



Gerroa Sand Resource

Quarry Environmental Management Plan

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Revision Register

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- D. LANDSCAPE AND REHABILITATION MANAGEMENT PLAN
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GLOSSARY

AHMP	- Aboriginal Heritage Management Plan (see Appendix G)
AEMR	- Annual Environmental Management Report
Area A	- An area of potential archaeological deposit nominated by Paton (1992), to be preserved from disturbance (see Figure 4.3)
Area B	- An area of potential archaeological deposit nominated by Paton (1992), part to be salvaged and part preserved (see Figure 4.3)
Area marked "X"	- An area defined in the project approval where separate approval is required from the DP&E for any vegetation clearing (see Figure 4.2)
CCC	- Community Consultative Committee (see section 10.1)
Compensatory Planning	- Land required to be revegetated in accordance with the LRMP (see Figure 4.2)
Conservation Area	- Land where native vegetation is required to be conserved in perpetuity (see Figure 2.3)
DP&E	- Department of Planning and Environment
DPI-W	- Department of Primary Industries, Office of Water
East-West link	- Existing habitat corridor defined in the project approval with pre- requisites for severance (see Figure 4.2)
EPA	- Environmental Protection Authority (formerly Department of Environment and Climate Change)
LRMP	- Landscape and Rehabilitation Management Plan (see Appendix D)
Northern Corridor	- Habitat area defined in the project approval to be developed north of the extraction area (see Figure 4.2)
PASS	- Potential acid sulphate soil
QEMP	- Quarry Environmental Management Plan (this document)
Southern Rehabilitation Area	- An area of rehabilitation defined in the project approval and shown on Figure 4.2
VENM	- Virgin excavated natural material

1 INTRODUCTION

1.1 BACKGROUND

Sand has been extracted from Cleary Bros sand quarry at Gerroa for over 50 years. The workings have been authorised by a succession of development approvals. From 1990 to 2008, extraction was undertaken in accordance with a development consent granted by the Land and Environment Court followed by a further development consent granted by the Minister for Infrastructure and Planning in 2003. The Court consent has since expired and the Minister's consent has been surrendered as a condition of the current project approval.

On 2 September 2008 the Land and Environment Court granted project approval to Cleary Bros (Bombo) Pty Ltd for "Extension and Continuation of Gerroa Sand Quarry". A copy of the approval is included in Appendix A.

Sand extraction by dredging on the property is licensed by the Environmental Protection Authority (EPA). A copy of the Environmental Protection Licence is included in Appendix B.

The location of the property is shown on *Figure 1-1*. Details of the site are presented in Section 2.

1.2 PURPOSE OF THE QEMP

This quarry environmental management plan (QEMP) describes management procedures associated with the Gerroa sand quarry relevant to managing the project's impact on the environment and incorporates matters required to be implemented or documented by the project approval. Its purpose is to be a reference document for use by:

- Cleary Bros staff with responsibility for managing the operation and its environmental performance;
- environmental auditors;
- regulatory bodies.
- the community consultative committee established in accordance with the project approval; and
- interested members of the public who may access the QEMP via the internet or in person.

For the QEMP to fulfil its purpose it needs to contain all information relevant to environmental management of the sand quarry. Consequently the QEMP incorporates the various plans and other documents specified in the project approval, either entirely or by summary of actionable items.

Table 1.1 lists the conditions of project approval requiring documentation to be prepared and indicates the manner in which the requirements of those conditions have been incorporated in the QEMP.



Figure 1-1 Locality Plan



Table 1.1 Conditions requiring approved documentation

Condition	Documentation Specified	Consultation Required	Location in QEMP
Schedule 3, Condition 1 & SOC* 17	Survey and mark the extraction boundaries and submit a survey plan	Qualified ecologist (to ensure adequate buffer - cond. 19)	Section 4.1.1
Schedule 3, Condition 4	Noise Monitoring Program	EPA	Section 8.3
Schedule 3, Condition 7	Air Quality Monitoring Program	EPA	Section 8.4
Schedule 3, Condition 11	Water Management Plan, including: <ul style="list-style-type: none"> – Erosion and Sediment Control Plan; – Surface Water Monitoring Program; – Groundwater Monitoring Program; – Acid Sulfate Soils Management Plan; – strategy for placing high hydraulic conductivity material in the pond 	EPA and DPI-W	Sections 6.4, 6.5, 6.6, 8.5, 8.6, 8.7, <i>Appendix C</i> , <i>Appendix E</i> and <i>Appendix F</i>
Schedule 3, Condition 21	Landscape and Rehabilitation Management Plan	EPA	Sections 6.7, 6.8, 6.9, 8.8, and <i>Appendix D</i>
Schedule 3, Condition 26	Long Term Management Strategy	EPA, Shoalhaven and Kiama Councils, DPI-W and the CCC	Section 6.10
Schedule 3, Condition 30	Aboriginal Heritage Management Plan	EPA and Aboriginal Communities	Section 6.11 and <i>Appendix G</i>
Schedule 5, Condition 1	Environmental Management Plan	EPA, Shoalhaven and Kiama Councils	This QEMP
Schedule 5, Condition 2	Environmental Monitoring Program	nil	Section 8

*SOC = Statement of Commitment (see section 1.6 and *Appendix A*)

1.3 DOCUMENT CONTROL

1.3.1 Approval

The QEMP is to be submitted to the Department of Planning and Environment (DP&E) for approval. The date of approval will be noted at the front of the document.

1.3.2 Distribution

Within one month of receipt of approval the QEMP is to be made available as follows:

- send copies to the EPA, Kiama Council and Shoalhaven Council;
- make the document available at the quarry;
- provide copies to members of the community consultative committee; and
- place a copy on Cleary Bros' Gerroa quarry web site

1.3.3 Amendment

The QEMP is a perpetual document, capable of being amended and updated as needed to take account of changes occurring from time to time. Such updates will enable the operator to keep the document relevant to changing circumstances including:

- the outcome of environmental monitoring and audits;
- any future modifications to the approval;
- periodic review and re-issue of the environment protection licence;
- modified practices based on market requirements or improved technology;

The QEMP may be amended at any time at Cleary Bros instigation or as requested by the DP&E. The document is required to be reviewed following submission of each independent environmental audit to the DP&E (see section 9.1) and if necessary, revised and re-issued. Any amendment must be approved by the DP&E before it has effect. An amendment to the QEMP is to be consistent with the project approval currently in force.

1.4 OBJECTIVES

The objectives of the QEMP are as follows:

- present the environmental management plan for the sand quarry extension;
- detail practices, procedures, work methods and other requirements necessary for the operation to achieve environmental goals specified by the development approval and environment protection licence; and
- include within a single document, all of the regulatory environmental requirements for operating the site.

Requirements for the environmental management plan are included in Condition 1 of Schedule 5 of the project approval, as follows:

- a) be submitted to the Director-General within 6 months of the date of this approval;*
- b) be prepared in consultation with the Relevant Agencies;*
- c) provide the strategic context for environmental management of the project;*
- d) identify the statutory requirements that apply to the project;*
- e) describe in general how the environmental performance of the project would be monitored and managed;*
- f) describe the procedures that would be implemented to:*
- g) keep the local community and relevant agencies informed about the construction, operation and environmental performance of the project;*
- h) receive, handle, respond to, and record complaints;*
- i) resolve any disputes that may arise during the life of the project;*
- j) respond to any non-compliance;*
- k) manage cumulative impacts; and*
- l) respond to emergencies; and*
- m) describe the role, responsibility, authority, and accountability of the key personnel involved in the environmental management of the project.*

The QEMP forms part of Cleary Bros Integrated Management System, certified to ISO14001.

1.5 SPECIALIST INVESTIGATIONS

Prior to the 2008 project approval being granted, a number of investigations were undertaken by specialists to determine characteristics of the site and make predictions relevant to the sand extraction operation. For the most part these investigations provided information for the application process. Specialist reports listed below are included in the *Gerroa Sand Resource, Proposed Extension Environmental Assessment* (Perram & Partners, October 2006). Any findings or recommendations relevant to environmental management of the site have been incorporated into the management procedures and work instructions referenced in Section 5 of this QEMP.

- Report on Geotechnical Assessment, Proposed Northern Extension of Gerroa Sand Quarry – Douglas Partners, June 2006;
- Addendum to Report on Geotechnical Assessment, Proposed Northern Extension of Gerroa Sand Quarry – Douglas Partners, September 2006;
- Report on Acid Sulphate Soil Management Plan, Proposed Northern Extension of Gerroa Sand Quarry – Douglas Partners, June 2006;
- Blue Angle creek Flood Study, Sand mine Extension – Evans & Peck, September 2005;
- Overview of the Flora and Fauna, Cleary Bros (Bombo) Property at Gerroa - Kevin Mills & Associates Pty Ltd, February 2005;
- Flora and Fauna Assessment, Extension of Cleary Bros (Bombo) Sand Quarry - Kevin Mills & Associates Pty Ltd, October 2006;
- Gerroa Sand Mine Extension, Archaeological Subsurface Testing Program – Navin Officer Heritage Consultants Pty Ltd, October 2006;
- Proposed Screen Planting, Extension of Sand Quarry, Seven Mile Beach Road, Gerroa - Kevin Mills & Associates Pty Ltd, September 2006;
- Gerroa Sand Resource, Extension of Northern Extraction Area, Environmental Noise Impact Assessment – Renzo Tonin and Associates Pty Ltd, September 2005; and
- Traffic Report, Gerroa Sand Resource – Masson Wilson Twiney, February 2001.

Specialist reports were also prepared for the Land and Environment Court prior to issue of the 2008 project approval. Information from those reports has been reviewed and incorporated into this QEMP where appropriate.

1.6 PERFORMANCE REQUIREMENTS

Condition 1 of Schedule 2 of the project approval requires the proponent, Cleary Bros, to implement all practicable measures to prevent or minimise any harm to the environment that may result from the project.

Condition 2 of the same Schedule requires that the development be conducted generally in accordance with the following:

- environmental assessment (Perram & Partners 2006);
- statement of commitments; and
- conditions of approval;

with the conditions of approval taking precedence.

A draft statement of commitments was included in the environmental assessment (EA). Following exhibition of the EA, the Department of Planning requested Cleary Bros to consider submissions received and prepare a revised statement of commitments. The revised statement of commitments comprised the original draft plus additional commitments added in response to submissions. Further minor additions to the statement of commitments were made during the court hearing. A copy of the revised statement of commitments is included in the project approval in *Appendix A*.

In addition to specific requirements referred to in the development consent, site operations are to be conducted in accordance with all relevant New South Wales legislation. New South Wales legislation applicable to sand extraction at Gerroa includes:

- Protection of the Environment Operations Act, 1997;
- Environmental Planning and Assessment Act, 1979;
- Fisheries Management Act, 1994
- Local Government Act, 1993;
- Mines Inspection Act, 1901;
- National Parks and Wildlife Act, 1974;
- Noxious Weeds Act, 1993
- Work Health and Safety Act, 2011;
- Roads Act, 1993;
- Threatened Species Conservation Act, 1995;
- Waste Avoidance and Resource Recovery Act; 2001; and
- Water Management Act, 2000

2 THE SITE

2.1 PROPERTY DESCRIPTION

The land to which the project approval relates comprises all of Lot A DP 185785 and part of Lot 2 DP 1111012. The property is owned by Bridon Pty Ltd, a member of the Cleary Bros group of companies.

The remainder of the property which is not within the sand quarry operational area is a farm used for turf farming and grazing. This land was formerly part of Foys Swamp and has been drained with several drainage channels constructed across the land. The farmland on the property contains areas of remnant and planted bushland.

The property has frontages to Crooked River Road and Beach Road and adjoins the South Coast Railway on its western side.

2.2 SAND QUARRY OPERATIONAL AREA

The approved sand quarry operational area, including the extension, has a total area of about 27.5 hectares and is shown on *Figure 2-1*. This is referred to as the project site.

The limits of the approved extraction area for the quarry extension are shown on *Figure 2-2*. A full scale copy of the survey plan from which the limits have been derived is available. The plan shows the quarry extension to have an area of approximately 7.12 hectares with the following boundaries:

Boundary	Identifying Features
East	Towards the southern end, set back 5 metres from the Littoral Rainforest vegetation as determined on site by an ecologist. Towards the northern end, set back approximately 8 metres from the property boundary with Crooked River Road.
North	Located within the cleared paddock where the paddock narrows approximately 110 metres south of the property boundary.
West	Set back 5 metres from the Swamp Sclerophyll Forest, as determined on site by an ecologist.
South	The foreshore of the existing dredge pond.

Further extraction may also be undertaken from within the existing dredge pond.

