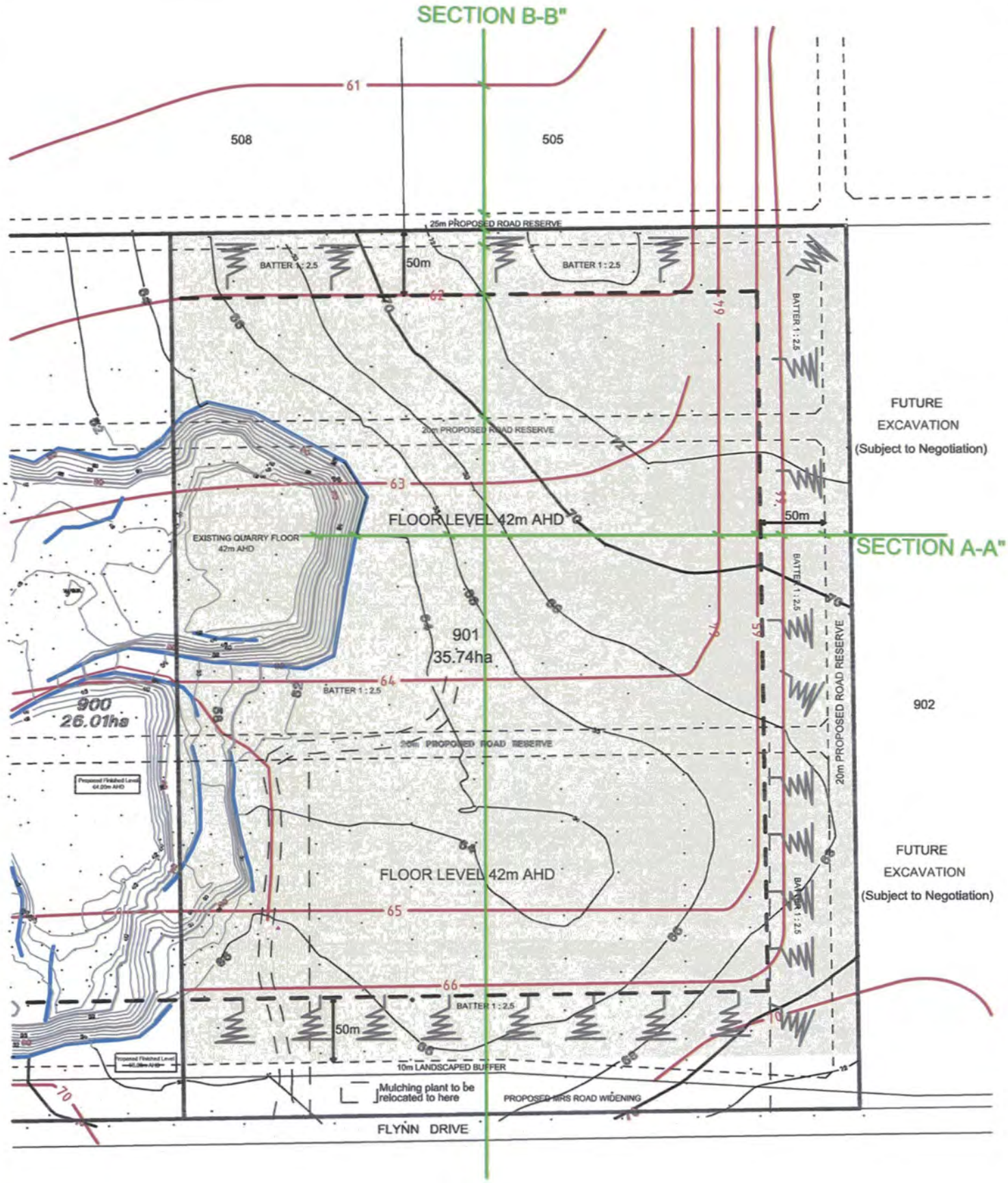
5.0 EXCAVATION MANAGEMENT

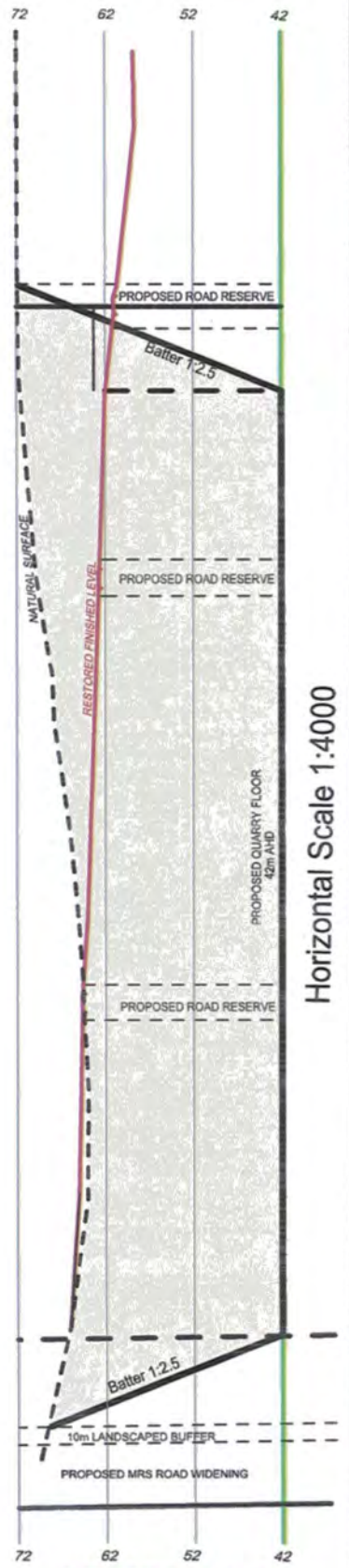
Extraction and Processing

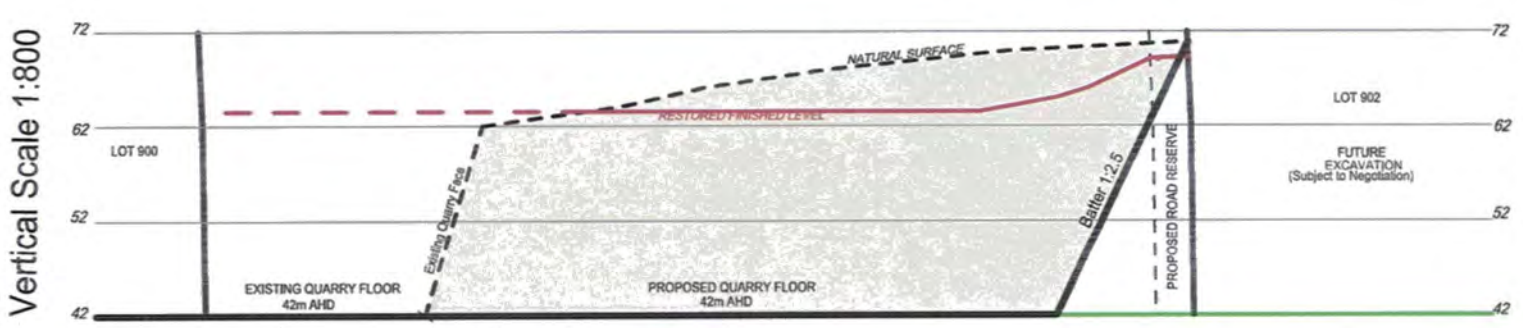
It is proposed to extract fill and other sand from the subject land over a 20 year period. Between 50,000 and 100,000 tonnes of sand will be excavated from the proposed excavation each year depending on market demands.

The majority of the sand on the subject land is yellow quartz sand with some brickies sand at depth and some leaching in the surface layer. The grade of sand does vary slightly both horizontally and vertically. This means that if the correct grade of sand for a particular market is not available, two working fronts may be used.

Excavation will proceed in a manner that will allow the final surface to be reformed and rehabilitated as the front progresses.







60 Natural Contours

62 Finished Surface Contours

Edge of Excavation

N

SCALE 1:4000 (A3)

0 100 m

GDA94 | Map Projection MGA94 - Zone 50

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PROPOSED EXCAVATION

LOT 901, FLYNN DRIVE, NEERABUP

DATE: 23 April 2014
Job No. : 1671

FIGURE 4

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Excavation will commence in the central part of the deposit and work towards the outside. This will leave the maximum amount of vegetation along Flynn Drive at all times and because sand will be excavated from below the level of the buffer zone, maximum screening from Flynn Drive will be retained.

Site Works

The vegetation will be cleared, followed by removal and stockpiling of the topsoil. Larger logs will be cut and removed for firewood, but smaller fragmental material and topsoil will be transferred directly to an area being rehabilitated. This will reduce stockpiles, maintain the viability of the micro-organisms and seed stores in the soil and assist the rehabilitation programme.

Where the level of vegetation is too great it will be formed into piles on an area of the ground and used in rehabilitation.

Where top soil cannot be spread directly, small stockpiles of topsoil and vegetation fragments will have to be created for later use.

Sand will be excavated from a single face where possible, however a two stage excavation of sand may be required if the grade of sand changes significantly with depth. Excavation will use a front end loader loading directly onto trucks.

