

PF FORMATION



## **HITCHCOCK ROAD SAND EXTRACTION AND REHABILITATION PROJECT, MAROOTA**

LANDSCAPE MANAGEMENT PLAN  
JANUARY 2016



**PF Formation**

## **HITCHCOCK ROAD MAROOTA**

**Sand Extraction and Rehabilitation Project**

# **LANDSCAPE MANAGEMENT PLAN**

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# Hitchcock Road Sand Extraction and Rehabilitation Project Maroota Environmental Management Plan

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## **Terms and abbreviations**

<b>Term</b>	<b>Definition</b>
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum. The standard reference level used to express the relative elevation of various features. A height given in metres AHD is essentially the height above sea level.
Airshed	Lower atmosphere within a defined geographic area.
Ambient	The background level at a specific location, being a composite of all sources.
Annual Exceedance Probability (AEP)	The probability of a flood event exceeding a nominated level in a year. A one percent AEP is the probability of an event exceeding a nominated level in 100 years.
Aquifer	Geologic formation, group of formations, or part of a formation capable of transmitting and yielding economic quantities of water.
ARI	Average Recurrence Interval-average or expected period between exceedance of a flood.
Batter	The side slope of walls, embankments and cuttings or the degree of such slope, usually expressed as a ratio of horizontal distance to one vertical height.
Bore	A cylindrical drill hole sunk into the ground from which water is pumped for use or monitoring.
Buffer	A physical barrier, structure or width of land which encloses, partially encloses or defines a particular environment. It serves to minimise the impacts of non-desirable external influences on the adjoining environment.
Bund Wall	A wall erected to prevent the escape of various emissions into the environment (liquids, noise or views).
Catchment	The area drained by a stream or body of water or the area of land from which water is collected.
Clay	Very fine grained sediment, often defined as having a particle size less than 2 microns (0.002mm) in diameter.
Compaction	The process of compressing individual grains in a soil or sediment in response to pressure.
Conservation	The management of resources in a way that will benefit both present and future generations.
Contaminant	Any physical, chemical, biological or radiological substance or matter in water or soil that is not of natural origin.
Contamination	The degradation of the natural environment as a result of human activities.
Council	The Hills Shire Council.

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<b>Term</b>	<b>Definition</b>
Day	The period from 7.00am to 6.00pm on Monday to Saturday and 8.00am to 6.00pm on Sunday and public holidays.
Department	NSW Department of Planning and Environment.
DPI Water	NSW Department of Primary Industries Water
EA	Environmental Assessment of the project entitled <i>Hitchcock Road Sand Extraction and Rehabilitation Project Environmental Assessment and Appendices</i> (3 volumes) dated November 2007, prepared by DFA Consultants, including the response to submissions and Preferred Project Report.
Ecology	The relationship between living things and their environment.
Ecologically Sustainable Development	Using, conserving and enhancing the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
Ecosystem	A functional unit of energy transfer and nutrient cycling in a given place. It includes all relationships within the biotic community and between the biotic components of the system.
Emission	Discharge of a substance to the environment.
Environment	A term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms, including humans, exists.
Environmental Assessment (EA)	A formal description of a project and an assessment of its likely impact on the physical, social and economic environment. It includes an evaluation of alternatives and an overall justification of the project. The EA is used as a vehicle to facilitate public comment and as the basis for analysing the project with respect to granting approval under relevant legislation.
Environment Protection Licence	A licence that allows pollution of the environment under controlled conditions regulated by the EPA.
EMP	Environmental Management Plan
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979.</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000.</i>
EPL	Environmental Protection Licence issued under the <i>Protection of the Environment Operations Act 1997</i> .
Erosion	The wearing away of the land surface by the action of water, wind and ice.
Evening	The period from 6.00pm to 10.00pm.
Excavate	Dig into natural material and remove using specialist machinery.
Extraction	A term referring to the removal of material from the earth synonymous with quarrying.

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<b>Term</b>	<b>Definition</b>
Extraction area	The land described as the extraction area in Appendix 1 of the Project Approval.
Evapotranspiration	Loss of water from a land mass through transpiration from plants and evaporation from the soil.
Fauna	All animals including birds, reptiles, marsupials and fish.
Flora	All plants
Friable	Easily crumbled.
Front-end loader	Machine used to lift and place soil, earth, rocks and other materials within an extraction site or to load products into trucks.
Gradient	Rate of change of a given variable with distance, such as temperature or elevation.
g/m <sup>2</sup> /month	grams per square metre per month
Greenhouse effect	Changes in climate that could occur due to increases in atmospheric concentrations of certain gases.
Groundwater	Subsurface water contained within the saturated zone.
Hawkesbury Sandstone	Cliff-forming sandstone occurring across the Sydney basin.
Heritage	Things of value which are inherited from the past.
Hydrogeology	The study of subsurface water in its geological context.
Impact	The effect of human-induced action on the environment.
Infiltration	The process of surface water soaking into the soil.
Infrastructure	Supporting installations and services supplying the needs of a project.
Introduced species	Plants and animals not native to Australia and known or thought to have been brought here by humans.
Land	Land means the whole of a lot or contiguous lots owned by the same landowner in a current plan registered at NSW Land & Property Information at the date of the approval.
Landform	A specific feature of the landscape or the general shape of the land.
µg/m <sup>3</sup>	micrograms per cubic metre
µs/cm	microsiemens per centimetre
micron	Unit of measure-one millionth of a metre.
mg/L	milligrams per litre
Mitigation measures	Measures put in place to reduce an impact.
Modelling	Use of mathematical equations to simulate and predict real events and processes.

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<b>Term</b>	<b>Definition</b>
Monitoring	Regular measurement of components of the environment to understand their condition and establish if necessary standards are being met.
Minister	NSW Minister for Planning and Environment or delegate.
Night	The period from 10.00pm to 7.00am on Monday to Saturday and 10.00pm to 8.00am on Sunday and public holidays/
OEH	Office of Environment and Heritage
Palaeochannel	An ancient river bed, often filled with more recent sediments.
Perched water	Unconfined groundwater separated from an underlying body of groundwater by an unsaturated zone.
pH	A measure of acidity or alkalinity of a solution, numerically equal to 7 for neutral solution, increasing with increasing alkalinity and decreasing with increasing acidity. Originally stood for the words potential of hydrogen.
Privately owned land	Land not owned by a public agency or the proponent or its related companies.
Preferred Project Report	The proponent's Preferred Project Report dated September 2008 prepared by DFA Consultants as modified in the Proponent's email to the Department of Planning on 18 November 2008.
Process plant	Equipment used to clean and separate sand into various sizes.
Project	The development as described in the EA.
Proponent	PF Formation or its successors in title.
Rehabilitation	Preparation of a final landform following extraction and its stabilisation with vegetation.
Remnant vegetation	Native vegetation remaining after widespread clearing has taken place.
Resource	Potentially usable material in a defined area that can be economically extracted.
Response to Submissions	The proponent's response to issues raised in submissions dated March 2008 prepared by DFA Consultants and subsequent submissions to the Department of Planning and Environment dated 27 August 2008.
RL	Reduced level, usually in metres to an arbitrary datum.
RMS	NSW Roads and Maritime Services
Run-off	The proportion of precipitation discharged through surface water systems.
Sand	Sediment comprising particles ranging between 0.063mm and 2mm.
Sandstone	A fine grained rock of sedimentary origin composed primarily of sand-sized particles (0.06 to 2 mm).
Secretary	Secretary (formerly Director-General) of the Department of



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<b>Term</b>	<b>Definition</b>
	Planning and Environment or delegate.
Sedimentation basin	An area where runoff is ponded to allow sediment to be deposited. The longer the period that the runoff is held, the smaller the size of the sediment deposited. Such basins have to be regularly cleaned.
SHTW	Sydney Hinterland Transition Woodland
Silt	Sediment comprising most particles between 0.004mm and 0.063mm.
Species	Taxonomic grouping of organisms that are able to interbreed with each other but not with other species.
Stakeholder	An individual or group with an interest in the proposal.
Statement of Commitments	The proponent's commitments in Appendix 3 of the Project Approval.
Stockpile	Mound used to store material.
Stormwater	Rainwater which runs off catchments following rain events. The untreated water is carried into creeks, rivers and lakes.
Strategy A, Strategy B	The alternative rehabilitation proposals described in the Preferred Project Report. Strategy A has been selected.
Terrestrial	Relating to the land as distinct from air or water.
Tertiary	Geologic time at the beginning of the Cainozoic era, 65 to 2 million years ago, after the Cretaceous and before the Quaternary.
Topography	The physical relief and contours of the area.
Topsoil	The surface layer of a soil profile containing most of the organic material and viable life forms and seeds.
Total Dissolved Solids (TDS)	The dissolved mineral content of groundwater, commonly expressed in milligrams/Litre.
Total Suspended Solids	A measure of suspended solids concentrations in a water body and expressed in terms of mass per unit of volume.
TSC Act	NSW Threatened Species Conservation Act.
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension.
Underflow	The volume of groundwater that flows through a cross sectional area of an aquifer. It depends on permeability and the prevailing gradient.
Unsaturated zone	That part of an aquifer between the land surface and water table.
Vegetation Offset	The conservation and enhancement program described in the Preferred Project Report to occur on the land shown on the plan in Appendix 5 of the Project Approval.
VENM	Virgin Excavated Natural Material as defined in the <i>Protection of the Environment Operations Act 1997</i> .

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<b>Term</b>	<b>Definition</b>
Water quality	Degree or lack of contamination.
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere.
Well	A hole sunk into the ground and completed for the abstraction or injection of water or for water observation purposes. Generally synonymous with bore.
1 in 100 Year Flood Level	The flood which occurs on average once every 100 years. Also known as the 100 year Average Recurrence Interval of a flood.