2.3 CONSERVATION AREA

The Conservation Area is defined in the project approval as the land shown on the surveyor's plan in Appendix 4 of the project approval. *Figure 2-3* has been derived from the surveyor's plan and shows the Conservation Area. The Conservation Area is located outside the quarry operational area and includes existing bushland, areas of the property to be planted in accordance with the project approval (Compensatory Planting) and land that has been rehabilitated following earlier quarrying activities.

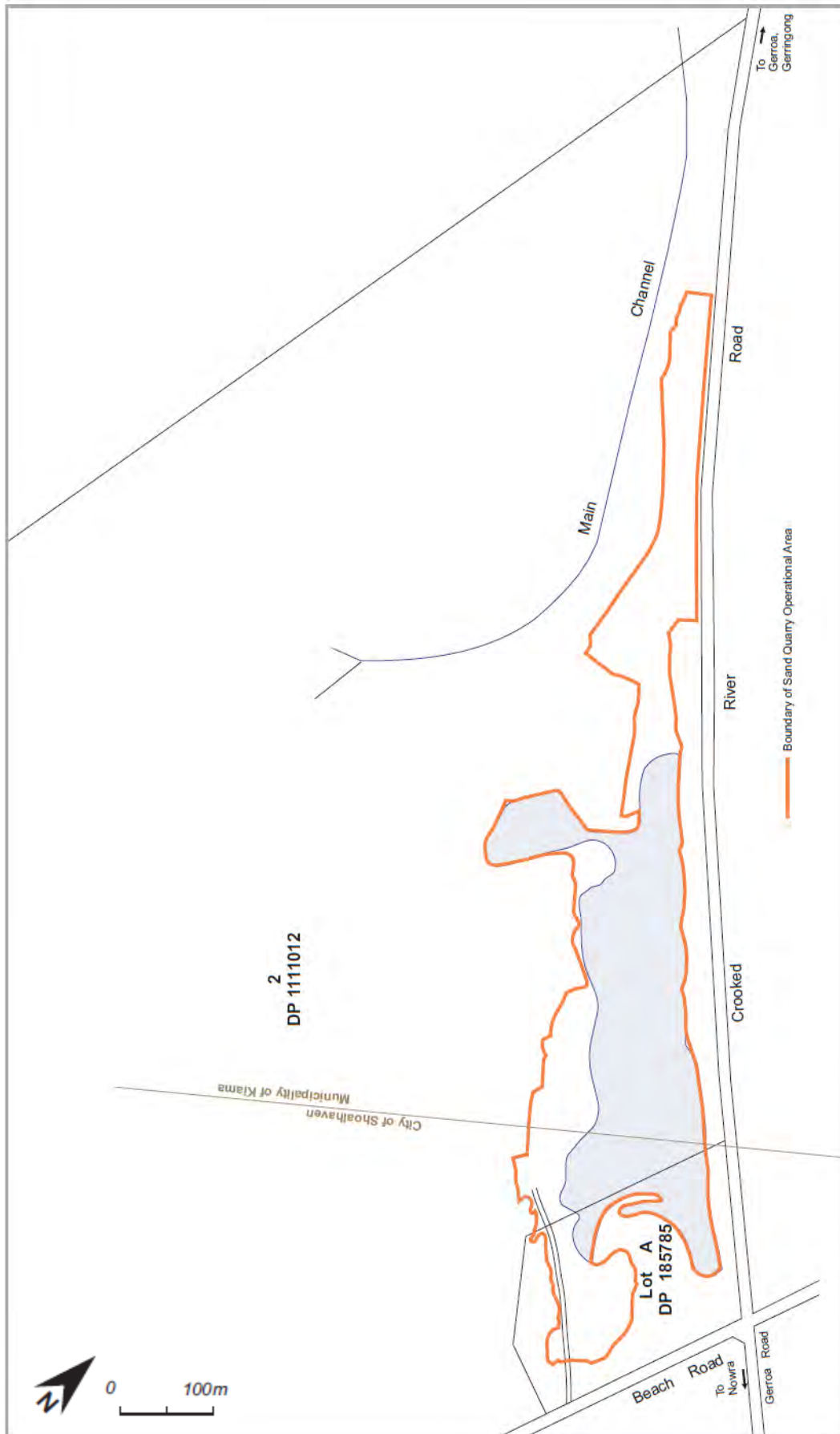


Figure 2-1 Approved Operational Area

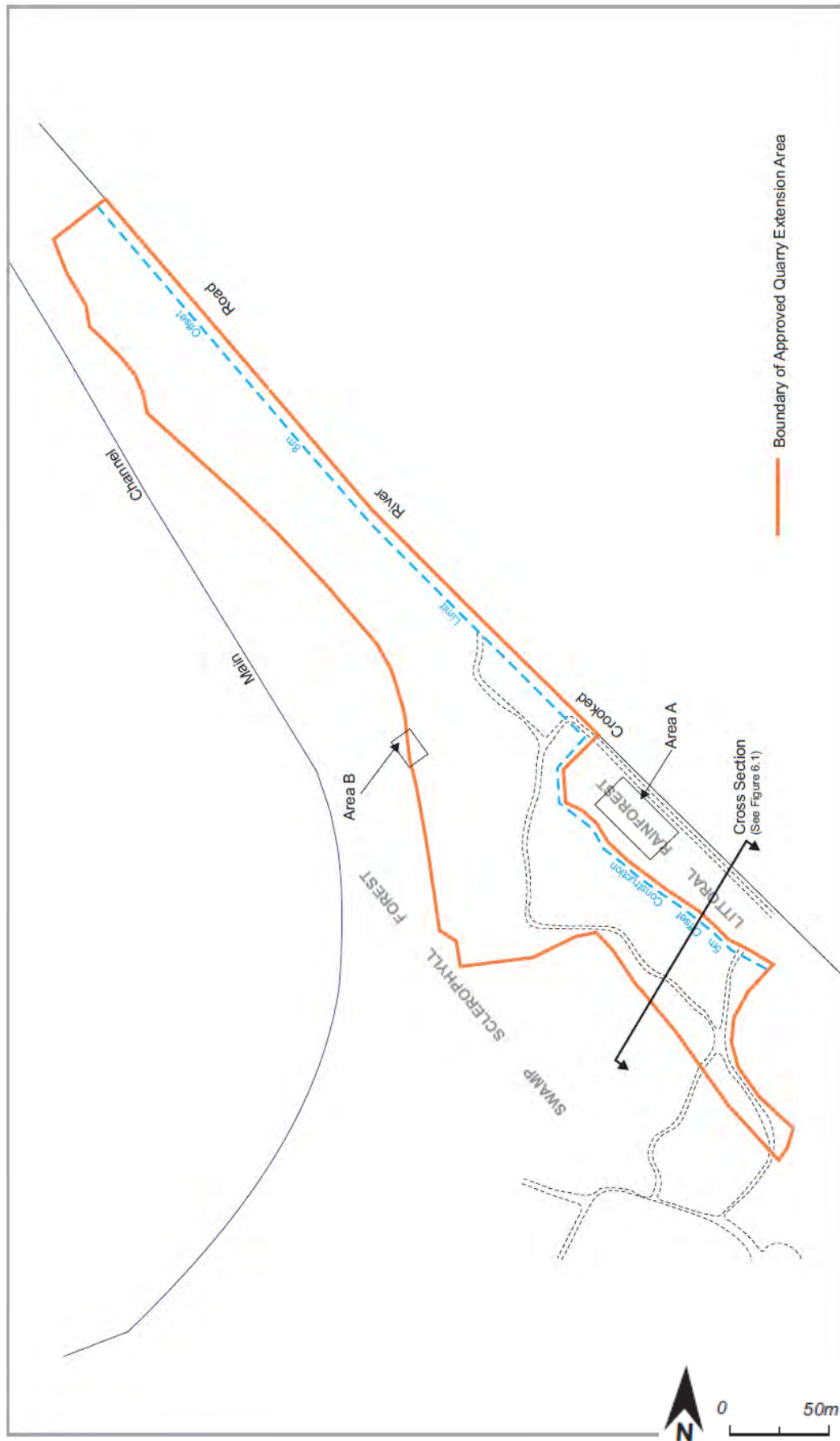


Figure 2-2 Quarry Extension

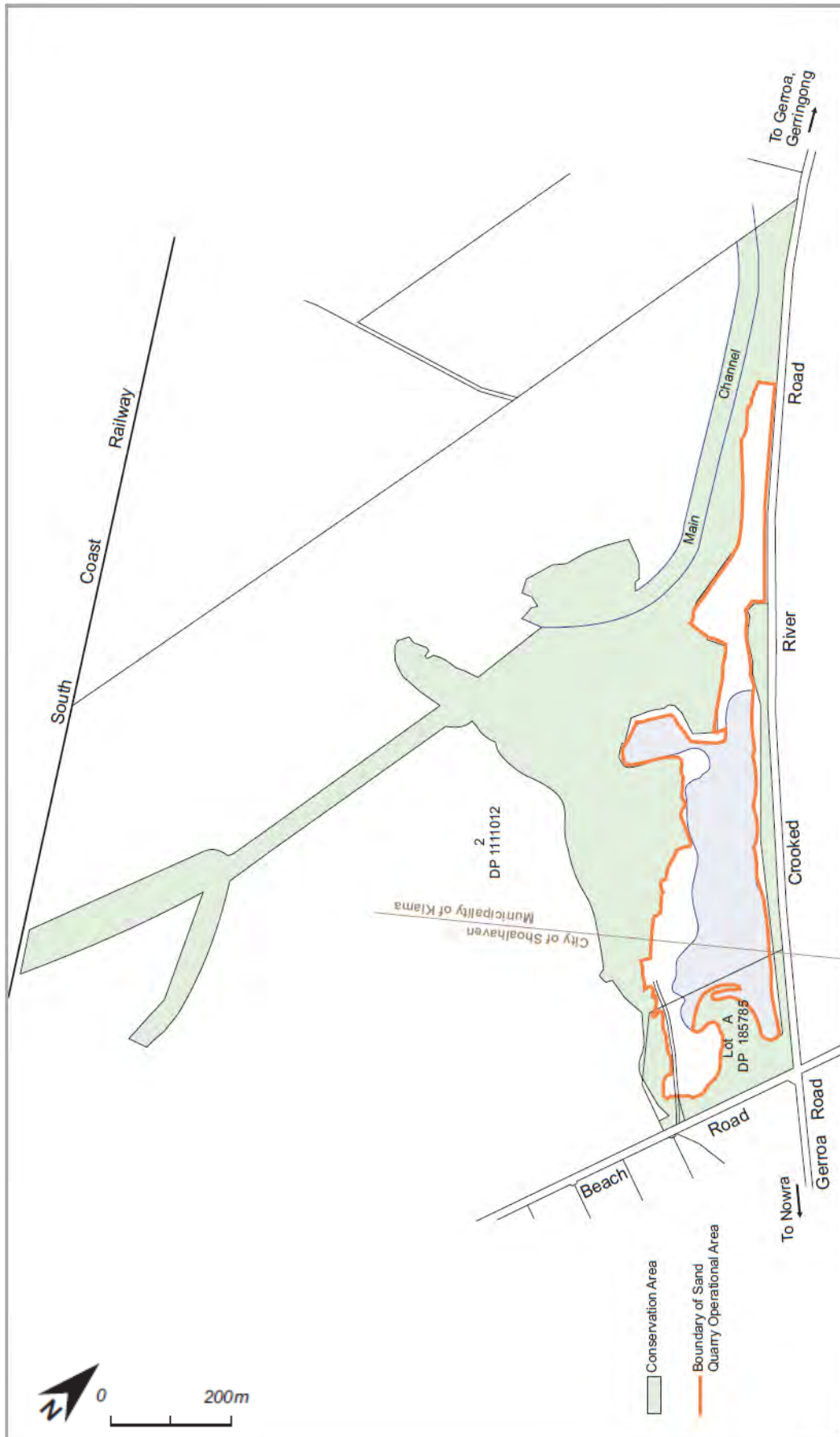


Figure 2-3 Conservation Area

2.4 ENVIRONMENTAL PLANNING INSTRUMENTS

The project site lies across the local government boundary, being approximately one quarter in Shoalhaven local government area and the remainder in Kiama.

The project approval granted by the Land and Environment Court under Part 3A of the EP&A Act is subject to section 75R(3) of the Act, which provides that “Environmental planning instruments (other than State environmental planning policies) do not apply to or in respect of an approved project”. The following environmental planning instruments therefore do not apply to the project:

- City of Shoalhaven Local Environmental Plan, 1985;
- Kiama Local Environmental Plan, 1996; and
- Illawarra Regional Environmental Plan No 1 – 1986;

The following State Environmental Planning Instruments apply to part or all of the site:

- State Environmental Planning Policy (Infrastructure) 2007
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;
- SEPP 44 – Koala habitat Protection; and
- SEPP 71 – Coastal Protection

SEPP 44 has application in Shoalhaven local government area but does not apply in Kiama. None of these planning instruments contain provisions that would regulate the carrying out of an approved project.