A portable screening plant may be used on the floor of the pit if required. At this stage there are no plans for a screening plant, but if one was utilised it would have to be licensed by the Environmental Protection Authority (EPA).

Approximately 2 metres of top soil will be spread over the reformed land surface followed by a thin layer of vegetation fragments from an area being cleared. The fragmental vegetation material will be a very important factor in reducing wind erosion of the surface and consequent sand blasting of the new vegetation. In addition the vegetation fragments will provide a valuable seed source of indigenous plant species.

Machinery and Equipment

A building exists on the site together with a toilet system. This will be maintained and will be used to store equipment and to act as a site office. The main equipment to be used will be a loader. A screening plant may be used if market demand requires a screened product. If a screening plant is to be used, a Grinding and Milling Licence from the EPA will be applied for.

A diesel fuel, above ground tank, will be installed and contained by a bunded enclosure lined with impermeable liner.

Workforce

The workforce will vary depending on the level of operation and market demands but will usually consist of 1 to 3 persons working on site during normal working hours.

Water Usage

Water for dust suppression will be drawn from the existing licensed bore on the site which will continue to serve the market garden.

Access and Transport

Access to the working faces will be along the existing access road constructed from Flynn Drive.

Access roads will be constructed from limestone materials with the first 20 metres being sealed with bitumen to reduce the potential for dust and sand to be carried onto Flynn Drive.

Visibility at each access point is good for all traffic.

Gates will be erected on the access roads and perimeter stranded wire fences maintained. When the site is not occupied, gates will be locked. Warning signs will be erected in accordance with Department of Mines and Petroleum and City of Wanneroo requirements.

Transport will be on contractor trucks which have a variety of load capacities depending on their size and whether they use a trailer. Generally load capacities will be between 10 and 35 tonnes per laden truck movement, although small volumes will be sold to the public.

An average of 10 to 20 laden truck movements per day can be expected depending on market demand.

Compaction and Fill Management

Following decommission it is proposed that the site will be developed for industrial and mixed business purposes. To comply with requirements, the following management procedures will be implemented:

- Filling with clean fill and recycled waste will occur in stages following the extraction of the sand resource;
- Fill material (clean fill) will be placed and compacted in 1m lifts; and
- A qualified geotechnical engineer will be engaged to test and direct filling and compaction of the site to ensure it is stable and suitable for future development.

Hours of Operation

Hours of operation applied for in this application are from 7.00am to 7.00 pm Monday to Friday and Saturday 7.00am to 5.00 pm. Working longer hours ensures greater efficiency in the use of equipment and thus a reduction in the operating costs. In addition full working hours are required on Saturday to enable clients to be serviced. An increasing number of construction businesses work 6 days per week.

No work is to be conducted on Sundays or on Public Holidays.

At any particular time the hours worked may be reduced depending on market demand.

6.0 ENVIRONMENTAL MANAGEMENT

Environmental Management

Environmental management procedures include supervision and quality control to ensure only suitable material is recovered, measures to control dust and noise, measures to protect ground and surface waters, implementation of monitoring programs to ensure detection of any compromise to ground water quality, and contingencies to deal with possible fuel spillage or fire outbreaks.

It is proposed to engage a qualified geotechnical engineer to test and direct compaction of the site to ensure it is stable for future industrial development.

It is proposed that current practices will continue as contained in the current planning approval.

Aesthetics

The proposed excavation should not be visible from any residence. The only part of the excavation that may be visible from outside the property along Flynn Drive, will be some of the higher levels of the excavation. As much of the buffer is well vegetated and as the operation will be worked from inside out, the proposed excavations will be substantially screened.

Noise Control

Machinery will be maintained and operated in a manner designed to reduce noise emissions. Current sand extraction and resource recovery activities, which involve numerous truck movements and heavy machinery operations, have not created a noise nuisance.

The width of the buffer zones, the distance to adjoining land users, the type of adjoining land users and the proposed end use of the property should ensure that noise does not impact on residences. There will be some traffic generation along Flynn Drive but this is expected to be between 10 and 20 laden trucks per day as is currently the case. Considering Flynn Drive is to be upgraded to a major transport route this can be easily accommodated.

The limited amount of machinery to be used will generate little noise, but in any event, the method of working from the inside out and the retention of the buffers at higher elevations then the excavation will ensure the noise levels are suppressed.

In accordance with the Environmental Protection Act, noise regulations, noise levels will note exceed 50dB (A) at the site boundary from Monday to Saturday between 7:00 am and 19:00 hours.