*Chapter One*

## **INTRODUCTION**

The landscape management plan has been prepared in compliance with **Condition 24** of **Schedule 3** of the Project Approval. It includes:

- Rehabilitation and offset management plan; and
- Quarry closure plan.

The progressive rehabilitation of the Hitchcock Road site has been undertaken since 1998 on the basis of the provisions of the EMP which complies with the requirements of the previous court consent. This has now been amended where necessary to comply with the requirements of the Project Approval.

Rehabilitation undertaken to date has comprised the drying and capping of redundant silt ponds, reprofiling of parts of the site where sand extraction has been completed and the revegetation of parts of these areas.

Chapter Two

## APPROVAL REQUIREMENTS

The approval contains a number of conditions relating to the management of the progressive rehabilitation of the site. This will be undertaken in a manner generally consistent with the concept final landform (Strategy A) in the preferred project report. The relevant conditions are:

### Schedule 3 Condition 2

Notwithstanding the layout plans in Appendix 2, the proponent shall not undertake extraction within:

- 30 metres of Hitchcock Road; and
- 10 metres of the property boundary of Lot 2 DP555184, unless sand extraction has commenced on that lot, and extraction in this buffer has been agreed with the Secretary.

### Schedule 3 Condition 22

The proponent will implement the offset strategy described in the preferred project report and summarised in **Table 2.1**, to the satisfaction of the Secretary.

**Table 2.1**      **Offset strategy**

Area	Minimum size (hectares)
On-site revegetation area (Sydney Hinterland Transition Woodland)	7.9
On-site revegetation area (other woodland)	4.1
<b>Total</b>	<b>12.0</b>

The offset strategy is described in **Section 3.5**.

### Schedule 3 Condition 23

Within 3 years of the date of this approval, the proponent will make suitable arrangements to provide long-term security for the offset areas to the satisfaction of the Secretary.

### Schedule 3 Condition 24

The proponent will prepare and implement a landscape management plan for the project to the satisfaction of the Secretary. The plan will:

- be prepared in consultation with EPA by suitably qualified expert/s whose appointment/s have been approved by the Secretary;
- be submitted to the Secretary for approval within 6 months of the date of this approval; and
- include a:
  - Rehabilitation and Offset Management Plan; and
  - Quarry Closure Plan.

A draft copy of this plan will be provided to the EPA for review and comment. Furthermore, ongoing consultation with OEHL via written correspondence (eg. Email), electronic correspondence (eg. Website) and verbal correspondence (eg. CCC

meetings) will be continually undertaken. OEH will be invited to attend an annual CCC meeting.

A copy of the Landscape Management Plan will be made publicly available on the PF Formation website.

**Schedule 3 Condition 25**

The Rehabilitation and Offset Management Plan will include:

- rehabilitation objectives for the site, vegetation offsets and landscaping (**Section 3.2**);
- description of the short, medium and long term measures that would be implemented to:
  - rehabilitate the site;
  - implement the offset strategy; and
  - maintain and enhance existing vegetation outside the disturbance area (**Section 3.3**);
- detailed performance and completion criteria for the site rehabilitation and implementation of the offset strategy (**Sections 3.4 and 3.5**);
- detailed description of the measures that would be implemented over the next 3 years including the procedures to be implemented for (**Section 3.3**):
  - progressively rehabilitating disturbed areas;
  - implementing vegetation offsets;
  - protecting vegetation and soil outside the disturbance areas;
  - rehabilitating creeks and drainage lines on the site to ensure no net loss of stream length and aquatic habitat;
  - undertaking pre-clearance surveys;
  - managing impacts on fauna;
  - landscaping the site to minimise visual impacts;
  - conserving and reusing topsoil;
  - collecting and propagating seed for rehabilitation works;
  - salvaging and reusing material from the site for habitat enhancement;
  - controlling weeds and feral pests;
  - controlling access; and
  - bushfire management.
- a program to monitor the effectiveness of these measures and progress against the performance and completion criteria (**Section 3.4**);
- a description of the potential risks to successful rehabilitation and/or revegetation and a description of the contingency measures that would be implemented to mitigate these risks (**Section 3.3.19**); and
- details of who would be responsible for monitoring, reviewing and implementing the plan (**Section 3.6**).

**Schedule 3 Condition 26** requires a Quarry Closure Plan described in **Section 4**.

Chapter Three

## REHABILITATION AND OFFSET MANAGEMENT PLAN

### 3.1 Introduction

The final landform of the Hitchcock Road site is influenced by the depth of extraction, the location of commercially available resource (both Tertiary Sand and friable sandstone) and the volume of overburden, mainly clay, available for re-contouring the extracted areas.

The main Tertiary Sand resource is located in the centre of the main part of the site with smaller volumes of friable sandstone in the southern part. The larger area provides opportunities for reformation of the contours using the large volume of overburden above the Tertiary Sand to create an integrated, continuous landform. A proportion of the area is expected to be reclaimed to Class 3 agricultural land suitable for grazing and improvement for pasture. This area, together with those to be revegetated as part of the offset program is shown on **Figure 3.1**.

Rehabilitation would comprise the return of the stored topsoil and the progressive revegetation of the site. Techniques to be used have been based on several sources: *Urban Erosion and Sediment Control Handbook* (Department of Conservation and Land Management 1992); *Managing Urban Stormwater* (Landcom 2006); and *Best Practice Environmental Management in Mining – Rehabilitation and Revegetation* (Environment Protection Authority 1995).

The project will require the removal of 3.7 hectares and revegetation of 7.9 hectares of *Sydney Hinterland Transition Woodland*.

An area of approximately 4.2 hectares has been replanted as at 2011 with the aim of recreating the vegetation to be removed from the central woodland located adjacent to the former Trigonometrical reserve. The revegetated area is adjacent to the western boundary of the site with further revegetation scheduled for the area to the south. This is close to remnant vegetation both within and outside the site boundary. This adjacent vegetation provides a potential source of seed for natural dispersal into the area to be revegetated.

The 4.2 hectares of revegetation has been established on the site to a standard that meets the ecological completion criteria in Appendix 6 of the Approval. In 2013 the Department of Planning confirmed that condition 10 of schedule 2 of the Approval had been met and that the clearing of the Sydney Hinterland Transition Woodland as shown in the plan in Appendix 5 of the Approval may commence.

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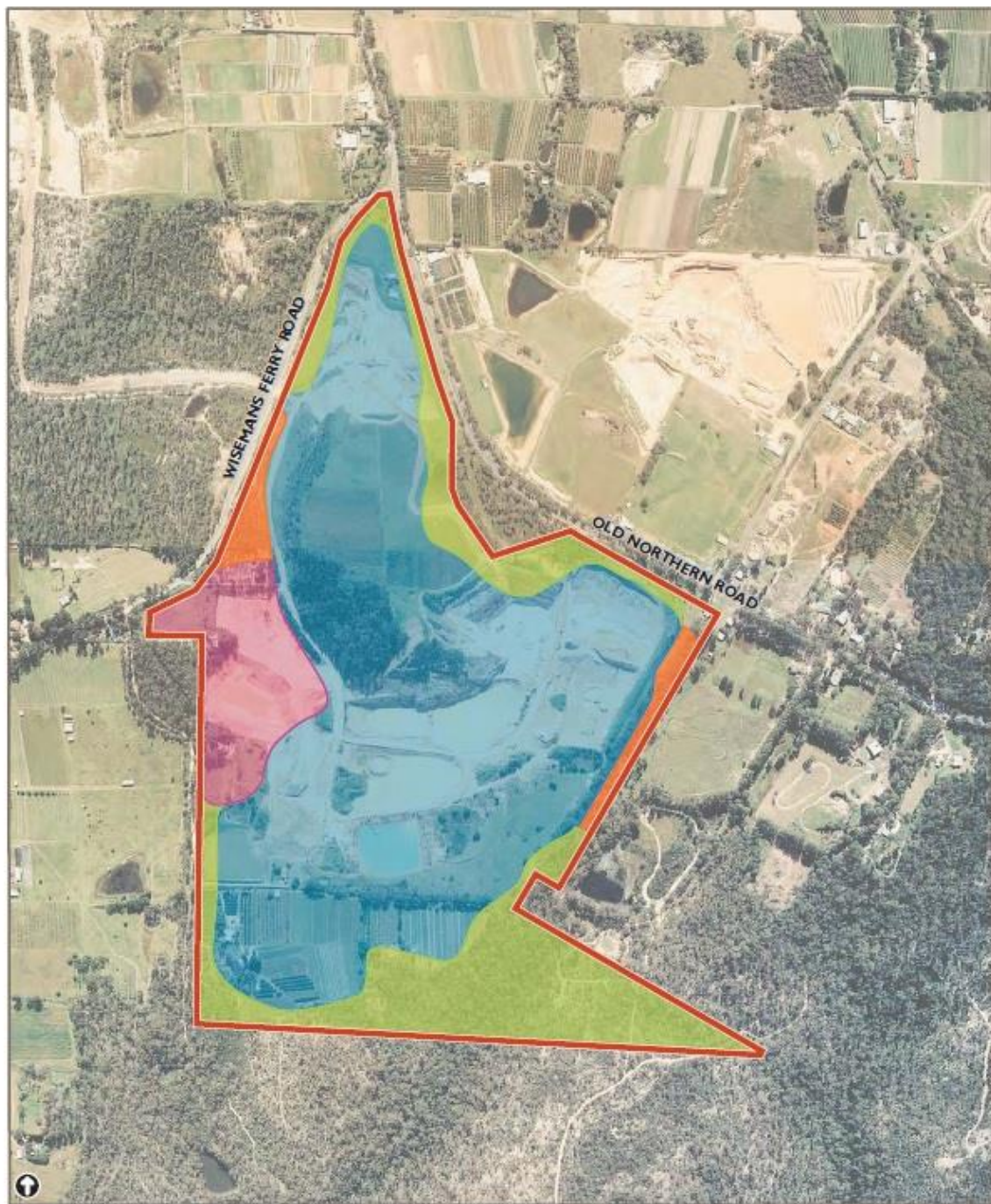