2.5 ENVIRONMENT PROTECTION LICENCE

The EPA has issued licence No 4146 for the premises regulating its use as a dredging operation. The licence is applicable for up to 100,000 cubic metres of material obtained or moved per annum.

A copy of the current licence is included in *Appendix B*.

2.6 ENVIRONMENTAL CHARACTERISTICS

2.6.1 Topography and Drainage

The sand resource is within the catchment of Blue Angle Creek, a tributary of the Crooked River which occasionally discharges to the sea at Gerroa Beach. The land has an altitude ranging from less than two to about six metres AHD. The highest area is a remnant sand dune parallel to Crooked River Road. Much of the former dune within the site has been extracted and replaced with the dredge pond.

The sand extraction site is configured to drain to the dredge pond, with bunding to prevent inundation by external floodwater from floods up to the 100-year ARI (average recurrence interval) event. Other earthen bunds have been constructed to prevent views into the site from Crooked River Road and to suppress noise propagation to residences south of Beach Road.

2.6.2 Geology and Soils

Douglas Partners investigated the remaining sand resource within the extraction area in 2006. The sand resource comprises three units:

- a fine grained, light coloured dune sand with no shells located generally at elevations above sea level varying in thickness from about one to seven metres (Unit 1);

- a more densely packed sand of variable grade and darker in colour with gravel and shells, located immediately below the top layer and varying in thickness from four to eight metres (Unit 2);
- a base layer of dark grey, coarse and densely packed sand with included gravel, up to four metres thick (Unit 4).

A layer of dark estuarine or lagoonal clay with high organic content up to 2.5 metres thick (Unit 3) overlies the deepest sand resource. This clay layer tapers away to less than one metre thickness towards the north eastern end of the extraction area.

The Douglas Partners report provides an assessment of resource volume and geotechnical constraints to the proposed extraction. The report indicates that about 660,000 cubic metres of sand can be readily extracted from the identified area. This estimate is based on removal of part of the Unit 3 clay band to access the underlying deep Unit 4 sand wherever the clay band is less than one metre thick. If the clay were to be removed at other locations where it is between one and two metres thick, it is estimated a further 16,000 cubic metres of sand can be obtained. However some 22,000 cubic metres of clay would have to be removed to obtain this additional sand.

During proceedings in the Land and Environment Court, design sections were produced enabling further estimates to be made of the sand quantity using two methods (average end area and digital terrain model). The estimated quantity of winnable sand using these models and allowing for removal of non-product material was 921,000 tonnes and 957,800 tonnes respectively. These figures were submitted to the Court and reported in the judgement (paragraph 23).

2.6.3 Climate

Climatic data has been collected from the site weather station since mid-2003 and is being progressively collated by Cleary Bros. The nearest source of long term climatic information is Kiama Bowling Club, approximately 17 kilometres north of the site.

Records have been kept from this recording station since 1897. *Table 2.1* presents a summary of significant data from Meteorological Station No 068038, Kiama Bowling Club.

Table 2.1 Temperature, rainfall, humidity and wind speed

Item	J	F	M	A	M	J	J	A	S	O	N	D	Year
Temperature													
Mean Daily Max. Temp. (oC)	25	24.9	24.1	22.1	20.1	17.6	16.8	18.1	19.8	21.7	22.5	23.8	21.1
Mean Daily Min. Temp. (oC)	17.5	17.7	16.4	14.1	12.2	9.3	8.4	8.8	10.6	12.4	14.3	16.3	12.8
Rainfall													
Mean Monthly Rainfall (mm)	111	119	145	132	121	126	87.6	77.4	75.2	86.7	86.8	94.4	1261
Mean No of Raindays	12.2	11.7	12.7	11.2	10.8	9.8	8.6	8.5	9.2	10.7	11	11.3	127.6
Humidity													
Mean 9am Rel. Humidity (%)	72	74	71	69	70	65	63	59	60	64	68	70	66
Mean 3pm Rel. Humidity (%)	67	70	67	67	65	58	58	55	58	63	65	66	63

Item	J	F	M	A	M	J	J	A	S	O	N	D	Year
Wind													
Mean 9am Wind Speed (km/hr)	8.2	8.1	8	8.1	8	10	10.1	9.2	10	9.8	9.1	9.1	9
Mean 3pm Wind Speed (km/hr)	10.8	10.7	10.3	9.1	8.5	9	9.6	11.2	11.7	10.8	11.3	11	10.3

Note: 1. Monthly rainfall entries rounded to three significant figures.

2. Data from meteorological station at Kiama Bowling Club.

Wind Data

Wind roses show predominance for north easterlies and south westerlies in spring and summer, with a stronger influence of westerlies in winter

2.6.4 Hydrology

In September 2005 Evans and Peck Pty Ltd undertook a study of the effect of the sand mine extension on flooding in the Blue Angle Creek catchment. The study concluded that Foys Swamp and Blue Angle Creek, to the west of the site, act as a large storage area during floods. The effect of bunding the sand quarry site marginally reduces the available flood storage area and is predicted to raise the external flood level by 15 millimetres in the 100 year ARI (average recurrence interval) flood, compared to the conditions existing in 2005. This minor change would not impact on surrounding areas and is not sufficient to cause changes in peak flows that would affect other areas or alter creek stability parameters.

The calculated flood height at the site for the 100 year ARI event is approximately 2.65 metres AHD. Bunding has been specified to 3.2 metres AHD to provide a margin of freeboard.

2.6.5 Surrounding Land Use

The sand extraction area is part of a rural property with frontages to Crooked River Road and Beach Road. Seven Mile Beach National Park occupies the land to the east of the site between Crooked River Road and the Pacific Ocean. To the immediate west of the extraction area is a band of native forest, giving way to cleared farming paddocks that occupy the bulk of the property. Farming land extends westwards about 1.5 kilometres to the South Coast Railway.

Blue Angle Creek generally flows north from the site, paralleling Crooked River Road for two kilometres to the Crooked River. The land in this direction is largely undeveloped through to Gerroa village apart from a sewage treatment plant constructed near the roadside.

The closest residences are located south of the site on the southern side of Beach Road near the site entrance. The closest residence is approximately 90 metres from the entrance and 400 metres from the main processing, stockpiling and loading area as shown on *Figure 2-4*. Other residences are located north west of the site. Caravan parks are the closest development within Gerroa village.

2.6.6 Existing Noise Levels

In August 2005 Renzo Tonin & Associates measured existing ambient noise levels at residences and other localities in the vicinity of the site, shown on *Figure 2-4*. The measured daytime L_{A90} background level and L_{Aeq} noise levels are summarised in *Table 2.2*.



Figure 2-4 Surrounding Land Use

Table 2.2 Measured L_{A90} and L_{Aeq} Noise Levels

Monitoring Location	Distance from quarry	L_{A90} Background	L_{Aeq} Ambient
No 670 Beach Road	500 m south	39	51
No 11 Banggarai Street	750 m south west	36	54
Seven Mile Beach Holiday Park	1500 m north	43	59
Coralea property	850 m north west	39	41
National park picnic area 1	780 m north east	48	49
National park picnic area 2	710 m south east	46	48

2.6.7 Natural Vegetation and Fauna

In a detailed assessment of the project area dated October 2006 Kevin Mills & Associates identified seven vegetation communities:

- Littoral Rainforest – Endangered Ecological Community, small boomerang shaped area adjoining the Blackbutt-Banksia Forest on the sand dune, about 0.9 hectares. Part will be removed by the quarry extension and part protected;
- Blackbutt-Banksia Forest – post-logging remnant growing on the sand dunes immediately north of the 2006 dredge pond, about 1.7 hectares. To be removed during quarrying;
- Bangalay Sand Forest – Endangered Ecological Community, a 1.6 hectare remnant occurs on partly cleared land north of the Blackbutt-Banksia Forest. This disturbed community will be removed during quarrying;
- Swamp Sclerophyll Forest – Endangered Ecological Community, occurs on lower elevation land immediately to the west of the quarry extension occupying over 43 hectares. This forest is valuable fauna habitat and will be protected during sand quarrying;
- Phragmites Reedland – part of the above Endangered Ecological Community, but separately listed as it has a different form. Occurs at low elevation beside the main drainage channel and will be protected during quarrying;
- Miscellaneous Forest – a 0.3 hectare stand of planted native trees at the southern end of the grassed paddock, planted about 1992 to form a visual screen for quarrying approved at that time. Will be removed during quarrying;
- Introduced Grassland – a grazing paddock extending from the planted screen to the northern end of the property. Will be removed during quarrying.

Nominated areas of naturally vegetated land on the property including the Swamp Sclerophyll Forest to the west of the extension area and a section of the Littoral Rainforest on the eastern side are to be protected and conserved. These areas will not be disturbed during and after quarrying.

2.6.8 Revegetation

Previously planted native trees and shrubs are well established in the revegetation area around the completed southern end of the dredge pond and on the bunding installed beside the dredge pond to provide a visual screen from Crooked River Road. Vegetation planted on the noise bunding near the site

office is also maturing. Further plantings have been undertaken in locations associated with the northerly extension of the sand quarry as follows:

- screening planting along the Crooked River Road frontage beside the grassed paddock to be quarried;
- an east-west fauna corridor from Crooked River Road to the main channel located immediately north of the grassed paddock to be quarried (the Northern Corridor);
- other compensatory plantings and bushland regeneration and management at various locations on the property as indicated in the project approval and described in the Landscape and Rehabilitation Management Plan (see section 4.1.5)

2.6.9 Archaeology and Heritage

The site has been the subject of a number of investigations to determine the presence of Aboriginal archaeological relics. The most recent subsurface study by Navin Officer, reported in October 2006, examined the extension area including 51 test pits. Shell middens were recovered from 26 of the pits and lithic items from five pits. The consultants concluded that the shell midden distribution is sparse and spasmodic across the site with some higher concentrations on the western side.

A previously identified conservation area with dimensions 60 by 30 metres, known as Area A, will continue to be preserved for archaeological values. This area is located within the section of Littoral Rainforest which is also to be preserved.

Salvage excavations have been undertaken as required to recover artefact material before quarrying proceeded, as described in the Aboriginal Cultural Heritage Management Plan (see section 4.1.7). A Salvage Report will be prepared that will provide details of the salvage excavations undertaken at the site.

2.6.10 Access

The site access road joins with Beach Road about 200 metres west of the intersection with Crooked River Road. This road system enables vehicles accessing the site to approach and leave from either the north, south or west. Specific routes have been set down in the project approval for vehicles travelling north beyond Gerroa or south into the Nowra area. The intersection of the access road with Beach Road has been upgraded as part of the development for extending the sand quarry (see section 4.1.3).

2.7 PLANNING AGREEMENT

Condition 16 in schedule 3 of the project approval requires Cleary Bros to enter a planning agreement with the Minister that provides for:

- implementation of the Compensatory Planting shown in the plan in Appendix 3;*
- protection of the vegetation in the area shown in Appendix 4 (Conservation Area);*
- identification by survey plan of the Conservation Area shown in the plan titled Vegetation Conservation Area (shown conceptually in Appendix 4);*
- implementation of the Landscape and Rehabilitation Management Plan for the site; and*
- insurance of the Conservation Area against the impact of fire or vandalism;*

The planning agreement is to be registered on the title of the land.

3 MANAGEMENT RESPONSIBILITY

3.1 ORGANISATION STRUCTURE

The chief executive officer of Cleary Bros (Bombo) Pty Ltd has ultimate responsibility for all operations including sand extraction at Gerroa. The Gerroa Quarry Production Manager is responsible for day-to-day operation of the quarry, reporting to the Divisional Manager Quarries. *Figure 3-1* shows an organisational chart for the company focussing on the line of responsibility for Gerroa sand resource.

When the Quarry Production Manager is absent for any significant length of time (holidays), an acting manager is appointed to take responsibility for site operations.

The staff complement and line of responsibility for the quarry is as follows:

Head Office	<ul style="list-style-type: none"> • Board of Directors; • Chief Executive Officer:
Albion Park Quarry	<ul style="list-style-type: none"> • Divisional Manager Quarries
On site	<ul style="list-style-type: none"> • Quarry Production Manager; • Operational staff (2); • Drivers (as required)
Environmental Review	<ul style="list-style-type: none"> • Environmental Officer

Cleary Bros' Head Office supplies the Environmental Officer who reports to the Chief Executive Officer via the company's Development Manager. The name and contact details of the Environmental Officer shall be notified to the DP&E, EPA, Kiama Council and Shoalhaven Council. Any change to the appointed Environmental Officer shall be similarly notified (Schedule 5, condition 2A).