Dust Control

Measures that will be applied to control dust will include, but are not limited to the following:

- Minimise the active working area and trafficked areas on site;
- Maintain speed limits for all vehicles on site;
- Vehicles visiting the site shall be restricted to movement on site tracks;
- Maintain existing fringe vegetation;
- Utilise water sprays via water cart to suppress dust on roads and during tipping where required;
- Temporary cessation of works in windy and dusty conditions;
- Use hydromulching techniques to stabilise soil surface; and
- Temporary revegetation to stabilise soils prior to re-development.

These dust control measures are currently being successfully applied to control dust emissions from sand extraction activities at the site. Current operations have not created a dust nuisance.

Dust will be managed by the watering of the access roads as required during dry periods. In addition Norlig 58 (Lignin sulphonate), a surface binding agent for roads may be applied to the limestone roads to reduced maintenance and the necessity for watering if required. Norlig 58 is a by-product from the manufacture of paper and has been approved by the Water Corporation for use in water management areas.

Dust should not affect any neighbouring property because of the distances involved and the lack of fines in the sand.

A sprinkler watering system will be used to water the access road or a tanker truck maintained permanently on site, whichever is most efficient.

Trucks will be wetted down before leaving the site and all trucking contractors will be told to place tarpaulins over their roads in summer.

Dust has the potential to be generated during land clearing and the reinstatement of top soil. Where possible this will be carried out during the wetter months. If dust generated during these operations affects an adjoining property, clearing and reinstatement will be stopped until such time as the wind is more favourable.

Water Quality

The area lies within the Wanneroo Underground Water Pollution Control and Public Water Supply Area.

Market gardening and extraction for water has taken place on the property for a number of years with no apparent alteration to the ground water. Water use will in fact be reduced and as there will be no addition of fertilisers or other chemicals, the likelihood of adverse impact on the ground water system from the site will in fact decrease.

Sand excavation is a clean industry that has the potential to release only small amounts of oils and fuels from isolated leakages of machinery. Small leakages such as these are readily broken down by soil bacteria.

Diesel fuel is to be stored on site in an above ground tank. This will be installed in a bunded enclosure that is lined with an impermeable liner. Servicing of machines will take place in a concrete floored shed.

No waste will be disposed of on site. Where possible materials will be salvaged and recycled otherwise they will be taken regularly to an approved disposal site.

Protection of Ground and Surface Waters

Measures have been applied to minimise the effect of operations on surface and ground water quality and include the following:

- A minimum separation distance between the base of the extraction surface and the highest known groundwater level of 2m will be maintained;
- Clean fill to be dispersed in defined layers; and
- All surface water to be diverted away from the extraction areas.

Fuel Storage

Fuel is currently stored on site. Measures have been implemented previously to prevent soil and/or ground water contamination from the spillage of fuel as follows:

- Diesel is stored in above ground fuel storage tanks on flat, stable ground;
- The tank storage area is secure, reducing the risk of vandalism or unauthorised access;
- The tanks are located within an impervious bunded area capable of containing 100% of the stored volume; and
- Adequately trained staff only are allowed to operate the fuel station.

Fencing

The existing fence line controls litter and is a preventative measure from vandalism and unauthorised tipping. Fencing is maintained at all times, and incorporates lockable gates at a single entry point. Litter is removed regularly from the fences. Signs are a visible indication of the name and nature of the site, and the types of waste accepted. Contact telephone number for after hours complaints or emergency are displayed.

Fire Protection

Experience has shown that there is little potential fire risk from sand mining operations of this type. The quarry itself will form a natural firebreak, but in the uncleared areas firebreaks will be maintained.

In addition, if a water tanker is used for dust suppression it will be made available for fire fighting. The loader can be used to clear additional breaks on the property in times of fire.

Flora

The survival of the flora in the area will be determined by the end use of the property. Currently there are areas of similar vegetation communities remaining uncleared in areas, such as Neerabup National Park and in the Yanchep area.

Species local to the area will be used for revegetation where available, however many species from the Banksia Woodland are not available either as seed or tube plants. If the top soil is managed appropriately, high levels of species richness and density will be obtained from germination of seed stored in the top soil. The key factor is the direct transference of top soil to an area being rehabilitated.

Fauna

In the long term, the survival of fauna in the area will be more related to the future land use of the area, rather than to the operation of the quarry. The site will ultimately be cleared and developed as part of the Neerabup Industrial Area.

The more mobile fauna will be displaced to nearby vegetation communities during land clearing, although the loss of some smaller fauna is unavoidable.

Social Impact

Quarrying for limestone and sand has taken place in the area for many years and a sand quarry has operated on the adjoining lot to the north. Approval to continue and extend the existing sand pit will help maintain prices for fill sand and other sand products at the lowest possible levels due to the reduced distances from quarry to markets and competition.