Figure 3.1

GENERAL FINAL CONFIGURATION OF THE SITE (STRATEGY A)

- |  |   |
|--|---|
| <span style="display: inline-block; width: 20px; height: 10px; background-color: red; border: 1px solid black;"></span> Hitchcock Road site  | <span style="display: inline-block; width: 20px; height: 10px; background-color: lightgreen; border: 1px solid black;"></span> Other vegetation including existing, established and new plantings |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: orange; border: 1px solid black;"></span> Undisturbed Sydney Hinterland Transition Woodland                 | <span style="display: inline-block; width: 20px; height: 10px; background-color: lightblue; border: 1px solid black;"></span> Area suitable for future agricultural/horticultural activities      |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: pink; border: 1px solid black;"></span> Sydney Hinterland Transition Woodland New offset strategy plantings |   |

### **3.2 Rehabilitation objectives**

The objectives of the rehabilitation and revegetation of the Hitchcock Road site are to:

- achieve a final landform which blends into the surrounding ground profile and natural landscape;
- ensure that rehabilitation is undertaken progressively;
- maintain the scenic and environmental quality of the site;
- return the site to its previous dominant land use: horticulture/agriculture;
- rehabilitate and revegetate areas subject to sand extraction;
- revegetate with native vegetation species characteristic of the community (*Sydney Hinterland Transition Woodland*) to be removed to make way for sand extraction activities; and
- recreate the existing characteristics of this community, to provide an area appropriate as a biodiversity offset for the clearance of this community at that time.

The approach is aimed at achieving an area of successfully recreated woodland community with similar characteristics to that to be removed prior to the clearance of any of the existing community. In total, the new community would ultimately cover at least twice the area of that to be removed.

### **3.3 Site rehabilitation and offset program**

#### **3.3.1 Final landform**

The final landform of the Hitchcock Road site would be influenced by the depth of extraction, the location of commercially available resource and the volume of overburden, mainly clay available for re-contouring the extracted areas on the site. Sand has been extracted from part of the site to the depth allowed in the previous consent and part of this area has been rehabilitated.

A substantial part of the site would be reclaimed to Class 3 agricultural land suitable for grazing and improvement for pasture. Rehabilitation would comprise the return of the stored topsoil and the progressive revegetation of the site. Techniques to be used have been based on several sources:

- *Urban Erosion and Sediment Control Handbook* (Department of Conservation and Land Management 1992);
- *Recovering bushland on the Cumberland Plain-Best practice guidelines for the management and restoration of bushland* (Department of Environment and Conservation 2005)
- *Managing Urban Stormwater* (Landcom 2007); and
- *Best Practice Environmental Management in Mining – Rehabilitation and Revegetation* (Environment Protection Authority 1995).



Setbacks around the periphery of the site, at the boundaries of properties not undertaking sand extraction and from buildings such as houses and other facilities not located on properties associated with sand extraction are defined in The Hills Shire Council Development Control Plan Part B Section 1 Appendix B – Extractive Industries. The setbacks shown on **Figure 3.2** generally comply with the requirements of the DCP with the following exception:

- A setback of 30 metres from the Rural Fire Brigade facility on Lot 3 DP542117 and the disused scout hut on Lot 1 DP555184 is shown on **Figure 3.2**. Due to the nature of this facility, activities at this location are not likely to be disturbed by adjacent sand mining and the 100 metre setback included in the DCP was considered to be excessive.

Two final landform proposals were prepared in the Approval. As a result of meeting condition 10 of schedule 2 of the Approval the final landform will be in accordance with Strategy A. The existing topography is also shown on **Figure 3.2**.

Strategy A (**Figure 3.3**) is similar to that shown in the EA (Figure 2.7). This comprises a large gently sloping basin with steeper side slopes along the boundary to Old Northern Road. Some of the levels have been amended to reflect changes in the extraction areas to minimise vegetation removal.

The final contours shown in **Figure 3.3** have been modified to correct an error on the corresponding figures included in the *Preferred Project Report* (DFA Consultants 2008). These showed differences in the landform within the buffer zone of Strategy A. In practice, no changes would take place within these areas and they would remain the same as the existing contours shown in **Figure 3.2**. This correction has resulted in some minor changes to the final contours within the active areas on the site.

The Approval allows sand extraction until June 2028. Successful rehabilitation of the site to a preconceived profile is dependent on a number of factors particularly the volume of material available for the reformation of site contours. Estimates have been made of the volume of this material, mainly clay, but these are constrained by the limited extent of the data in a highly variable geological substrate. These factors will ultimately have a major influence of the final land profile, but are only known in outline at present. The site reformation will therefore focus at this stage on the final landform strategy set out in the *Preferred Project Report* (DFA Consultants 2008) and in particular on site activities to be undertaken over the next three years. The landform resulting from the implementation of the strategy is shown on **Figure 3.3**.

# Hitchcock Road Sand Extraction and Rehabilitation Project Landscape Management Plan

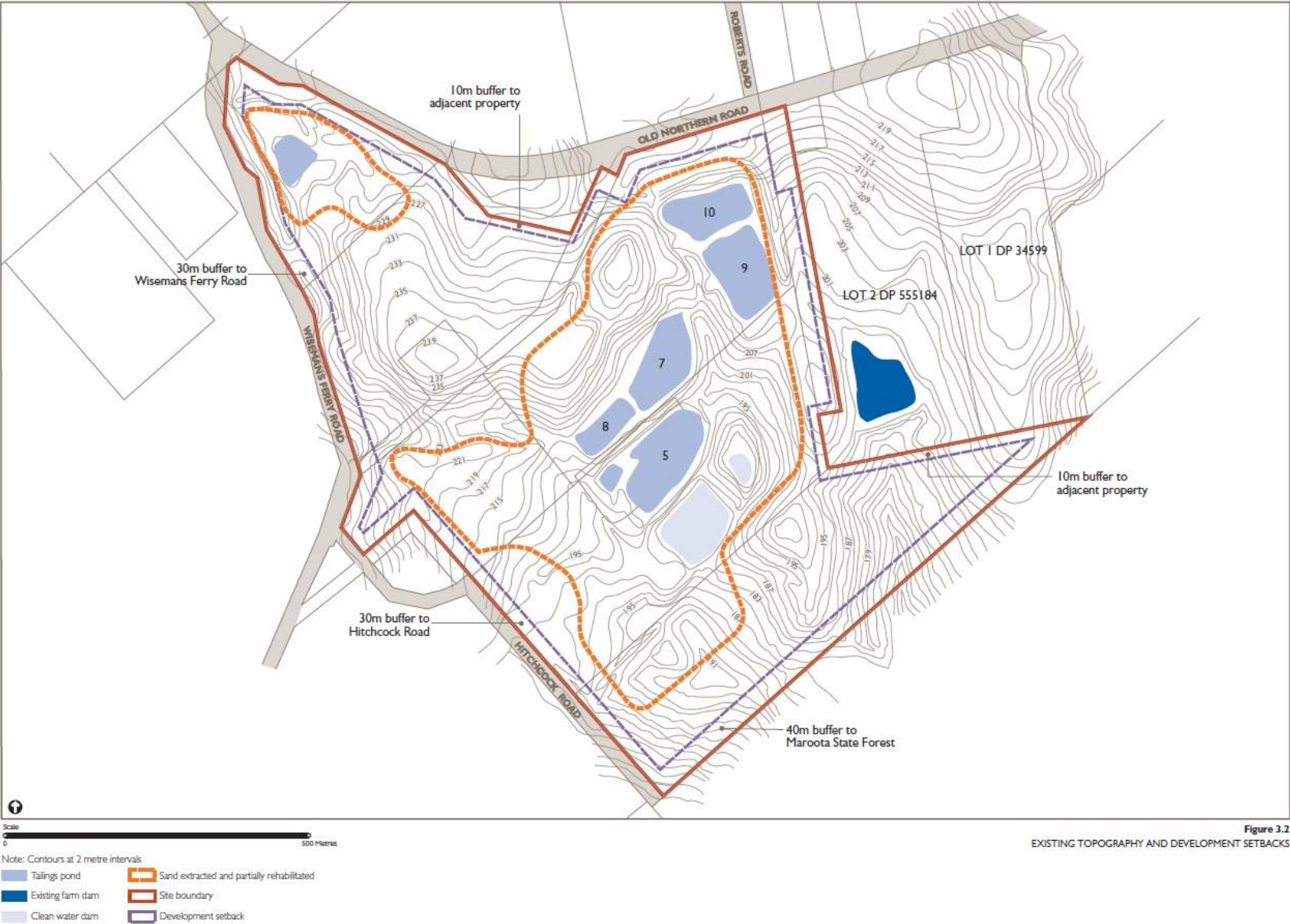


Figure 3.2  
EXISTING TOPOGRAPHY AND DEVELOPMENT SETBACKS

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### **3.3.2 Progressive rehabilitation**

Rehabilitation on the site is undertaken in a number of stages:

- drying and capping of the sedimentation ponds following decommissioning and introduction of new ponds into the cycle. Drying and capping can take up to three years to complete;
- land reformation to achieve the final contours;
- preparation of topsoil and re-soiling;
- seed collection and germination, undertaken in parallel with the previous activities;
- area seeding and planting of specimens;
- protection of plants from fauna; and
- weed control and general maintenance.

These activities will continue to be undertaken throughout the development stage.