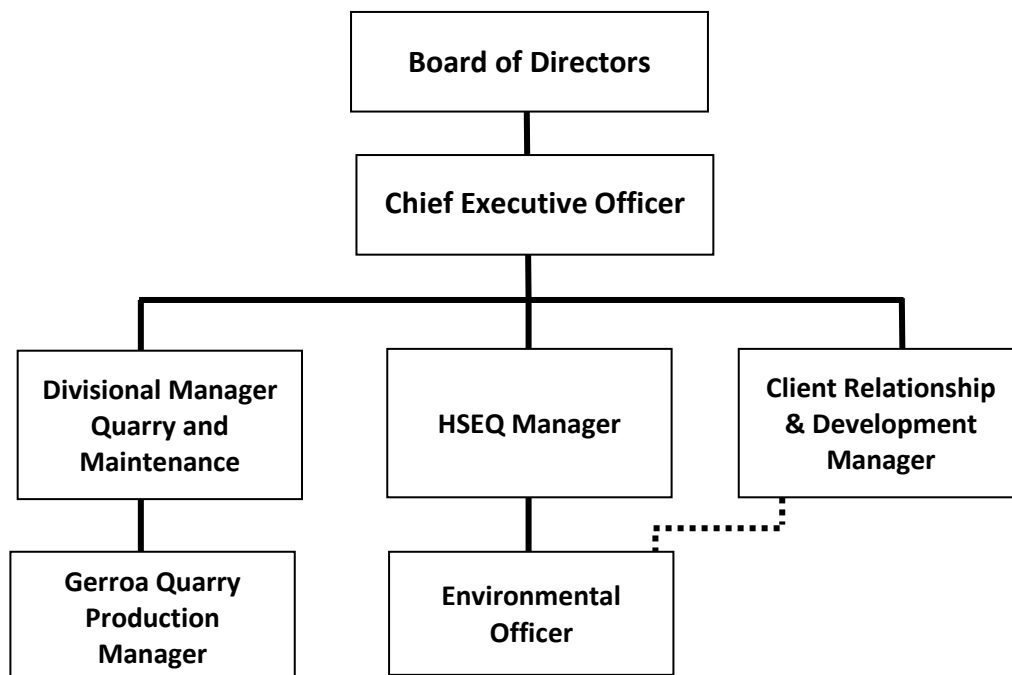


Figure 3-1 Organisational Chart for the Gerroa Sand Resource

3.2 ROLE RESPONSIBILITY AND AUTHORITY

Quarry personnel are multi-skilled, undertaking a number of tasks during the course of their work. The formal management roles of staff at various levels is summarised in *Table 3.1*.

Table 3.1 Role, Responsibility and Authority

Task	Chief Executive Officer	Divisional Manager Quarries	Quarry Manager	Operational Staff	Environmental Officer
Quarry Development	Set objectives, provide broad industry overview, review detailed planning and approval processes.	Assess future needs of the quarry, develop plans, obtain approval, then coordinate and oversee projects to achieve overall objectives.	Provide input to long term planning; undertake minor construction projects.	Assist with minor construction projects as required.	Ensure that minor construction and development projects are consistent with approvals; monitor development works for environmental performance.
Sand Production	Review performance of the quarry, assist Divisional Manager Quarries in market development.	Develop markets for sand; overview operation of the quarry to ensure production objectives are achieved.	Plan and supervise quarry operation on a daily and longer term basis to produce the required quantity and quality of sand; operate mechanical plant for maximum efficiency	Undertake day to day operational tasks as required	
Environmental Management	Independently review indicators of environmental performance, confirm compliance with environmental objectives and approvals.	Approve the QEMP and any subsequent amendments; ensure that environmental objectives are understood; monitor quarry operation to confirm compliance	Program work and take corrective action as required to maintain operations within environmental objectives set down in this QEMP. Respond to all incidents and complaints.	Undertake work within guidelines set down by the quarry production manager and in accordance with work instructions.	Review monitoring results and programs; consider and advise the Quarry Manager and Development Manager of any environmental issues relating to matters in the approval or licence.
Community Liaison	Assist or take the lead with community relations if major issues arise.	Assist the Quarry Manager as required	Attend all community consultative committee meetings; ensure that an adequate response is given when issues are raised.		Attend all community consultative committee meetings; prepare agenda, take minutes and distribute; arrange for all issues to be followed up.

Task	Chief Executive Officer	Divisional Manager Quarries	Quarry Manager	Operational Staff	Environmental Officer
Induction and Training		Ensure that an adequate induction and training program is given to staff	Provide induction and training for all staff. Retain records of all training given.	Attend training sessions conducted by the quarry production manager; if unsure about any aspect of the work, ask the Quarry Manager.	Participate in staff induction and training to stress the importance of environmental matters and observing requirements of the QEMP.
Complaints Register		Review complaints register. Ensure procedures are followed. Review effectiveness of corrective action. Ensure records are available for audit.	Record details of any complaints and investigate. Provide a response to every complaint. Decide and implement corrective action.		Confirm that complaints register is up to date for reporting purposes; follow up complaints with environmental issues to see if modifications to the QEMP or additional training is required.
Monitoring		Ensure that the monitoring program is adequate and effectively implemented. Review all results with the QPM. Initiate audits.	Review monitoring results with the Divisional Manager Quarries. Initiate corrective and follow up action where needed.		Undertake or arrange for all monitoring and audits to be completed according to the schedule in this QEMP. Arrange for Annual Environmental Management Report to be prepared.
Recording		Ensure that an adequate system of record keeping is being implemented.	Maintain records of quarry operations, including quantities of materials received and dispatched and all monitoring results.		Review all monitoring, auditing and environmental reporting records for compliance.

Task	Chief Executive Officer	Divisional Manager Quarries	Quarry Manager	Operational Staff	Environmental Officer
Emergency Action		Intervene at any time where there is an unacceptable risk to safety, or significant environmental damage may occur. Review procedures as required. Ensure that any reports of environmental damage are forwarded to appropriate authorities within time frames specified in this QEMP or the current EPL.	Take action at any time where there is an unacceptable risk to safety, or significant environmental damage may occur. Arrange remedial measures to overcome the emergency.	Advise the Quarry Manager of any suspected risk to safety, or any likelihood of significant environmental damage. Take action as required to prevent emergency situations arising.	Review and provide advice on any reports of environmental damage that are forwarded to appropriate authorities.

3.3 EMERGENCY CONTACT DETAILS

The phone number of the premises for business calls during operational hours is 02 4275 1000.

3.4 STAFF TRAINING

All staff employed at the site are trained in their responsibilities. The Gerroa Quarry Production Manager provides training to any new operational staff. The Environmental Officer may assist to explain the environmental basis for operational procedures. Refresher training is provided as required with a maximum time between training of two years.

4 PREPARATION FOR SAND MINING

4.1 PREPARATORY WORK

Preparatory work includes site activities to be undertaken either prior to sand mining operations moving into particular parts of the extension area or at an early stage of sand extraction. Where actions are specifically required by conditions of consent, the condition is referenced. The location of preparatory works is shown on *Figure 4-1*.

4.1.1 Boundary Identification

(Schedule 3, condition 1)

The extension area approved for extraction in 2008 has been delineated and permanently marked to aid in containing extraction within the approved limits. *Figure 2-2* has been derived from the survey plan prepared and submitted to the DP&E.

Painted steel star stakes are installed along the western, northern and part of the eastern sides of the extraction area, as a permanent mark of the approved limit of extraction. The eastern boundary will be fenced where it runs parallel with the Littoral Rainforest to be retained. The fence will comprise steel star stakes with tensioned wire.

4.1.2 Flood Bund

Where the natural ground level surrounding the extraction and processing area is lower than 3.2 metres AHD, a bund is to be provided raising the level to this height. The purpose of the bund is to prevent ingress of external floodwater resulting from a 100 year ARI (average recurrence interval) storm. Approximately 250 metres of the boundary on the western side in the widest part of the extraction area will require bunding in this manner, with a bund height up to about one metre.

The extraction area existing prior to the 2008 project approval is already bunded to 3.2 metres AHD or higher. Part of the bunding is occupied by the access road from the processing area to the northern end of the pond.

Where additional bunding is required it may be constructed using hard fill material, suitable for extending the access road. *Figure 4-1* illustrates the location of additional bunding required for the extension area.

4.1.3 Access Road and Entry Upgrade

(Schedule 3, condition 33)

The existing road entry to the site from Beach Road has been upgraded to a “sealed Type BAL left turn and sealed Type BAR right turn configuration, in accordance with the RTA *Road Design Guide*”. This modification has been undertaken to comply with the project approval. The first 200 metres of the site entrance road has also been sealed.

An existing unsealed access road leads from the site office to the northern end of the dredge pond. This road has been progressively extended to the north. Where a flood bund is required and if suitable, the road has been located on the bund. In other locations the existing sandy surface may be suitable for the road or may require improvement with hard fill.

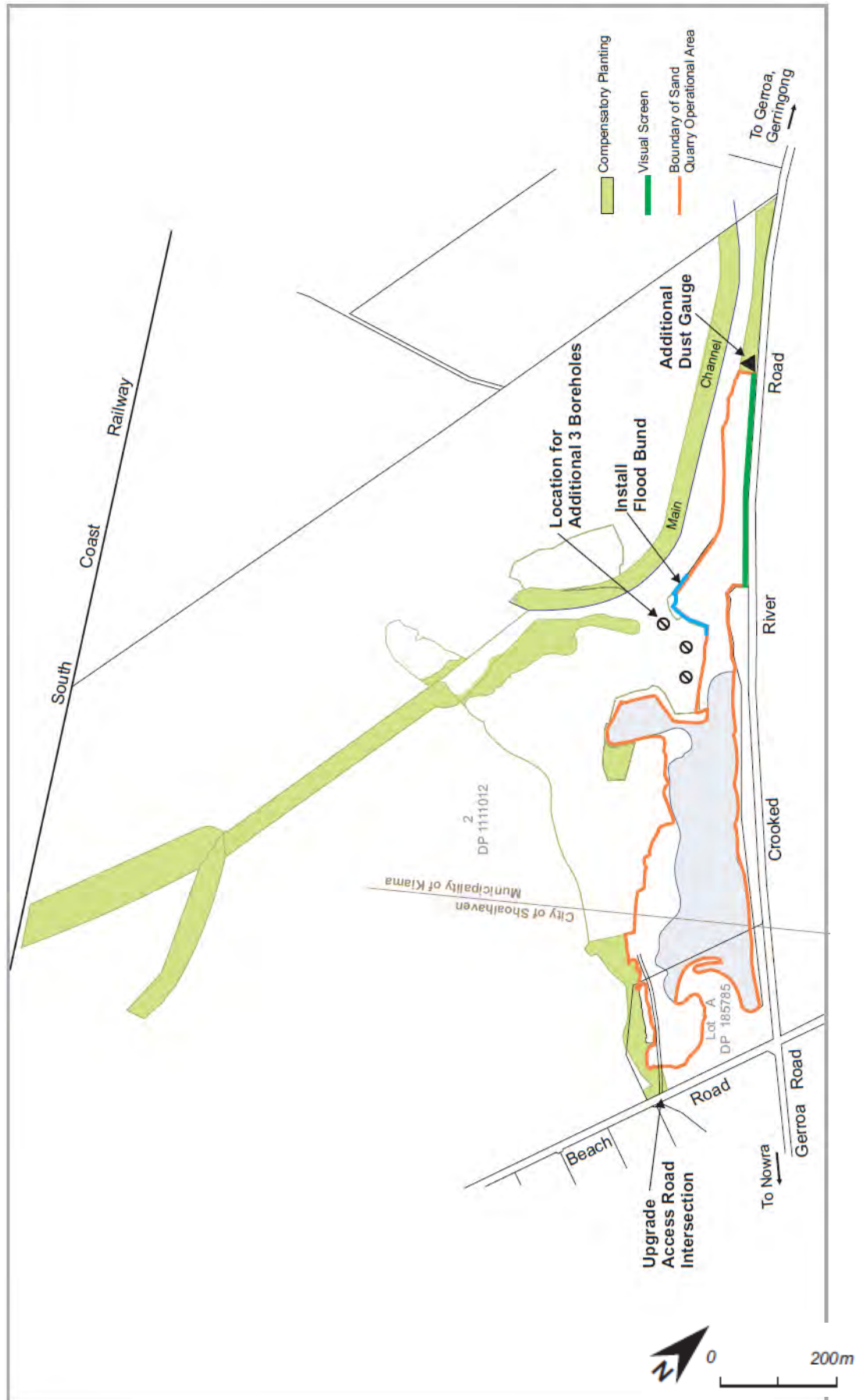


Figure 4-1 Location of Preparatory Works – note refers to old monitoring station locations

4.1.4 Erosion and Sediment Controls

Siltstop fencing using geotextile fabric or similar will be placed along the western boundary of the quarry extension area wherever soil disturbance is likely to occur in establishing a flood bund or access road. Details of these controls are shown in the Erosion and Sediment Control Plan (*Appendix C*).