Aboriginal Sites

No evidence of aboriginal occupation has been found on the property. In addition the Department of Indigenous Affairs has no records of any ethnographic or archaeological sites in the area. The archaeological and ethnographic study completed for the east of Joondalup Urban Development did not identify any site in the similar landform adjoining to the south. Known sites are related to the wetlands 4.5km to the west.

Rehabilitation

Rehabilitation of the excavated area will be carried out progressively as the excavation front moves forward.

The aims of the rehabilitation program will be to:

- Restore the land surface to a profile visually consistent with the surrounding land and compatible with likely future land uses; and
- Revegetate the land surface with a variety of plant species to hold the sand and provide vegetation, particularly trees that can be incorporated into possible future land uses.

Steps to be used in the rehabilitation process are as follows;

- During excavation the Banksia Woodland will be cleared. If possible larger logs will be offered to a service organisation for firewood. Otherwise they will be used in the rehabilitation process;
- The top 200 to 300 mm topsoil will be scraped clear and spread directly onto an area to be vegetated. Storage will be avoided where possible because it reduces the viability of soil micro organisms and seed. If the top soil it to be stored it will be retained in low dumps not exceeding one metre in height. Dumps of this height allow a large portion of the soil micro flora and soil fauna to remain active;
- Smaller branches and litter from vegetation being cleared, will be spread directly onto the areas of top soil used in the revegetation process. This will add to the indigenous seed sources and help prevent sand movement;
- The area will be planted with indigenous tube plants during June – July at 3 metre spacings. A 10g tree tablet will be placed next to each plant;
- Over succeeding years the rehabilitation will be assessed to determine the success for the revegetation and establish the requirements for further seeding and planting taking into account the site's eventual industrial use;
- In previously cleared areas where weeds are a potential problem, the quality of the top soil will be assessed and the methods outlined under 'Weeds' will be used. Decisions on the best methods of handling top soil from previously cleared areas will be made during assessments of individual sites;
- Recycled waste will be deposited and compacted in accordance with an agreed Waste Recycling Plan;
- Following excavation the land surface will be reformed as a finished surface ranging from 62 to 66m AHD; and
- This surface will be visually compatible with the surrounding land surface and the elevations will be consistent with the proposed changes to Flynn Drive and the levels proposed for the industrial area. The proposed final contours will be modified to incorporate the elevations proposed in the current Neerabup Industrial Structure Plan.

Weeds

Weeds have the potential to affect the indigenous vegetation in the area, however it should be remembered that there are two separate vegetation areas on the property, the area previously used for market garden and Banksia Woodland.

A weed management policy can be instituted relatively easily for areas of Banksia Woodland in which natural top soil will be used for rehabilitation. It should also be noted that it is common for exotic weed species to be present in natural Banksia Woodland where they form a minor part of the community, however following land disturbance such as fire, their impact may increase, giving the impression of a rapid introduction of weeds to the area. These situations can be hard to deal with because any spraying is likely to damage germinating indigenous species.

In Banksia Woodland areas, weeds will be prevented by the following methods:

1. No top soil from weed affected areas will be brought into areas to be rehabilitated with Banksia Woodland top soil; and

2. Outbreaks of weeds regarded as having a major potential to affect rehabilitation will either be spot sprayed, or buried.

In areas that have been previously cleared for market gardens, weeds will be harder to control. In these areas, seeds of weed species are likely to be very common, but seeds of indigenous species will be rare, in the top soil. The best method to reduce weeds in these areas is to provide a rapid cover of indigenous plant species. Few local species are capable of achieving this because they are not present as seeds in the top soil, they are not commercially available or are prohibitively expensive, they are not coloniser species and their growth patterns are too slow. In these areas the addition of some non-local indigenous species is preferred.

This means that choices have to be made about the use of top soil from previously cleared and market garden areas. These choices are best made during the excavation and rehabilitation stages when decisions can be made on individual sites and treatments developed as appropriate.

To reduce weeds in previously cleared areas, the following management options are available:

1. Top soil can be buried to prevent the seeds of weed species from germinating. This creates a shortage of top soil for rehabilitation;
2. Top soil can be used for rehabilitation with suitable spraying for perhaps two years to eliminate germinating weeds. Sprays appropriate to particular weed species will be selected because some sprays are environmentally sensitive and may interfere with rehabilitation; and
3. Use the existing top soils to produce a cover of indigenous species that will reduce weeds by competition. This cannot be produced by the exclusive use of local species for the reasons mentioned above.

The most satisfactory option is likely to be a combination of methods 2 and 3.