### **3.3.3 Short term site activities**

Activity on site over the next three years will mainly comprise:

Extraction:

- completion of sand extraction within Lot 214 DP752039;
- sand extraction moving north from Lot 1 DP1091018 to Lot 2 DP570966;
- continuing extraction of sand in south direction and the development of stockpiles adjacent to the slurry plant on Lot 1 DP570966;  
(Extraction involves removing the topsoil and overburden from the extraction areas and then stockpiling this material. When the overburden is removed the sandy material is transported by dump truck to the existing slurry plant in Lot 1 DP570966 with subsequent transport by pipeline to the wash plant on Lot 198 DP752025).

Rehabilitation:

- final capping of existing silt ponds in Lot 167 DP752039;
- commence capping of silt ponds in Lot 1 DP1091018. This will start after it's removal from the water cycle and the drying out phase is completed;
- introduction of new silt ponds located on Lot 214 DP752039 into the water cycle – these have been constructed but not yet included in the system;
- formation of final landform profile on the eastern side of Lot 167 DP752039;
- ongoing review and maintenance of the Sydney Hinterland Transition Woodland on Lot 2 DP233818;
- extraction of the small area adjoining Hitchcock Road on Lot 167 DP752039 and then the soil preparation and revegetation of the area;
- minor works required for maintenance and safe working of the plant, machinery and infrastructure on the site; and

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- site activities in the medium and long term will be undertaken in a similar manner with the final landform profile (Strategy A) gradually being achieved. The predicted phasing of this development prepared in 2007 when the EA was prepared is shown on **Figure 3.4**.



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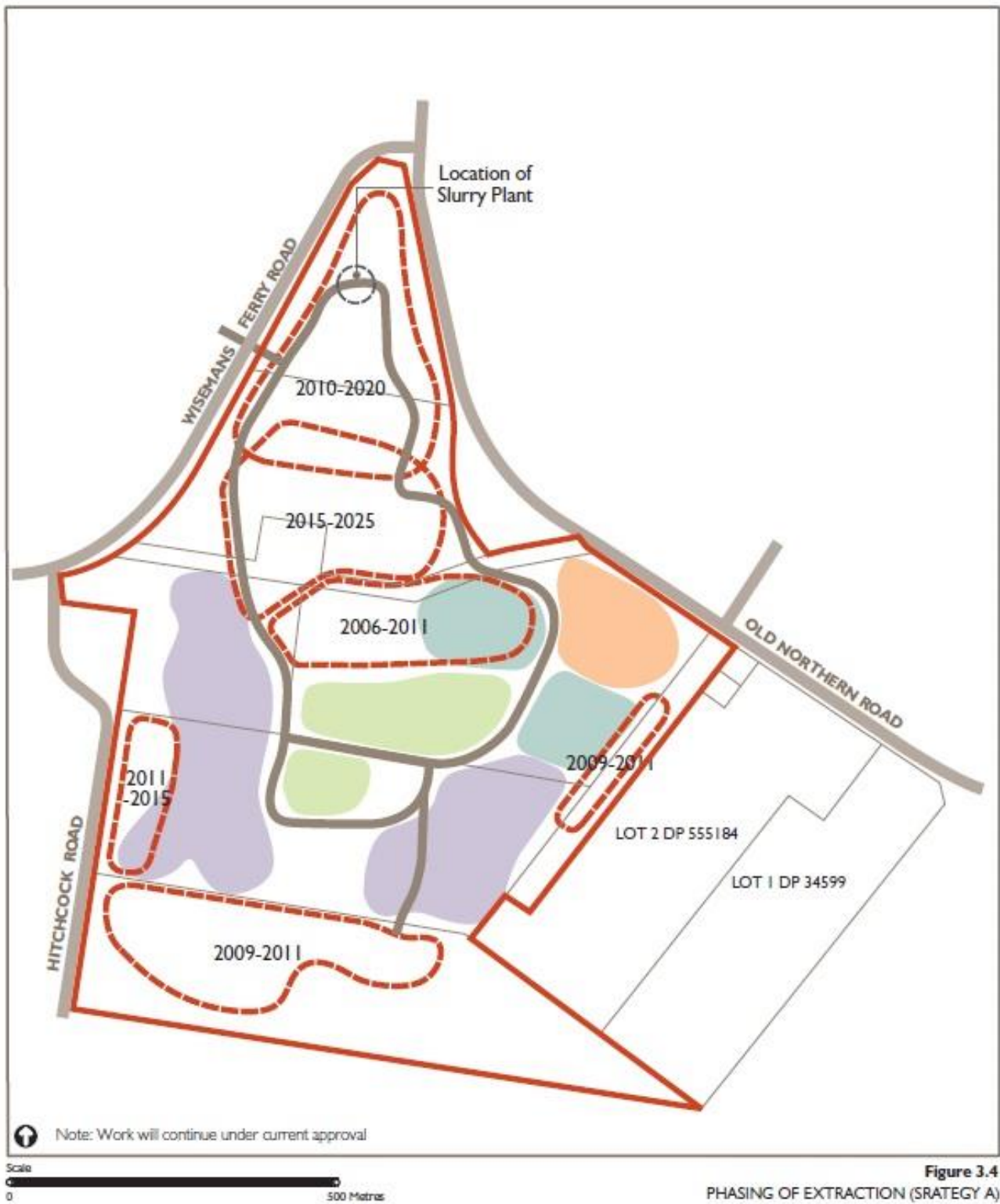


Figure 3.4  
PHASING OF EXTRACTION (STRATEGY A)

- |  |  |
|--|--|
| Extraction completed - rehabilitation underway         | Areas for future extraction and rehabilitation |
| Areas to be capped and rehabilitated - currently ponds | Areas currently working / almost completed     |
| Area extracted - to be used as detention basin         | Existing internal haul road                    |
| Land included in the application                       | Temporary access                               |

### **3.3.4 Existing site vegetation**

Vegetation communities on the site in 2007 are shown on **Figure 3.5**. The area shown as on the eastern side of the site (0.8 hectares) is noted as Sydney Hinterland Transition Woodland notwithstanding it does not have sufficient species to be recorded as such (likely to be a degraded community on this 2 hectare property). The areas within which these are protected have been indicated on site and all site operatives informed of the importance of avoiding any damage during site operations.

### **3.3.5 Rehabilitation of on-site creeks and drainage lines**

The site is located at the highest point in the surrounding area and is therefore at the top of all local drainage catchments. There are no creeks on the site and stormwater dissipates via overland flows quickly recharging the groundwater by filtration through the sandy soil. Bund walls constructed in compliance with the previous consent restrict any drainage flows from leaving the site. New drainage lines will be developed in the final ground profile during the final stage of rehabilitation. These will drain to the dams serving the two internal catchments. The drainage lines will be vegetated as part of the final site landscape proposals.

### **3.3.6 Pre-clearance surveys**

The majority of the SHTW vegetation community in the centre of the site shown on **Figure 3.6** has been cleared based on the successful development of an area at least equal to that to be cleared of a community comprising a defined range of diagnostic species for SHTW. The success of this revegetation would be determined by an independent flora and fauna specialist based on random quadrat surveys and using the criteria set out in Table 3.1.

### **3.3.7 Impacts on local fauna**

The site only contains small areas of habitat suitable for local fauna. The site is adjacent to areas providing much greater resources for native fauna.

The following mitigation measures will be implemented on site prior to the start of vegetation clearance:

- preparation and implementation of a clearing management plan. The clearing protocols would include the following:
  - > shaking the tree using a bulldozer;
  - > slowly pushing the tree to the ground so that it largely remains intact;
  - > inspection of hollows and removal of any animals if possible (to be undertaken in consultation with the OEH)
  - > leaving the tree in place once felled for at least one day/night before removing to allow animals to relocate to nearby vegetation; and
  - > undertaking vegetation clearing during September/October or in March/May to avoid summer breeding seasons and the winter hibernation for hollow dependent species.
- installation of sediment control devices prior to clearing vegetation; and
- removal of topsoil from areas of native vegetation that are free of weeds and stockpiling for use in rehabilitation.