4.1.5 Compensatory Planting and Visual Screen

(Schedule 3, conditions 17 to 20)

The project approval contains extensive requirements with regard to landscape management including management of the Conservation Area. This is separate from the need to progressively rehabilitate land disturbed by the project (such as the pond foreshore) and includes activities on the property beyond the boundaries of the project site. Essentially there are three components to the work:

- a) Protect nominated areas of existing vegetation and habitat on the property from further disturbance;
- b) Re-vegetate nominated areas of cleared farm land on the property to re-create bushland and habitat (Compensatory Planting and visual screen); and
- c) Manage the above nominated areas of the property to enhance and maintain bushland and wildlife attributes.

A substantial proportion of the work is ongoing management and appropriately covered in section 6.9 of this QEMP, but there are certain aspects that may be considered preparatory works because particular outcomes are required to be achieved in the short term. These priority works have now been completed, and include:

- undertake works aimed at establishing a visual screen along the Crooked River Road frontage of the sand mine extension. This included a combination of bund construction and planting which was undertaken prior to excavating areas previously visible from the road and was commenced by September 2009 - refer to statement of commitment 12 and condition 20(a);
- establish the “Northern Corridor¹”. This was a pre-requisite to severing the existing “East-West Link²” - refer to condition 20(b). Criteria for determining successful establishment of the Northern Corridor are presented in section 8.8 of this QEMP;
- densely plant *Banksia Integrifolia* along the five metre setback zone to the Littoral Rainforest, which was completed by September 2009 - refer to condition 18;
- commence the “Compensatory Planting³”, which was undertaken by September 2009 – refer to condition 20(a); and

¹ The “Northern Corridor” is defined in the Court conditions as the area shown stippled in Appendix 3 of those conditions (see *Appendix 1* of this QEMP, also see *Figure 4-2*)

² The “East-West Link” is defined in the Court conditions as the area shown cross hatched in Appendix 3 of those conditions (see *Appendix 1* of this QEMP, also see *Figure 4-2*)

³ The location of the “Compensatory Planting” is defined in the Court conditions as areas marked 2A.1, 2A.2, 2A.3, 2B.1, 2B.2, 2C.1, 2C.2, 2D, 2E, 5C.1 shown in Appendix 3 of those conditions (see *Appendix 1* of this QEMP, also see *Figure 4-2*)

- ensure that at least 60% of additional planting in the “Southern Rehabilitation Area⁴” and Northern Corridor are representative of communities affected by the quarry extension, which was achieved by September 2012 – refer to condition 17(b).

The location of the Compensatory Planting is identified on *Figure 4-1*. The location of defined habitat corridors is shown on *Figure 4-2*.

Full details of planting requirements are included in the Landscape and Rehabilitation Management Plan (LRMP) included as *Appendix D* of this QEEMP. A summary of the requirements for re-planting in exotic grassland areas (section 6 of the LRMP) is shown in *Table 4.1*. This table is included as a management guide to the essential steps in the task. Reference should be made to the LRMP for more detail, including species lists.

The LRMP anticipates that the majority of revegetation and enhancement activities will be completed by the end of year eight (2016). For the remainder of the project the focus will be on management and maintenance of the revegetating areas.

Table 4.1 Planting Protocols for Cleared Pasture

Activity	Summary of Requirement
Sourcing plant material	Arrange for a nursery to obtain plant material of nominated species from the site or close by if possible, and to propagate tube stock for the planting program
Species selection	Select species for planting from the varieties nominated for the specific locality in sections 6 and 7 of the LRMP. Species nominated for the screen planting location include plants intended to establish a cover of trees and shrubs as quickly as possible
Surface preparation	Prepare the area to be planted by slashing/mowing followed by spot spraying to create bare patches of about one metre diameter, or fully spray the locality
Habitat elements	Lay out tree trunks, logs, debris from native vegetation clearing on the site prior to planting the tubestock
Protection from grazing	Fence the planting area where this is necessary to keep farm animals out
Planting density	Space trees and shrubs at no more than two-metre centres and in a random pattern as opposed to straight lines or grids
Planting method	Insert tubestock in the centre of each sprayed area in a suitably sized hole. Include two slow release fertilizer tablets and a handful of water-holding crystals
Protection while young	Install plant guards around each plant for protection against rabbits and swamp wallabies but do not stake
Mulching	Mulch the area around each planting using mulch obtained from native vegetation on the property or nearby
Watering	Water each tubestock at the time of planting and follow up at least once per week depending on rainfall
Maintenance	Proceed to implement ongoing maintenance protocols (see LRMP)

4.1.6 Fencing the Conservation Area

As specified in the Landscape and Rehabilitation Management Plan, the retained forest and planting zones, which together comprise the Conservation Area, will be fenced wherever necessary to keep out grazing animals.

⁴ The “Southern Rehabilitation Area” is defined in the Court conditions as areas marked 1.2, 1.3 and 2A.2 shown in Appendix 3 of those conditions (see *Appendix 1* of this QEEMP, also see *Figure 4-2*)

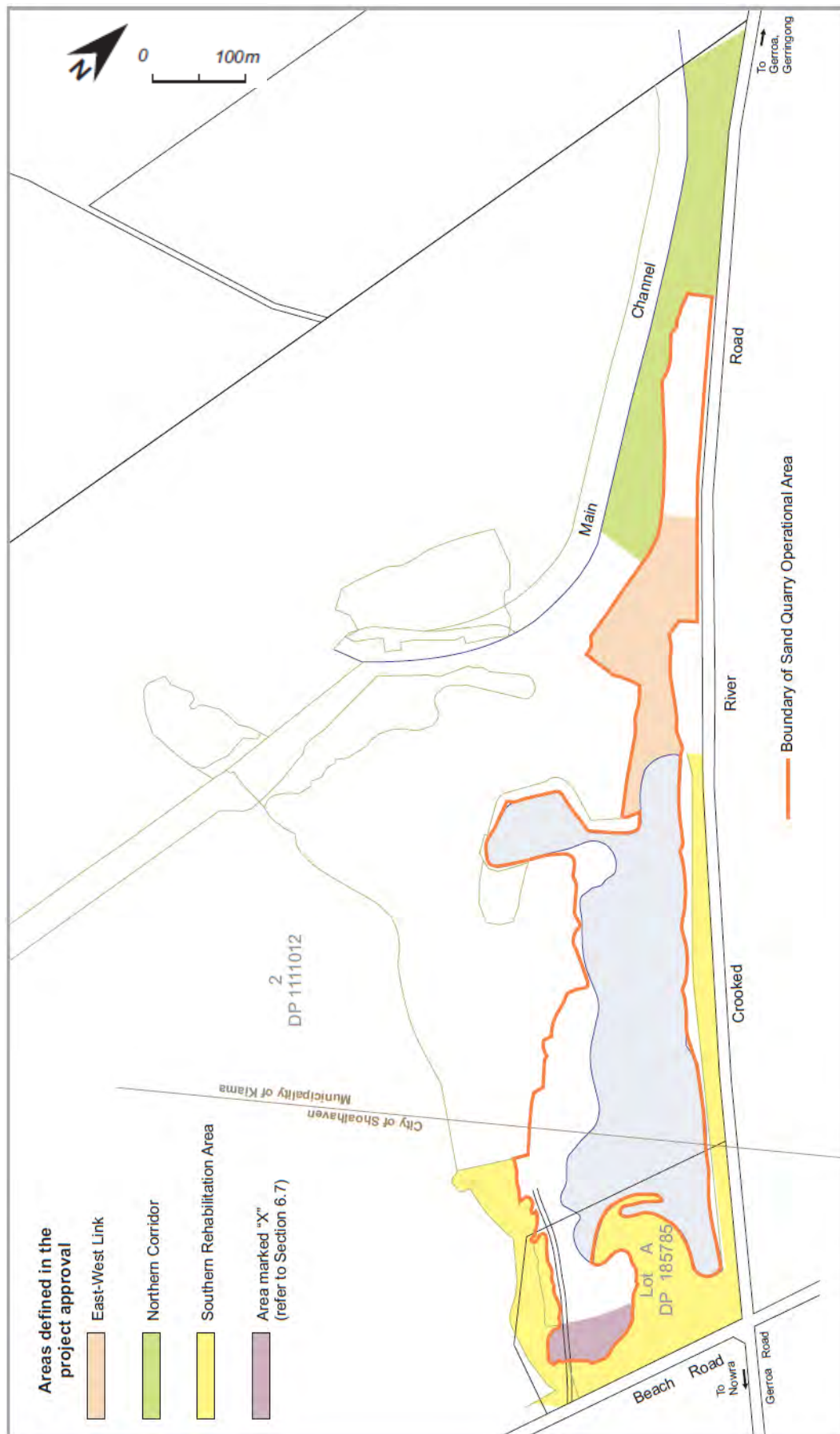


Figure 4-2 Defined Areas

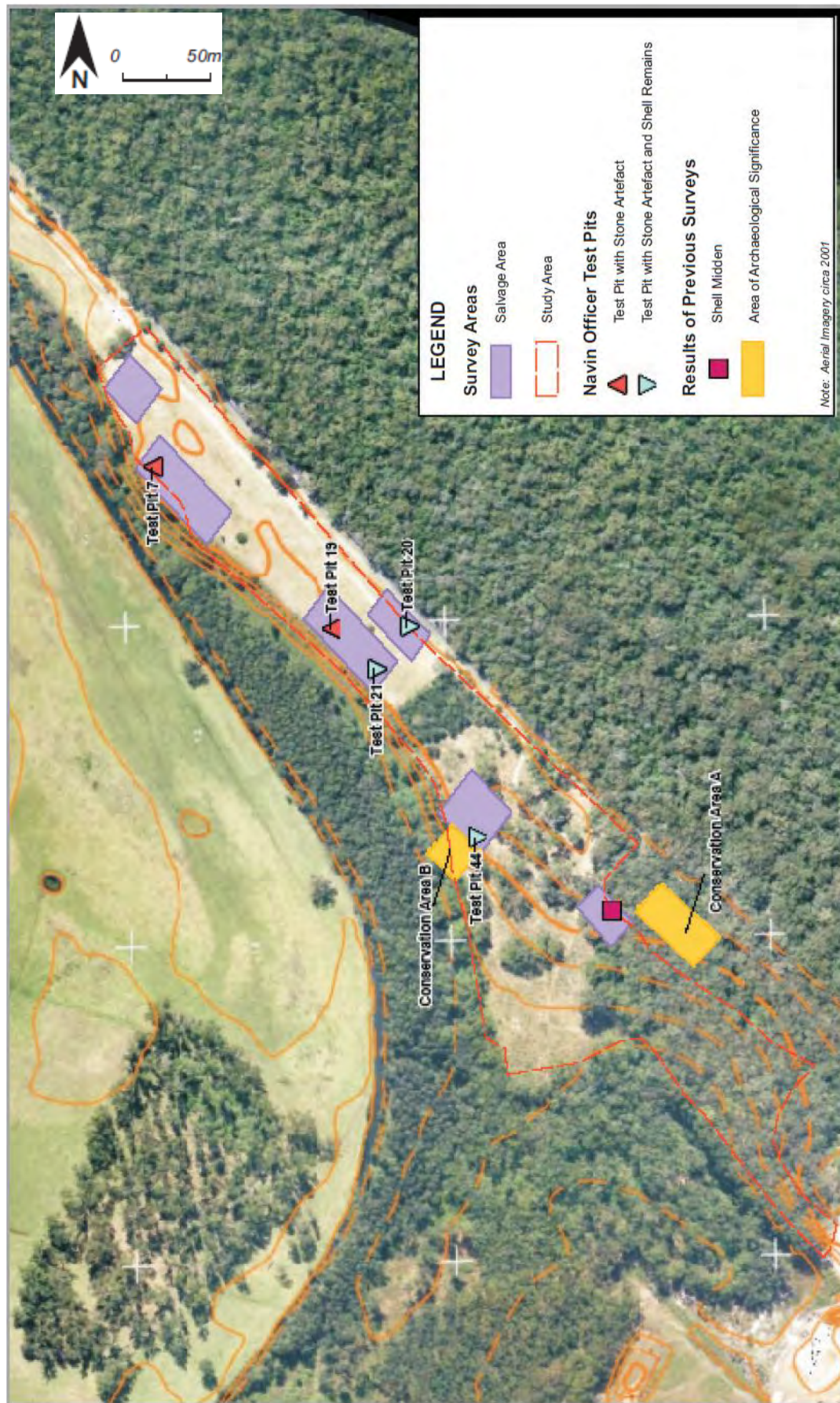


Figure 4-3 Aboriginal Artefact Salvage Locations

4.1.7 Archaeological Salvage Operations

(Schedule 3, condition 30)

The project application proposed that salvage of archaeological relics would take place from selected locations prior to those locations being disturbed by sand mining. The Aboriginal Heritage Management Plan prepared for the site proposes that salvage occur from the locations shown on *Figure 4-3*. Land or vegetation disturbance for sand mining will not commence in any location identified for salvage until the salvage field work in that location has been completed.

4.1.8 Additional Groundwater Monitoring Bores

(Schedule 3, condition 14)

An additional six monitoring bores were installed as recommended by Douglas Partners in the environmental assessment (Perram & Partners 2006). These bores were installed in August 2007 following receipt of the (now superseded) approval from the Minister for Planning and are designated 1/Aug07 to 6/Aug07. The bores were licensed by the Department of Water and Energy (bore registration 10BL602133) and are located as shown on *Figure 8-1*. Borehole MW06(07) has now been decommissioned, as approved by the DP&E.

As recommended by Douglas Partners a further three boreholes were installed in the Swamp Sclerophyll Forest to the west of the quarry extension. These boreholes are necessary to comply with requirements of the project approval to assess the hydraulic conductivity of sections of the foreshore as they are completed and to monitor the groundwater level within the Swamp Sclerophyll Forest. The location of these further bores is indicated on *Figure 8-1*, and are labelled MW1D, MW2B, and MW3C.

4.1.9 Additional Air Quality Monitoring Gauge

A further dust deposition gauge has been installed at the northern end of the property as shown on *Figure 4-1* as dust gauge 3A.

The two existing gauges will remain in their current locations to give continuity of data from the southern and central parts of the site. The location of all monitoring devices is shown on *Figure 8-1*.

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4.1.10 Reversing Alarms

Statement of commitment No 30, adopted in response to community submissions states as follows: *Investigate and if practicable, install “clacker” reversing alarms on mobile plant within the sand quarry site.*

Cleary Bros has acted upon this commitment during sand mining works in the extension area by installing “clacker” reversing alarms on the site loader and off road truck.

4.2 CONSTRUCTION ENVIRONMENTAL MANAGEMENT

Site construction activities have now been completed, and any further construction activities are expected to be minimal. In the event of any further construction works, the following environmental management controls will be implemented consistent with conditions of consent and as otherwise required to minimise environmental impacts.

4.2.1 Hours of Construction

Construction work is restricted to the following hours:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturdays: 7:00 am to 1:00 pm
- Sundays & public holidays: No work

4.2.2 Construction Noise

The noisiest construction activities are bund wall construction, access track extension and entry road intersection upgrading. These activities have been completed and construction activities are now expected to be minimal. Any construction works are expected to have similar noise characteristics to normal operations and should not result in any exceedence of noise criteria at the nearest residences.

4.2.3 Dust Control

Earthworks associated with construction or preparatory measures will be subject to standard dust control practices for quarries. In particular:

- unsealed parts of the haulage route for material used in constructing the flood bund and extending the internal access road will be kept moist;
- trucks bringing construction fill to the site will have covered loads;
- to minimise wind-blown dust, the flood bund will be stabilised with mulch and revegetated as soon as practicable following completion of earthworks; and

4.2.4 Soil and Water

Erosion and sediment controls referred to in section 4.1.4 above have been installed prior to constructing the flood bund or extending the access road to the north.

4.2.5 Revegetation

All areas disturbed by construction activities that will not be affected by ongoing operations were revegetated as soon as practicable after construction earthworks were completed.

4.2.6 Fill Control

Fill materials imported to the site will consist of virgin excavated natural material or new construction materials.

4.2.7 Flora and Fauna Protection

The Conservation Area will be protected from disturbance during preparatory work. There is no requirement for vegetation clearing to occur during preparatory work that would not be required in subsequent normal sand mining operations.

5 SAND MINING OPERATIONS

As the QEMP is a public document, this section has been included for descriptive purposes to explain the manner of normal operations on the site. There are no specific auditable requirements or processes described. Figure 5-1 is a process flow diagram illustrating the manner in which sand is extracted from the site and prepared for sale.

5.1 PREPARATION

5.1.1 Clearing

The sand extraction operation will proceed northwards in stages. Each clearing campaign provides about 20 metres of working space for sand extraction. The approved extraction area comprises woodland, tall grassland and grazed paddock. Woodland areas are firstly logged for useable timber leaving the undergrowth, lesser valued timber and grass to be cleared with a bulldozer. Prior to clearing the affected vegetation is inspected by an ecologist to confirm that no koalas or other arboreal mammals are present (refer to the vegetation clearing procedure in section 6.7).

If the clearing debris is suitable, it may be chipped or mulched on site for use in rehabilitation. Larger logs are retained for placement around the completed pond foreshore as habitat features, where suitable. Any logs with hollows will be strapped to standing trees under supervision of an ecologist. Unsuitable clearing debris is removed from the site for disposal as green waste.

5.1.2 Topsoil Stripping

Topsoil is progressively stripped from the cleared area and stockpiled separately for use in rehabilitation work. Monitoring for archaeological material is carried out during the stripping process (refer to section 6.11).

The thin layer of organic rich sand immediately beneath the topsoil is used for site works or stockpiled for sale as top dressing.

5.2 SAND EXTRACTION AND PROCESSING

5.2.1 Sand Extraction

The upper layers of aeolian sand beneath the topsoil and organic layer may be removed by excavator and loaded directly onto trucks. The remainder of the sand profile will be extracted by dredging.

Material is extracted from the base and leading edge of the dredge pond using a floating suction dredge. The resulting slurry is piped to the shore and passed through various screens in the wet sorter and cyclone, as required. The wet sorter separates sand from stone and finer particles. Screened sand is pushed away from the sorter and allowed to drain back to the dredge pond, subject to acid sulphate soil procedures (see section 6.6). Heavier materials may be further screened to grade into saleable size ranges to meet market requirements. Fine particles return directly to the dredge pond with the wash water.

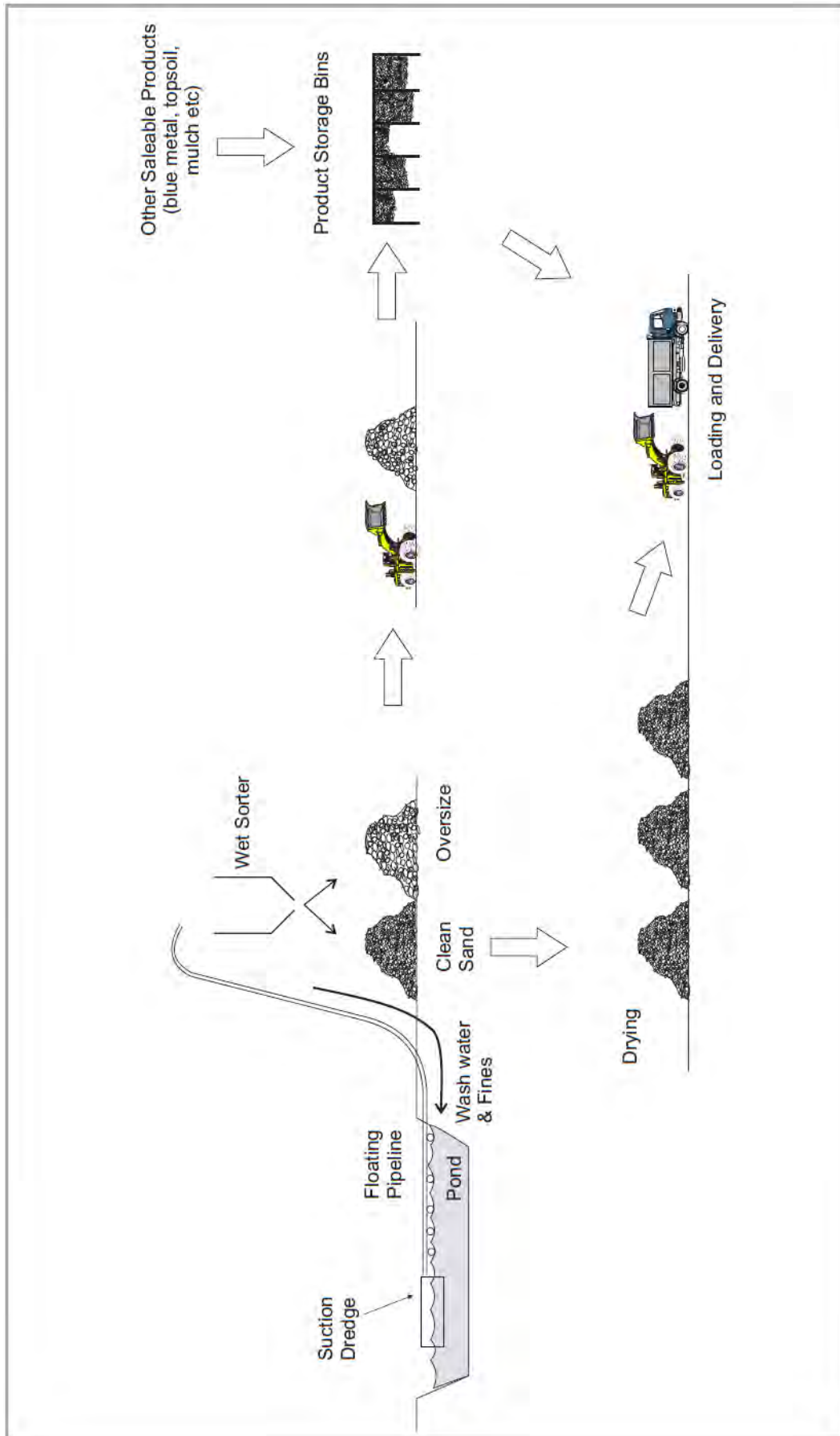


Figure 5-1 Process Flow Diagram

5.2.2 Materials Stockpiles

After standing and draining, screened products are stockpiled for sale. Sand is normally left in freestanding stockpiles, while storage bins are used for grades of stone and specialised products. Other saleable construction materials such as blue metal, road base, top soil and mulch may be brought to the site from time to time and stockpiled in bins.

5.2.3 Loading and Dispatch

A rubber tyred loader is used to load products to transportation vehicles. All vehicles accessing and leaving the site are required to use the sealed access road and report to the site office at the southern end of the loading area. Loaded vehicles must have covered loads.

5.3 POST EXTRACTION

Dredge pond foreshores are shaped and rehabilitated progressively as extraction is completed in sections of the pond.

5.3.1 Batter Shaping

Temporary excavation batters around the pond need to be partially backfilled and shaped using the dredge and other equipment to produce a stable landform. The shoreline zone, extending over the range of normal water levels, is graded to final design profiles.

Towards completion of the project, virgin excavated natural material may need to be brought to the site as back loads to provide sufficient fill material to complete profiling the pond foreshore.

5.3.2 Rehabilitation

Progressive rehabilitation of disturbed areas is carried out in accordance with the Landscape and Rehabilitation Management Plan (see *Appendix D* and section 6.9 of this QEMP). As part of site rehabilitation following completion of extraction, the flood bund may be removed from the periphery of the extension area. The existing flood bund in the southern part of the site will not be removed to prevent disturbing advanced revegetation.

6 ENVIRONMENTAL MANAGEMENT

The environmental management requirements included in this section of the QEMP are auditable at each scheduled external audit and should be reported upon in the Annual Environmental Management Report (refer to section 9.2). References to the “project approval” and to conditions refer to the project approval granted by the Land and Environment Court on 2 September 2008.

6.1 GENERAL REQUIREMENTS

6.1.1 Duration of Operations

(Schedule 2, conditions 5 and 5A)

Extraction and processing are permitted to continue within the approved area until 31 July 2023. The approval permits other site operations to continue beyond that date until the site has been rehabilitated to the satisfaction of the DP&E.

6.1.2 Production Limits

(Schedule 2, condition 6)

There are two production limits applicable to the site:

- transport of product from the site is limited to 80,000 tonnes per annum of material extracted from the site. This limit does not include dispatch of material imported to the site for separate sale or for blending with quarry products obtained from the site;
- the scale of operation is limited to 100,000 cubic metres “obtained or moved” by dredging (environment protection licence - condition A1.2).

6.1.3 Boundary of Operational Area

(Schedule 3, condition 1)

The approved limit of extraction for the extension area has been surveyed and permanently marked in a manner that will remain obvious to operating staff and inspecting officers. Auditors should verify that the boundaries remain clearly marked and that extraction remains within the boundaries and state this in the audit report. A surveyor’s plan of the limits to extraction has been submitted to the DP&E as required in the condition.

6.2 NOISE

6.2.1 Performance Objective

Source - Project approval, schedule 3, conditions 2 and 3

Requirement - Noise generated by the development must not exceed the following impact assessment criteria:

Location	L _{Aeq} (15 min) (dB(A))
670 Beach Road	41
11 Bangarra Street	40
Seven Mile Beach Holiday Park	36

Coralea Property	43
Picnic Area 1	46
Picnic area 2	43

The criteria are to be satisfied at wind speeds (10 metres above ground) of up to 3 metres per second. The limits do not apply if Cleary Bros enters an agreement with the relevant owners to generate a higher noise level and the DP&E is advised of the terms in writing.