# Hitchcock Road Sand Extraction and Rehabilitation Project Landscape Management Plan

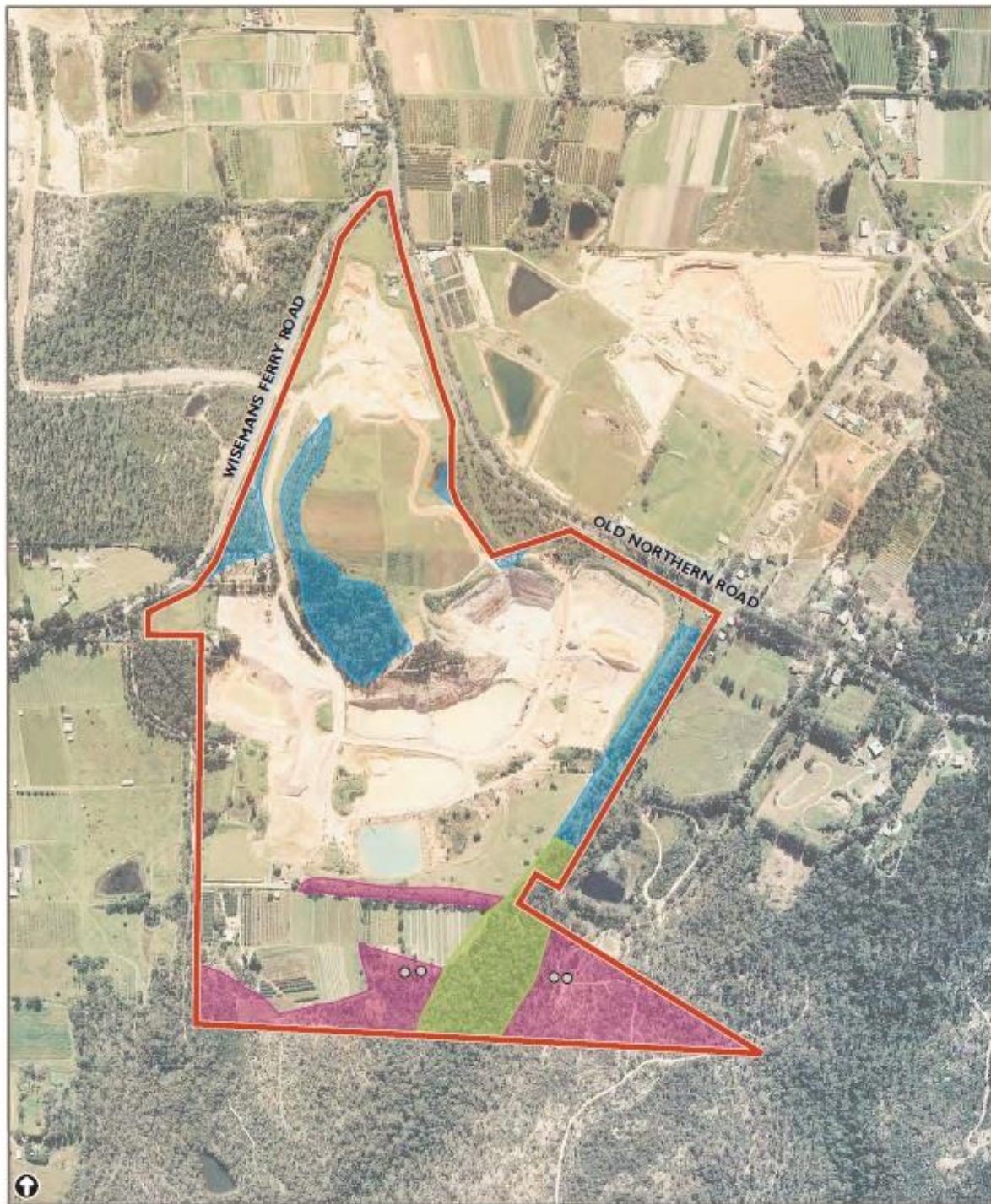


Figure 3.5

VEGETATION COMMUNITIES AND LOCATION OF THREATENED SPECIES

- Hitchcock Road site
- *Tetratheca glandulosa*
- Sydney Sandstone Gully Forest
- Sydney Sandstone Ridgetop Woodland
- Sydney Hinterland Transition Woodland



### **3.3.8 Potential impacts on visual quality**

Most of the site is not visually accessible from external roads or adjacent private property. The dominant natural feature of the site is the former Maroota Trigonometrical Hill which reaches an elevation of 240.7m AHD. The lowest point on the site has a level of approximately 188m AHD while the majority the area has an elevation at or above 200m AHD. The site is therefore generally higher than the surrounding areas. As a result, views into and across the site from the peripheral roads are available at a small number of locations along Old Northern Road and Hitchcock Road. Views from other locations are usually restricted by rising ground within the site or bunds constructed as part of the previous consent.

The approved development will remove some local vegetation, topsoil, overburden and the available Tertiary Sand and friable sandstone resource from defined areas on the site. This will result in remoulding of the existing landform and, during active extraction, the exposure of substantial parts of the site. Progressive rehabilitation will return the site to a vegetated state over a number of years.

The current landform will be substantially modified as a result of the approved development. The former Maroota Trigonometrical Reserve hill, which has the highest elevation in the general area, will be reduced with the result that its final form would be some 30 metres lower than its current level. The profile of the central part of the site would be changed from a ridge with steep batters to the north and south to a lower landform which is less visually prominent and better integrated with the surrounding topography with shallower batters. The final landform is shown on **Figure 3.3**.

While the landform changes will be observable over a period of time, particularly on the high points of the site, there will come a point when these changes are no longer apparent. Boundary mounding and screen planting measures already in place, will ensure that any visual contrasts developed as a result of the landform changes would be minimised.

### **3.3.9 Conserving and re-using topsoil**

Topsoil will only be sourced from within the site. Topsoil layers will be stripped from a minimum area of between two and five hectares to form a bund near the boundary of the area. The bund will not exceed 3m in height with a minimum crest width of 3m and side batters of 1 vertical to 2 horizontal. The bund will be revegetated for the duration of the operations. Bulky vegetation will be removed and stockpiled prior to soil stripping for respreading as a surface stabiliser or for mulching. Stripping will take place in moist conditions to avoid pulverisation and dust generation.

Topsoil will be removed and replaced in two layers according to its organic matter content. Organic matter is characterised by the darker colour of the upper 50 to 100mm of the soil. The darker layer will be replaced uppermost above about 200 to 250mm of lighter coloured material spread over the ripped surface.

Where revegetation is to be based on agricultural species, soil testing will be undertaken to assess lime and fertiliser requirements.

Topsoil will be respread to an even, but roughened surface with moderate compaction for optimum seedbed tilth.

Areas being rehabilitated to native species will be lightly sown to annual cereal species and allowed to regenerate naturally. Supplementary planting and inoculation will be undertaken as and if required.

Areas where improved grass cover is required will be limed, fertilised and sown according to seasonal recommendations of NSW Department of Primary Industries.

### **3.3.10 Collection and propagation of seed**

Material for propagation is available on-site. The use of site-adapted local seed for propagation is best for restoring pre-existing plant communities and conserving local biodiversity. It is also more likely to lead to a successful self-perpetuating plant community as local provident seed is adapted to local soils, climatic conditions and ecological processes. The rate of change in many endangered communities is very slow, particularly for understorey species, remaining highly localised with very limited dispersal.

Seed collection will be carried out within the framework of a formal collection policy or code of practice such as *The Model Code of Practice for Community Based Collectors and Suppliers of Native Plant Seed* (Florabank 1999) and collectors will be required to meet the requirements of the *Threatened Species Conservation Act 1995* including a Section 91 licence from the OEH when seed is collected from a plant community listed under the Act. The proportion of seed taken from any site will not exceed 10 percent of the species total annual seed crop from that site per year. There are no known threatened species on site.

However, seed collection can be time consuming and specialised skills and knowledge are required. In some cases the seed drops immediately it ripens or is located high in the tree canopy. Some species have dormancy mechanisms which inhibit immediate seed germination. It will therefore be undertaken by an organisation skilled in these procedures such as Greening Australia.

Subject to specialist advice seed will also be purchased from suppliers of locally collected seeds.

### **3.3.11 Site preparation for revegetation**

Revegetation of the site is mainly based on a mixed approach using broadcast seed reinforced by the planting of tubestock. Where suitable topsoil is available, this will be used, but the volume available is not expected to be sufficient to cover the area required.

Revegetation also requires the mitigation or treatment of any degrading influences. The presence of environmental weeds and problems such as erosion need to be addressed. Any efforts that can be included in site preparation will benefit the restoration results. These would include, where necessary:

- stabilisation of the soil using fast growing native grasses such as *Chloris ventricosa*, *Austrodanthonia racemosa* or *Capillipedium spicigerum*;
- ripping of any severely compacted soil following the contours of the site;
- mulching of areas or around individual plants to conserve moisture and suppress weed growth taking care not to equally suppress native plant growth;
- weed and rabbit control undertaken during the site preparation phase using methods appropriate to the area and the degree of infestation;
- pre-watering of holes and plants; and

- restriction of access to the rehabilitated site to protect the planted areas.

### **3.3.12 Direct seeding**

Direct seeding will also be considered as an approach following experience gained in the earlier stages of rehabilitation. This has a number of advantages. It is quick, little labour is required, the cost per plant is low and plants grow quickly as their roots have not been disturbed. It is also believed that directly seeded trees, once established, are more resistant to drought and better able to recover from insect defoliation. However, total failure can result if the seed is not viable, the ground is not sufficiently moist or the temperature not conducive to germination. Drought can also be disastrous and heavy rains can wash away the seed if the site is poorly prepared.

Site preparation and the climatic conditions experienced after planting are the two major factors in determining the success of seedling establishment. Good site preparation would maximise the chances of a successful project. This aims to provide ideal conditions for seed germination and seed establishment. Basic requirements are:

- soft soil so that air, water and roots can penetrate; and
- bare soil, free of leaf litter and especially weeds as weeds will compete with the native plants for water and nutrients.

Bare soil will be achieved by:

- scraping off debris and leaf litter;
- fire alone, or in combination with prior weed control using herbicides;
- spraying weeds with herbicides three times in the 12 months before seeding;
- scrapping off the top soil to remove weed seeds – the top 20 to 100mm, depending on soil type, contains the highest concentration of these; or
- spot preparation where small areas are prepared by removing the weeds by hand before being sown (Buchanan 1989).

Associated weed control will be undertaken over the period needed to allow good establishment and growth of seedlings in the first year (see **Section 3.3.16**).

The re-establishment of the top soil previously removed is important for rehabilitation as it contains seeds, vegetative reproductive organs and most of the organic matter from the site.

### **3.3.13 Planting**

Planting of seedling tubestock will be included in the rehabilitation program. While seedlings are better than seeds in a number of ways, they require substantial labour to establish, the process is slow and the cost per plant is higher. Plant selection would focus on local species adapted to the prevailing conditions and providing the right resources for local wildlife. Planting will take place at the most opportune time of year, generally in the early autumn. The main areas to be planted are shown on **Figure 3.6**.

Agricultural crops to be established on the site will include those grown throughout Maroota including pastures such as oats and sorghum. A typical pasture mix would be sown at a rate of 50 kilograms per hectare during the autumn or greater where conditions dictate.