Verification - Noise monitoring as described in section 8.3 of this QEMP

6.2.2 Design Features

- i. Noise bunds exceeding five metres in height have been constructed both sides of the access road immediately south of the site office. These bunds attenuate noise transmission in the direction of the nearest residences on the southern side of Beach Road.
- ii. Should any new equipment be introduced to the site, noise emissions from that plant will be measured and if necessary, attenuated to ensure the above criteria continue to be met.

6.2.3 Management Procedures

- i. Limit hours of operation as follows:
 - o 7.00 am to 6.00 pm Monday to Friday;
 - o 7.00 to 1.00 pm Saturdays;
 - o no operation on Sundays or public holidays.
- ii. Maintain plant and equipment to manufacturers' specifications for noise attenuation.

6.3 AIR QUALITY

6.3.1 Performance Objective

Source - Project approval, schedule 3, conditions 5 and 6

Requirement - the contribution from site operations to annual average dust deposition must not cause additional exceedances of the following criteria at any residence on privately owned land or on more than 25 per cent of any privately owned land:

- 2 g/m²/mth, maximum increase in deposited dust level; and
- 4 g/m²/mth, maximum total deposited dust level.

Visual air pollution generated by the project is to be assessed regularly and if necessary to minimise air quality impacts on private land, operations are to be modified, relocated or stopped as required while adverse climatic conditions prevail.

Verification - Dust monitoring as described in section 8.4 of this QEMP

6.3.2 Design Features

- i. The first 200 metres of the access road within the site is sealed.
- ii. The intersection of the access road with Beach Road has been further upgraded with sealed shoulders.

6.3.3 Management Procedures

- i. Keep to a minimum the area of land disturbed for operational purposes at any one time. When a disturbed area is no longer to be used, revegetate it as soon as practicable.
- ii. Restrict the speed of vehicles operating within the site, particularly on unsealed areas.
- iii. Cover the loads of all loaded vehicles carrying materials to or from the site.
- iv. Keep unsealed internal roads and loading areas moist when in use to minimise vehicle-generated dust.
- v. Regulate sand production to avoid excessive product stockpiling.
- vi. Continually watch for any visible air pollution and if necessary, minimise dust generation by modifying operations, such as closing the site for loading and transport in extreme weather conditions.

6.4 SURFACE WATER MANAGEMENT

6.4.1 Performance Objective

Source - Project approval schedule 3 conditions 9, 10, and 11.
Environment Protection Licence, condition L1.1

Requirement - Cleary Bros shall aim to meet the following water quality objectives for water in the dredge pond:

Analyte	Units	Objectives
Turbidity*	NTU	5-20
pH	pH	6.0-8.5
Electrical conductivity	µS/cm	<1,500
Dissolved oxygen*	mg/L (saturation)	>6 (>80-90%)
Total phosphorus	µg/L	<30
Total nitrogen	µg/L	<350
Chlorophyll-a	µg/L	<5
Faecal coliforms	Median No./100 mL	<1000
Enterococci	Median No./100 mL	<230
Algae and blue-green algae*	No. cells/mL	<15,000
Sodium	mg/L	<400
Potassium	mg/L	<50
Magnesium	mg/L	<50
Chloride	mg/L	<300
Sulphate	mg/L	<250
Bicarbonate	mg/L	<750
Soluble Iron	mg/L	<6
Ammonium	mg/L	<20

* objectives relevant to dredge pond water only.

Short term exceedances may occur naturally, as well as during natural events such as heavy rainfall or saline water inflow.

Water shall not be discharged from the project site except to restore normal pond level after significant rain.

Any discharge must comply with s120 of the Protection of the Environment Operations Act, 1997. Section 120 prohibits pollution of any waters, except as permitted in a licence issued under the Act. The site licence does not permit any pollution of waters.

- Verification - Surface water monitoring as described in section 8.5 of this QEMP. Records to be retained of any discharge from the dredge pond.

6.4.2 Design Features

- i. Flood protection has been provided in the form of a continuous flood bund to a height of at least 3.2 metres AHD around all parts of the approved extraction area where natural ground level is less than 3.2 metres AHD.
- ii. The wet sorter is located immediately beside the dredge pond so that wash water draining from the sand slurry will return directly to the pond.
- iii. Provision is made for the dredge pond to overflow via a 150 millimetre diameter pipe, delivering overflow water to a sediment pond and then passing through the flood bund to discharge into Foy's Swamp on the other side.
- iv. Siltstop fencing using geotextile fabric or similar is to be maintained on the western side of the extraction area wherever disturbed land slopes away from the extraction area as described in the Erosion and Sediment Control Plan (*Appendix C*).

6.4.3 Management Procedures

- i. Maintain continuity of the flood bund to prevent ingress of flood water to the site.
- ii. Maintain the sealed access road with a well-drained and clean surface to minimise material tracking from the site on the wheels of departing vehicles.
- iii. Suspend sand extraction and processing for the duration of any period when the dredge pond is overflowing its banks, or when the pond level is being lowered by discharging water from the site.
- iv. Ensure that refuelling of mobile plant is carried out in a designated refuelling area and that maintenance of mobile machinery is undertaken well away from the dredge pond, where practicable.
- v. Maintain and operate all plant and equipment to minimise the risk of contaminants escaping to soil or water.
- vi. Implement the management requirements of the Erosion and Sediment Control Plan (*Appendix C*). In particular:
 - maintain siltstop fencing to prevent sediment leaving the site from reaching the main channel or the Swamp Sclerophyll Forest;
 - ensure that completed sections of the pond foreshore and associated batters remain stable and do not erode to add turbidity to the pond.
- vii. Monitor surface water in accordance with the surface water monitoring program in section 8.5.
- viii. Should it become necessary to lower the pond level after a period of intense rain or flooding, follow the procedure in section 6.16.

6.5 GROUNDWATER MANAGEMENT

6.5.1 Performance Objective

- | | |
|--------------|---|
| Source | - Project approval, schedule 3, conditions 10, 11 and 14. |
| Requirement | <p>- Aim to meet the water quality objectives provided in section 6.4.1 for groundwater within the project site, except that the objectives for turbidity, dissolved oxygen and algae or blue green algae do not apply for groundwater.</p> <p>Maintain similar groundwater flow through the site to the Swamp Sclerophyll Forest on its western side as existed prior to the excavation. Condition 11(d) specifies how this is to be done: high hydraulic conductivity material is to be progressively placed at intervals along the length of completed sections of the pond extension.</p> |
| Verification | <p>- Undertake the groundwater monitoring procedure described in section 8.6, encompassing:</p> <ul style="list-style-type: none"> • monitoring water levels in the dredge pond and surrounding bores including in the Swamp Sclerophyll Forest; • assessing impacts on groundwater dependent ecosystems and vegetation; and • testing hydraulic conductivity of in situ material and completed sections of pond foreshore |

6.5.2 Design Features

- i. Emplace high hydraulic conductivity material at 50 metre intervals along completed sections of the dredge pond foreshore to maintain comparable groundwater flow to the Swamp Sclerophyll Forest as existed prior to excavation. The emplaced material is to have a hydraulic conductivity of at least 10^{-4} m/sec and be of sufficient depth to be in contact with in situ material underlying the batters.
- ii. A hydrogeologist is to regularly monitor the progress of the works and hydraulic conductivity test results from completed 20 metre wide extraction zones and may vary the designed spacing and sizing of the panels and material permeability as required to achieve the objectives.
- iii. Three additional groundwater monitoring bores installed on the western side of the extension, as recommended by the hydrogeologist, to further assess hydraulic conductivity and material types for input to the design of panels of high conductivity material.

6.5.3 Management Procedures

- i. Undertake a monthly review of groundwater monitoring results, to be carried out by the Environmental Officer who will maintain auditable records confirming that the review has taken place.
- ii. In the event that the water level in any bore lies outside the range of two standard deviations from the mean (in that bore) for more than 6 months and does not follow a trend that can be attributed to climatic events as evident in other monitoring bores, investigate, notify and mitigate the impacts according to the protocol described in section 8.6.
- iii. Should any other groundwater impacts be identified as a result of the groundwater monitoring program, the matter will be referred to a hydrogeologist for advice prior to implementing measures to mitigate, remediate and/or compensate for those impacts.

6.6 ACID SULPHATE SOILS MANAGEMENT

6.6.1 Performance Objective

Source	- Project approval, schedule 3, conditions 11 and 15.
Requirement	- Implement the acid sulphate soils management plan (ASSMP, Appendix F).
Verification	- Sample and test for acid sulphate conditions in accordance with the monitoring program in section 8.7

6.6.2 Design Features

- i. The processing/stockpile area is to be next to a deep section of the dredge pond (preferably deeper than 4 metres) suitable for reburial of reject material.

6.6.3 Management Procedures

- i. Provide directional bunds in the processing/stockpile area(s) as necessary to constrain rejects to flow directly to the dredge pond and to allow leachate from stockpiles to be intercepted for remediation, if necessary.
- ii. Dredging, processing and restoration works will be carried out in general accord with the requirements of the ASSMP, with full implementation being carried out on the basis of:
 - o progressive sampling and testing of the sand profile in advance of the mining face;
 - o monitoring of dredge pond, groundwater and stockpile condition in accordance with current practice;
 - o weekly monitoring of the pH of the primary stockpile leachate when leachate is present; and
 - o additional sampling and testing of the processed and stockpiled product at a rate commensurate with the assessed risk as determined by results of pre-extraction testing, pH monitoring of leachate and materials zones being excavated (clay from Unit 3 - see section 2.6.2 - or deeper sand units).
- iii. Where full implementation is indicated:
 - o prepare the base of the processing/stockpile area(s) by liming with medium-fine aglime at the rate of 5 kg/m² per metre height of the processing stockpiles.
 - o observe the stockpiles daily and add extra aglime to any locations where leachate has washed the aglime away.
 - o monitor leachate pH daily until stockpile leachate ceases. If pH falls below 6.5 add aglime directly. If a more significant pH fall is observed, neutralise with calcium hydroxide solution.
 - o if leachate from stockpiles resumes following rain, recommence monitoring and liming as necessary.
- iv. progressively test processed sand for total oxidisable sulphur in a NATA laboratory. If total oxidisable sulphur exceeds 0.03% reprocess the sand stockpile as soon as practicable and retest.
- v. Re-bury treated sulphidic fines and PASS clay from Unit 3 (see section 2.6.2) as follows:
 - o select and record the locations in the pond, deeper than 4 metres, for emplacement;
 - o sluice or pump the processed fines to the emplacement area;
 - o if Unit 3 clay cannot be reburied within 2 days, retain the material in lined and banded pads for surface remediation prior to emplacement in the pond;

- monitor water quality over the emplacement site, determining a vertical profile;
- if the buried material appears to have been oxidised, seek advice from a hydrogeologist regarding appropriate remedial measures;
- continue dredge pond monitoring for two years following completion of quarrying, implementing remedial work as appropriate.

6.7 VEGETATION CLEARING PROCEDURE

6.7.1 Performance Objective

Source	- Project approval: schedule 3, conditions 20 and 20A; Statement of Commitments, Commitment No 21.
Requirement	- Ensure that a pre-clearing inspection for koalas is undertaken Do not clear any trees or other vegetation in the area marked “X” on Appendix 1 of the project approval (see Appendix A and <i>Figure 4-2</i>) without firstly obtaining the approval of the DP&E. Do not undertake clearing that constitutes severing the east-west link (see <i>Figure 4-2</i>) until pre-requisites have been met to the satisfaction of the DP&E. The relevant requirements are presented in section 6.8 below.
Verification	- Letter from ecologist to be obtained verifying the outcome of each pre-clearing survey and included in the AEMR.

6.7.2 Management Procedures

The following procedures apply for all vegetation clearing undertaken for the project, subject, in the locations indicated above, to firstly meeting pre-requisites or obtaining approval.

Vegetation clearing protocols are detailed in the Landscape and Rehabilitation Management Plan (see *Appendix D*). A summary of the requirements is as follows:

- i. Clear the understorey the day prior to trees being felled to allow time for arboreal fauna to move away.
- ii. Arrange for an ecologist to inspect trees to be felled on the day proposed for felling. Any trees with hollows are to be tagged.
- iii. If on the day of tree clearing a koala is present then clearing must be delayed until the koala has moved away of its own accord. This may take several days.
- iv. Immediately prior to felling, any tagged tree with a hollow is to be shaken by machinery to encourage fauna to escape.
- v. The ecologist will examine each tree hollow immediately after felling to determine if animals are present. If injured animals are present the site manager will arrange for immediate transfer to a vet or animal carer.
- vi. The ecologist will inspect tree sections containing hollows and indicate to the site manager whether they are suitable for retention. The site manager will recover nominated hollow-bearing logs and arrange for them to be strapped to other trees identified by the ecologist to re-create animal habitat.
- vii. Trees are to be felled in a manner that does not damage adjoining forest to be retained.