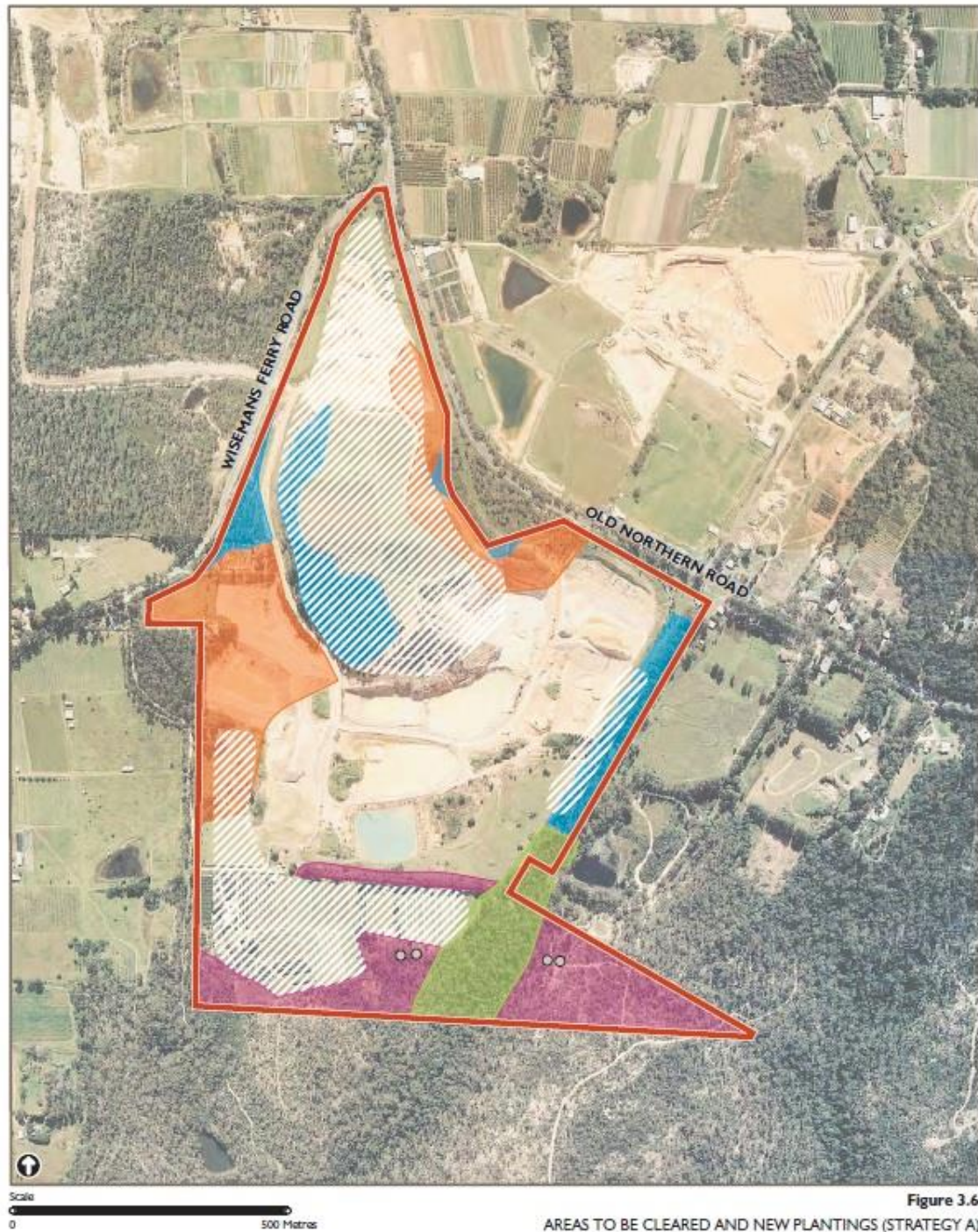
Grasses and cover crops are the most effective for initial erosion control in most areas (Department of Conservation and Land Management 1992 – now Department of Primary Industries). A cover crop of oats would be sown to establish ground cover, stabilise and increase the organic content of the soils within the site. Legume species such as lucerne could also be established to encourage nitrogen accumulation and improve soil fertility for future agricultural uses.

Stands of local native vegetation will be re-established around the perimeter and on the highest points of the site, if required and on all batters too steep to accommodate agricultural uses. Existing stands of native vegetation and the perimeter planting would be reinforced to improve the screening of site operations. Disturbance of existing screen planting would be minimised. The area to be seeded and planted with native vegetation would be approximately twice that removed to allow the present proposal to be implemented.

The Quarry Closure Plan includes an outline of future crop management approaches and monitoring practices for the site. Revegetation would be regularly monitored and supplemented by reseeded where this is necessary. Cover crops would either be slashed or left on the ground surface to provide a mulch (Department of Conservation and Land Management 1992 – now Department of Primary Industries). Pasture less than five years old would receive annual maintenance fertiliser in spring and autumn while more established pasture would receive supplements in autumn only.

Weeds would be controlled as required until pasture/ground cover is established.

# Hitchcock Road Sand Extraction and Rehabilitation Project Landscape Management Plan



- Hitchcock Road site
- Areas for new plantings
- *Tetraetheca glandulosa*
- Sydney Sandstone Gully Forest
- Sydney Sandstone Ridgetop Woodland
- Sydney Hinterland Transition Woodland
- ▨ Area to be cleared

Note: Sydney Hinterland Transition Woodland shown at time of photograph (2005)  
Parts of this area can be cleared under the current consent

#### **3.3.14 Care and maintenance after planting**

The native plant communities established on the site will be developed to cope with local conditions. They will therefore have as little reliance as possible on watering. However, if the soil is dry during planting, each plant will be drenched using up to 20 litres each. There may then be no need to water again.

Watering may be needed during the first year entailing several drenching to encourage a deep root system. Conservation of water occurring naturally within the system is the best way of watering seedlings. This requires the removal of competing weeds and the provision of individual weed mats or mulch to keep the soil cool and reduce evaporation.

Fertiliser is not recommended for native plants. In addition, fertiliser runoff can be detrimental to waterways and encourage weed growth.

The most important influence on seedling survival and growth during the first six months is believed to be competition from grass and weeds. It is therefore crucial to reduce weed and grass growth as much as possible during this period.

An area of approximately one metre in diameter around each plant should be kept weed-free. There are numerous methods available to control weeds including the application of residual herbicides to bare soil after planting to prevent weed germination; repeated applications of knockdown herbicides; thick applications of mulches; and weed control mats (Buchanan 1989).

Large scale control by the use of insecticides will not be undertaken.

#### **3.3.15 Salvage of material for habitat enhancement**

When clearing of large areas of vegetation takes place as much organic material as possible will be reused on site as a source of seed, as a surface stabiliser or for mulch. There is little other material on site which would be appropriate for use in habitat enhancement.

#### **3.3.16 Control of weeds and feral pests**

Weed control is required during the initial stages of revegetation to achieve a suitable base for planting and as a follow up to ensure that there is a high rate of survival if competition with weeds becomes a problem.

Primary weed clearance will be undertaken prior to seeding/planting. This will entail hand removal and/or herbicide treatment depending on the degree of infestation. Secondary treatment may be required where high levels of infestation are encountered.

Follow up maintenance is required to achieve high levels of seedling survival if weeds are not to become a problem. Maintenance includes the application of appropriate herbicides to reduce competition from weeds, slashing, ensuring the quality of staking, where necessary and appropriate fire hazard reduction. It is crucial to reduce weed and grass growth during the first six months of growth as the dense roots of many weeds compete with native trees and scrubs for water.

If weeds become a problem (this has not been the case so far with the revegetation of parts of the site), an appropriate herbicide, such as *Roundup* will be applied approximately three months after planting to a small area around the base of the

new plants to reduce competition for water. This will be repeated, if necessary during the first 2-3 years of the life of the plants.

Feral animal control, particularly of rabbits, may be required for up to two years after seedling establishment. This has not been a problem to date but it may be necessary to introduce fencing and/or individual tree guards.

### **3.3.17 Access control**

The site is securely fenced along the perimeter where public access would be possible. The vehicular access points are equipped with lockable gates.

### **3.3.18 Bushfire management**

A fire in the first five years of plant development will kill the majority of the plants. However, fire will encourage native grasses and in later years, a managed fire regime could be beneficial. Bushfire management is discussed in more detail in the following section.

### **3.3.19 Risks to rehabilitation**

The risks associated with the operations relating to rehabilitation undertaken at the site relate to environmental issues such as landslip and bushfire. The storage and use of dangerous goods is unlikely to represent a risk as all such materials are stored on Lot 198 DP752025.

#### ***Landslip***

The landslip potential of the site is limited to failure of excavated sand profiles within the operational areas, along the haul road and access roads to the cut faces and within batters associated with detention ponds and acoustic bunds.

Potential hazards of landslip would be mitigated by drainage control measures which divert surface runoff away from excavated areas and the use of appropriately designed batters with intermediate benches during extraction and bund construction. The excavated faces and bunds would be completed to maximum final slopes of 1 vertical to 3 horizontal to reduce their susceptibility to failure. All extraction operations would be undertaken in compliance with standard quarry safety procedures.

All cut slopes and batters will be inspected annually by a suitably qualified geotechnical engineer and any necessary modifications made.

#### ***Bushfire***

Approximately one third of the total area of the site is classified as Vegetation Category 1 on *Bush Fire Prone Land Map, Sheet 12* (Baulkham Hills Shire Council 2012), approximately one third Vegetation Buffer (100m and 30m) and approximately one third unclassified. Vegetation Category 1 includes Groups 1 and 2 vegetation types which are forest, woodlands, heaths and wetlands. Agricultural lands used for annual and/or perennial cropping, orchards, market gardens and nurseries are excluded from these categories.

The site comprises cleared horticultural/agricultural land which has experienced extensive sand extraction. There remain isolated stands of vegetation within this area and extensive areas of woodland are located in the south eastern parts of the site contiguous with the denser vegetation of Maroota State Forest creating a potential fire hazard downslope of the site.



The proposal would require the removal of isolated stands of trees and shrubs and a proportion of the denser woodland would also be removed where necessary. Access is available via the current haul road and an ample water supply is available for fighting fires from existing dams across the site. The proposal would progressively reduce the bushfire hazard on the site although substantial areas of woodland would remain in the south eastern part of the site together with the new vegetation forming part of the rehabilitation program.

Bushfire response measures will include:

- provision of training on related hazards and fire control for all site operatives;
- establishment of response procedures for the control of accidental fires;
- identification of potential fire hazards and establishment of coordinated response procedures with Council and the Rural Fire Service;
- provision of well-maintained fire fighting equipment;
- fitting of spark arresters on equipment; and
- provision of fire extinguishers in all on-site vehicles.

### **3.4 Success criteria and monitoring**

Rehabilitation can be considered to be successful when the site can be managed for its designated land use without any greater management inputs than other land in the area being used for a similar purpose. Restored native ecosystems may be different in structure to those in the surrounding area, but there should be confidence that they will change with time along with or towards the make-up of the surrounding area. The rehabilitated land should be capable of withstanding normal disturbances such as fire or flood.

Components of the success criteria include:

- physical (stability, resistance to erosion, re-establishment of drainage);
- biological (species richness, plant density, canopy cover, seed production, fauna  
return, weed control, productivity, establishment of nutrient cycles);
- water quality standards for drainage water; and
- public safety.

Monitoring involves observing the changes that take place on the site during and after the activities being undertaken and keeping accurate and comprehensive records to measure the success of these activities. Effectiveness can be measured by undertaking regular assessments and surveys, recording the results and periodically comparing and evaluating them to determine their effect and the progress being made towards the rehabilitation of the site. This monitoring program is designed to focus on progress with site rehabilitation.

The program will be predominantly undertaken using visual inspections reinforced by the assessment of aerial photography, regular site photography and site assessments using vegetation mapping.



Regular assessments will include:

- inspection of all silt ponds for construction adequacy and structural integrity;
- inspection of haul roads, pipeline bunds and associated overflow structures;
- development and implementation of an annual program of reinstatement and maintenance works;
- inspection of all batters to determine geological integrity and stability ;
- assessment of rehabilitation progress over the previous audit period and determination of work program for the following period; and
- assessment of regular aerial photography and before and after photographic records to identify changes occurring over the previous period.

Structured visual inspections will be undertaken each month. These will focus on the determination of the effectiveness of the measures employed in addition to recording the progress of site rehabilitation. The following will be determined and reported annually:

- additional area of cleared/disturbed/excavated land over the reporting period;
- additional area of backfilled/re-contoured/rehabilitated/planted land over the reporting period; and
- confirmation of final rehabilitated slope grades of new work undertaken during the reporting period.

The monthly inspections together with the vegetation audits will be reported on an annual basis in the AEMR with notification of any changes which need to be made. This will identify the need for any reworking, reseeding or application of fertilizer within the rehabilitated areas. The need for additional work and possible treatments prior to completion is set out in **Table 3.1**.

Monitoring of progress in the revegetation of the site is described separately in **Section 3.5**. Other programs, including ground and surface water monitoring are described in other management plans prepared in compliance with the requirements of the project approval.

**Table 3.1 Need for Additional Work and Potential Treatments**

<b>Failure characteristic</b>	<b>Potential treatment</b>	<b>Completion criterion</b>
<b>All areas</b>		
Slope stability	All slopes graded to not more than 4(H):1 (V) on north and west facing slopes and 3(H):(V) on east and south facing batters	No finished slope exceeding criteria
Erosion within drainage channels and water storages	Regrading and compaction of slopes Additional planting of native species Reconfigure inlet structures where necessary	No erosion within drainage channels and water storages
Erosion of access road and tracks	Regrade where necessary Additional erosion controls if required	No erosion on access road and tracks
<b>Offset areas</b>		
Isolated patches of exposed earth	Additional planting of native species	No patches of exposed earth within rehabilitated areas
Widespread areas of exposed earth	Planting of native species Application of fertilizer Seeding	
Isolated areas of erosion within planted areas	Planting of native species	No erosion within rehabilitated areas
Widespread/severe erosion	Erosion control devices (hay bales) Application of fertilizer Spreading native seed	
Increase in weed cover within areas of native species	Hand weeding or spot-spraying of herbicide	No excessive weed cover in areas of native species
Dead seedlings	Replant area Review nursery and planting methods	No areas of dead seedlings
<b>Buffer zones and remnant vegetation areas</b>		
Fences/marker posts down or missing	Reinstate	All fences/marker posts in good order
Isolated patches of weeds	Hand weeding	No areas of weeds
Widespread areas of weeds within areas of native vegetation	Hand weeding or spot-spraying of herbicides	

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<b>Failure characteristic</b>	<b>Potential treatment</b>	<b>Completion criterion</b>
Soil erosion	Additional planting of native species Erosion controls where necessary	No soil erosion in buffer zones and areas of remnant vegetation
Dead seedlings	Replant Review nursery and planting methods	No areas of dead seedlings
<b>Rehabilitated areas for agricultural use</b>		
Isolated patches of exposed earth	Reseeding Application of fertilizer	No areas of exposed earth in agricultural areas
Widespread areas of exposed earth	Application of alternative fertilizer Reseeding Reworking of soil if compressed	
Isolated areas of erosion within planted areas	Reseeding	No erosion within planted areas
Widespread/severe erosion	Reshaping Application of fertilizer Reseeding Erosion control devices	
Isolated patches of weeds within planted areas	Hand weeding	No areas of weeds within planted and native vegetation areas
Widespread areas of weeds within areas of native vegetation	Hand weeding or spot-spraying of herbicides Reseeding	

### **3.5 Vegetation offset strategy**

#### **3.5.1 Overall approach**

The strategy aims to achieve an area of successfully recreated woodland community with similar characteristics to that removed. In total, the new community would ultimately cover at least twice the area of that to be removed. A series of criteria have been developed and are applied by an independent specialist to determine whether the principle characteristics of the original community have been achieved before any of the existing community can be removed.

Targets would be set to be achieved at five year intervals and comparisons made with the existing condition of the vegetation to be removed. Where a value is not achieved at the appropriate time, it is indicative of a requirement for improved management of the program so that the overall goal can be achieved.

Annual surveys, unless the specialist consultants recommend less frequent periods, would become part of the established environmental audit process that has been established on the site for over ten years.

### **3.5.2 Performance assessment criteria**

The criteria to determine whether the principle characteristics of the original vegetation community have been achieved before any of that community can be removed include:

- native species diversity;
- diagnostic species for Sydney Hinterland Transition Woodland present;
- native species cover;
- weed abundance and presence of noxious species;
- vegetation structure;
- canopy height and cover;
- native shrub height and cover;
- percentage ground cover; and
- ecosystem function and habitat values.

Targets would be set to be achieved at five year intervals and comparisons made with the existing condition of the vegetation to be removed. Where a value is not achieved at the appropriate time, it is indicative of a requirement for improved management of the program so that the overall goal can be achieved.

The results of the field surveys and the typical characteristics of the community provide baseline information against which the revegetation program can be assessed. The criteria for assessment and the target values for these goals are set out in **Table 3.2**.

### **3.5.3 Monitoring and reporting**

Monitoring the performance of the revegetation program will be undertaken annually (or as required) and include observational information in addition to the collection of data from random 400 square metre quadrats (at least one per revegetation area). Each species of plant in the quadrat will be recorded and its cover abundance estimated. Additional information recorded at each site will include position using GPS, slope, aspect, landform, soil type/geology, evidence of disturbance, condition, evidence of canopy recruitment, natural regeneration and fauna habitat values.

The values provided as targets in **Table 3.2** are intended to be used as goals. Where the value is not achieved, this provides an indication that some additional management is required in order to achieve the re-creation of the vegetation community.

**Table 3.2 Criteria to monitor success of revegetation**

Category	Criteria	Target 5 years	Target 10 years	Target 15 years	Condition of vegetation to be removed
<b>Native species</b>	Native species diversity (average number per 400m <sup>2</sup> quadrat)	20	35	40	46
	Average number of characteristic species for the site occurring within 400m <sup>2</sup>	15	20	27	34.5 (+/-1.5)
	Native species cover (% vegetation cover in 400m <sup>2</sup> quadrat)	>50	>85	>95	99
<b>Weeds</b>	Weed abundance (% of vegetation cover in 400m <sup>2</sup> quadrat)	<50	<15	<5	<1
	Invasive or Noxious weed species (e.g. Lantana, Blackberry, exotic vines)	Controlled	Controlled	Controlled	Restricted
<b>Vegetation structure</b>	Vegetation structure	Canopy, shrub layer and groundcover species present. However, structure limited, generally consisting of low canopy and ground cover.	Canopy, shrub layer and groundcover species present. Structure beginning to develop.	Well structured and includes canopy, mid-storey and ground cover units.	Well structured and includes canopy, mid-storey and ground cover units.
<b>Canopy<sup>a</sup></b>	Average canopy height (m)	4	8	12	12-16
	Native canopy cover (minimum %)	5	5	5	5

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Category	Criteria	Target 5 years	Target 10 years	Target 15 years	Condition of vegetation to be removed
	cover) [modified braun blanquet scale] <sup>b</sup>	[3]	[3]	[3]	[3]
<b>Shrub layer<sup>a</sup></b>	Native shrub cover (minimum % cover) [modified braun blanquet scale] <sup>b</sup>	10 [3]	15 [3]	25 [4]	32.5 (+/-7.5) [4]
	Average shrub layer height (m)	0.5	1	1	1.25
<b>Ground cover</b>	Native ground cover (minimum % cover) [modified braun blanquet scale] <sup>b</sup>	5 [3]	10 [3]	10 [3]	15 (+/-5) [3]
<b>Ecosystem function</b>	Habitat values	Vegetation structure beginning to develop.	Woodland birds recorded.  Habitat structure beginning to develop, including groundcover such as leaf litter and fallen timber.	Woodland birds recorded.  Habitat structure beginning to develop, including groundcover such as leaf litter and fallen timber.	Provides minimal habitat for fauna, however, many woodland birds present.  Well structured habitat, includes moderate levels of leaf litter and fallen timber.
	Natural regeneration indicating dispersal of seed into site and/or presence of soil seed bank.	Yes	Yes	Yes	Yes

Notes: a) cover of canopy species and shrubs may be higher initially due to successional changes with dense growth potentially occurring initially particularly due to the presence of colonising species. Natural thinning is expected as colonising species senesce and canopy species mature, however, some thinning of vegetation may be required after 10 years if too dense.

b) Modified braun blanquet scale:

1. <5%-rare or few individuals
2. <5% common
3. 5-25%
4. 25-50%
5. 50-75%
6. 75-100%

### 3.6 Responsibilities

PF Formation is responsible for the management of the project in a manner which achieves the environmental outcomes set out in the approval conditions. The project team members responsible for the implementation of the EMP have been nominated although these may be changed with approval over the life of the consent. Their responsibilities are:

**Quarry manager** - responsible for the day to day activities on the extraction and process sites. The site is managed Peter Watt (Quarry Manager) who has a Certificate III in Extractive Industry Operations from Illawarra TAFE and is the Mine Manager under the Department of Primary Industries Mine Safety protocol. He is responsible to John Graham (Director of PF Formation) for the safe and efficient management of all site related operations.

**Environmental manager** - responsible for the environmental management of the activities on the extraction and process sites. Joshua Graham is the Environmental Manager. He has a Certificate IV in Extractive Industries Management and a Diploma in Extractive Industries Management. He is responsible to John Graham for the environmental management of PF Formation operations at Maroota.

Each person with responsibilities (as identified above) will hold a controlled copy of the EMP.

Site inspections during operations, the assessment of environmental impacts and the performance of mitigation measures will be carried out regularly by a nominated **environmental officer** or the **environmental manager**. Such inspections will be documented in a standard format and a copy submitted to the **quarry manager**. Issues arising from these inspections will be addressed immediately. Overall environmental performance will be addressed at management meetings as appropriate.

Suitably qualified independent specialists would be also be used to assess particular aspects of the rehabilitation process when required. These would include:

- geotechnical engineer to assess and certify the stability of the final landform;
- flora and fauna specialist to undertake quadrat surveys of the revegetating areas and prepare assessments of the success of the program against the agreed criteria; and
- environmental planner to review the environmental performance of the development against the requirements of the approval conditions and assist with the AEMR.



Chapter Four

## QUARRY CLOSURE PLAN

### 4.1 Introduction

**Schedule 3 Condition 26** of the Project Approval requires the following in a Quarry Closure Plan:

- include provision for certification from a qualified geotechnical engineer that the final proposed landform is stable;
- define the objectives and criteria for closure of the quarry;
- investigate options for the future use of the site including any final void;
- describe the measures that would be implemented to minimise or manage the ongoing (post closure) environmental effects of the project; and
- describe how the performance of these measures would be monitored over time.

The Project Approval allows on site operations to extract sand and other associated material and rehabilitate the site until June 2028. The last few years of this period is expected to see the slow run down of sand production as a shift in emphasis takes place to the preparations for closure. By this time, a number of factors which remain unclear at present will have been clarified and the final landform and the revegetation of the site will be close to completion.

While rehabilitation has been undertaken as part of the overall management of the site and will continue, the final few years will focus predominantly on quarry closure issues. These will encompass the rehabilitation process as an ongoing program aimed at restoring the physical and ecological quality of the site disturbed by quarrying to an acceptable level. Its principal aim is to leave the site in such a way that rehabilitation does not become a burden to the community at the cessation of extraction. It must also aim to create a self-sustaining ecosystem and an area suitable for continuing economic activity.

The majority of the site, in particular that part where the final slopes will be relatively gentle is mapped as Class 3 on the *Agricultural Land Classification Atlas* (NSW Agriculture 1995). Land in this classification has the following characteristics:

- well suited to grazing, including the use of improved pastures;
- cultivation is limited to cash or forage crops in rotation with pastures; and
- limitations to production include shallow, stony or eroded soils;

### 4.2 Closure objectives

Four principal quarry closure objectives have been identified:

- Provision of a safe post extraction site requiring all remaining slopes to be stable and securing potentially dangerous areas, if necessary.

- Achievement of a successful self-perpetuating plant community with the characteristics of the *Sydney Hinterland Transition Woodland* on the site.
- Establishment of a viable and sustainable post extraction land use.
- Reduce any residual impacts to acceptable levels particularly ensuring that there is no surface or groundwater contamination or negative effects on surface or groundwater flows.

Criteria for closure of the quarry will be further developed, determined and reported on in more detail in the AEMRs as quarry closure approaches.

#### **4.3 Potential future uses**

The proposed final land use within the site has not yet been determined. One or more land uses may become appropriate towards the end of the operational life of the current project. Potential land uses would reflect the characteristics of the site and its surroundings and its specific attributes. These include large areas of land and a substantial store of surface water in the dams on the site.

Such land uses might include agricultural activities such as cultivation or cropping in rotation with sown pasture, grazing and/or more intensive horticultural uses similar to those undertaken over large areas of Maroota at present including nurseries and orchards.

The final landform within the site could be modified to suit the final land uses by the importation and placement of inert materials should these be available at the time. Any excess of material required above that allowed in the Project Approval would need to be approved by the Department of Planning & Environment or its successor agency.

The final landform and use of the site will be determine 2 years before the expected closure of the quarry and will be certified by a qualified geotechnical engineer that it is stable for such usage.

#### **4.4 Soil management for rehabilitation**

On-site constraints to rehabilitation following the cessation of sand extraction include:

- seasonal water logging and low wet strength;
- acidity in most soil profiles;
- sodicity in all layers;
- low fertility;
- potential aluminium toxicity in layers with pH <4.5;
- low permeability in layers with >30% clay;
- moderate erosion hazard on slopes over 30%;
- poor moisture holding capacity in topsoils; and
- rill and gully erosion under concentrated flows.

These limitations will be managed by implementing the following measures:

- reshaping gradients to a maximum of 1 vertical to 4 horizontal or 1 vertical to 3 horizontal on south or east facing slopes;
- lime those soils to be used in rehabilitation;
- respread all topsoil where practicable; and
- re-establish temporary vegetation on topsoil stockpiles.

Conservation farming practices and the efficient management of fertilisers are two important factors in long term sustainable agriculture. Such measures assist in preventing or slowing down soil erosion and other soil-degrading processes. Some important conservation farming practices are:

- maintenance of groundcover at all times, where practicable, to protect the soil against erosion, impede and slow down runoff and encourage water infiltration;
- use of crop/pasture rotations that include well-managed perennial pastures and legumes;
- use of herbicides rather than tillage to control weeds during fallows;
- improvement of grazing management to minimise compaction and maintain adequate surface cover, especially during droughts;
- confinement of machinery traffic as much as possible;
- increase of topsoil organic matter levels by mulching and including pastures in crop rotations;
- application of lime and/or gypsum to acid soils and sodic clay soils;
- promotion of vigorous plant growth generally using sound soil, crop and water management practices;
- incorporation – rather than broadcasting – of fertiliser wherever possible;
- restrict the use of fertiliser close to or across dams or waterways;
- storage of fertiliser under cover on compacted or impervious soil away from dams and waterways and divert run off from higher ground around fertiliser stockpiles; and
- maintenance of records of fertiliser usage and calibration of spreading equipment to reduce the possibility of overuse.

#### **4.5 Post-closure environmental management**

The anticipated change of use to horticulture/agriculture on cessation of sand extraction would require the institution of an environmental management regime appropriate for the new uses in compliance with the legislation and guidelines applying at the time. This would be little different from other sites in Maroota where

rural activities are taking place where sand has been extracted and the area rehabilitated.

There are not expected to be any residual environmental impacts resulting from previous activities on the site. Recontouring of the site following extraction will leave a surface free of any steep slopes or pits which would raise safety issues and no reject stockpiles will remain to present problems for the future. Cessation of extraction activities and the removal of all related infrastructure will eliminate other environmental impacts which have been monitored over the life of the operation, including noise and air quality impacts. Groundwater will not have been affected due to the maintenance of a two metre buffer above the aquifer. Groundwater quality and levels will have been monitored throughout the operational period. As this remains an important issue, especially if irrigated agriculture becomes a final use, monitoring, using the existing bores could be continued beyond site closure.

The success of the site revegetation will be determined using the process described in **Section 3.5** and the viability of future land use will be determined by the economic and environmental factors prevailing at the time.

#### **4.6 Performance monitoring**

With the exception of groundwater plus any issues relating to the new activities on site, there would not appear to be any reason to monitor the performance of any measures relating to potential residual impacts. The AEMRs will report on removal of material from the quarry and progressive implementation of the rehabilitation and offset management plan.

Issues in relation to further development of the Quarry Closure Plan including refinement of closure objectives, criteria and future uses will be reported on in more detail in AEMRs as quarry closure approaches after 2025.

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