- viii. On the advice of the ecologist the site manager will retain suitable clearing debris including logs, crowns and mulch for use in site revegetation and habitat restoration.

6.8 SEVERING THE EAST-WEST LINK

6.8.1 Performance Objective

Source	- Project approval: schedule 3, condition 20(b)
Requirement	- The east-west link may not be severed until it is demonstrated to the satisfaction of the DP&E that established communities in the Northern Corridor comprise at least 60% of the species listed in Appendix 6 of the approval and the Northern Corridor is successful in terms of the criteria presented in section 8.8.
Definitions	<p>- East-west link: refer to <i>Figure 4-2</i></p> <p>Northern Corridor: refer to <i>Figure 4-2</i></p> <p>Not sever: no works of clearing, tree removal or other habitat removal shall take place which will reduce or impede the function of the east-west link to provide connectivity to the National Park from the Swamp Sclerophyll Forest on the western side of the site, as measured by whether a majority of animal species utilising the east-west link are present in the Northern Corridor.</p> <p>Successful: the success of the Northern Corridor for the purposes of triggering removal of the east-west link is to be measured according to the criteria in Condition 25. These criteria are detailed in section 8 (monitoring).</p>
Verification	- Annual inspection of the east-west link to confirm that it has not been severed prior to receiving approval from the DP&E.

6.8.2 Management Procedures

The East-West link has now been severed following completion of all pre-requisites and approval from the DP&E. Prior to its severing, the following management procedures were in place to maintain the integrity of the corridor, as described below.

- i. Habitat was managed in formerly cleared areas of the east-west link prior to its severing by:
 - o undertaking no further slashing; and
 - o not removing weeds from this area.
- ii. Ensuring that fencing was in place to prevent farm animals from entering the east-west link to retain its interim habitat value.
- iii. Minimising intrusion by motor vehicles into the east-west link and confine any movements to existing tracks prior to its severing.

6.9 LANDSCAPE AND HABITAT MANAGEMENT

6.9.1 Performance Objective

Source	- Project approval: schedule 3, conditions 17 to 25 and Landscape and Rehabilitation Management Plan (Appendix D).
Requirement	- Progressively rehabilitate the sand quarry site including:

- create safe and stable landforms with a natural appearance designed for low maintenance;
- progressively revegetate all land disturbed by sand mining using indigenous species to create wildlife habitat including wetland habitat;
- maintain vegetation by nurturing plantings, replacing failed specimens and countering weeds and other threats;
- at the completion of sand mining remove all sand mining artefacts and tracks, except as required for rural management.

Undertake the preparatory works described in section 4.1.5, being:

- create a visual screen along the Crooked River Road frontage;
- establish the Northern Corridor;
- plant *Banksia integrifolia* in the setback to the Littoral rainforest;
- commence the Compensatory Planting wherever specified; and
- achieve a specified species mix in the north and south habitat corridors.

Manage the rehabilitated, revegetated and protected lands to protect and enhance vegetation and wildlife habitat.

Verification - An ecologist to examine rehabilitation areas and the Conservation Area in detail once per year and provide a comprehensive report for inclusion in the AEMR (see section 8.8).

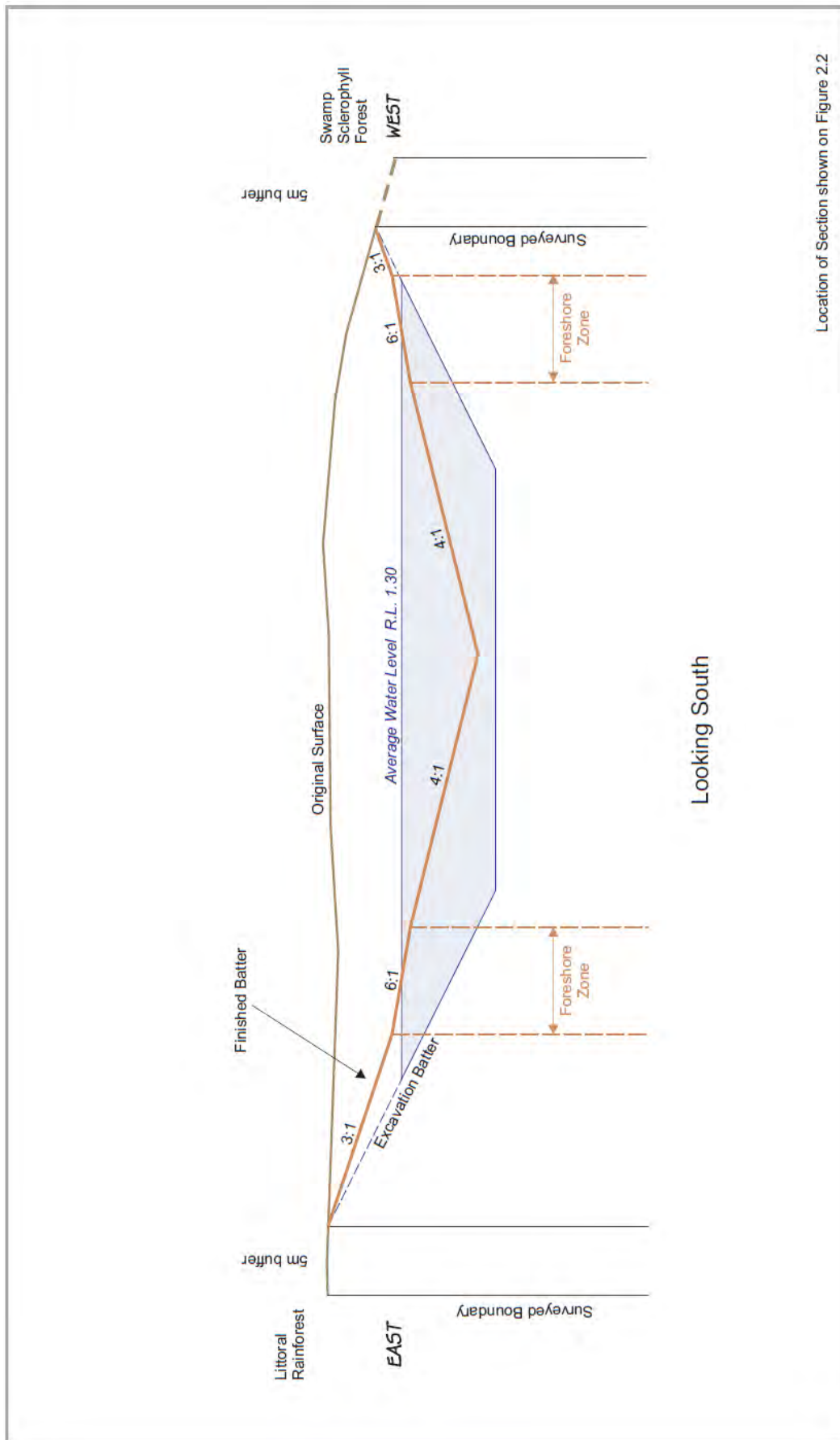
6.9.2 Design Features

- The extraction area has been set back from the Crooked River Road frontage to establish a vegetation screen.
- The northern end of the extraction area is several hundred metres from the northern property boundary to leave room to establish the Northern Corridor.
- The Southern Rehabilitation Area has been expanded from areas previously planted to establish a more effective link to retained vegetation on the site.
- The eastern boundary is configured to preserve an area of Littoral Rainforest, with a setback to be densely planted to minimise edge effects.
- The western boundary is configured to maintain a setback from Swamp Sclerophyll Forest.
- Finished dryland surfaces are designed for a maximum batter gradient of one in three and the pond foreshore will be one in six, to assist in maintaining stability.

6.9.3 Management Procedures

- In preparing a new cleared area for sand extraction:
 - remove vegetation in accordance with the vegetation clearing procedure (see section 6.7);
 - remove topsoil and transfer it directly to a rehabilitation site or stockpile it for later use (ensure that topsoil stripping is witnessed as required in section 6.10).
 - keep topsoil stockpiles as low as possible, less than two metres high and do not compact, to limit de-oxygenation and sterilisation.
 - take all practicable measures to prevent erosion from topsoil stockpiles including stabilising with vegetation where topsoil is to be stored for longer than six months.
- As each 20 metre section of the pond is fully extracted, progressively backfill with reject material (or imported VENM, if required) and re-profile the excavation sides as follows:

- modify the shoreline to create an irregular edge and some shallows and islands;
 - establish a final gradient of 6H:1V in the beach zone extending from the design minimum pond level RL 0.7 to the design maximum pond level RL 2.0 as shown on *Figure 6-1*;
 - create a maximum batter gradient of 3H:1V between the beach zone and the natural surface or the crest of the flood bund as the case may be;
 - allow a gradient of approximately 4H:1V to remain within the pond below the beach zone, placing high conductivity panels in this area as required to maintain pre-quarrying groundwater conditions in the adjacent Swamp Sclerophyll Forest (see section 6.5); and
 - leave approximately two extraction zones (about 40 metres) between the northward moving dredge face and the re-profiled foreshore (to minimise disturbance from ongoing operations).
- iii. Progressively plant re-profiled areas of the excavation in accordance with methods described in the Landscape and Rehabilitation Management Plan (LRMP, Appendix D). In summary:
- arrange for a nursery to propagate suitable indigenous plants, as nominated in the LRMP for the foreshores and batters, from plant material collected on the site or nearby, where possible;
 - prepare the surface for planting by placing topsoil transferred from recently stripped areas of the quarry or from stockpiles;
 - lay out tree trunks, logs and other suitable material for habitat creation and to assist with batter stability;
 - plant the tubestock with slow release fertilizer and water-holding crystals;
 - water tubestock at the time of planting and at least once per week thereafter depending on rainfall and foreshore inundation;
 - protect the plantings from animals, particularly while young; and
 - closely control weeds and grass while the plants are young.
- iv. Actively manage all areas rehabilitated after quarrying, planted as part of the Compensatory Planting or within the Conservation Area in accordance with methods described in the Landscape and Rehabilitation Management Plan (*Appendix D*). In summary:
- inspect all replanted areas at least every three months;
 - check that fencing remains intact, where provided;
 - control weeds and remove any rubbish;
 - water plants as required;
 - replace any dead or poorly performing specimens; and
 - rectify any damage from erosion or animals.
- v. After completion of sand extraction remove all machinery and quarry artefacts from the site except where required for ongoing rural management.
- vi. Rehabilitate any disturbed land within the loading and processing area when it is no longer subject to operational disturbance by re-profiling, topsoiling and establishing native vegetation where required, following the processes of (iii) above.



Location of Section shown on Figure 2.2

Figure 6-1 Typical Pond Cross Section

6.9.4 Fish Management

(Statement of Commitment 14)

The dredge pond is an artificial body of water formed in the excavation of an active quarry and should not contain fish. If during the course of operations, fish are observed to inhabit the dredge pond, having arrived from whatever source, an ecologist will be requested to catch and identify specimens and prepare a suitable management strategy. The strategy will have regard to whether the fish are indigenous or introduced species.

At the completion of sand mining the dredge pond will be considered aquatic habitat and managed in accordance with the Long Term Management Strategy. This may include introducing native fish species to the pond.

6.10 LONG TERM MANAGEMENT STRATEGY

6.10.1 Objectives

The objectives of for quarry closure and long term management include:

- remove from the site all sand mining artefacts including machinery, structures, buildings, signage, products and roads, except as required for site maintenance purposes or ongoing rural use of the property;
- leave safe and stable landforms with a natural appearance, designed for low maintenance;
- establish indigenous vegetation on all land areas disturbed by the sand quarry in accordance with the LRMP to create wildlife habitat including wetland habitat within and around the shoreline of the dredge pond;
- complete rehabilitation of land disturbed by quarrying as soon as possible following the cessation of extraction;
- in the post-closure period nurture to maturity vegetation planted as part of the quarry project;
- continue to provide protection to the vegetation on the land referred to as the “Conservation Area” in the planning agreement (refer to *Figure 4-2*);
- control weeds within the rehabilitation and compensatory planting areas;

6.10.2 Future Use

Cleary Bros will consider future use of the site when opportunities become available. In the absence of any firm proposal for alternative development the land will remain in rural use with the Conservation Area protected as provided in the planning agreement.

6.10.3 Ongoing Environmental Effects

Potential ongoing environmental effects from the sand extraction operation would be monitored following completion of sand mining and managed as follows:

- weather data will continue to be collected from the site weather station for as long as other monitoring continues on the site to assist with the interpretation of changes in dredge pond and groundwater levels;
- the foreshore of the dredge pond and associated batters will be monitored annually and rectification works undertaken for any erosion or slumping until an engineering geologist certifies that the landforms have achieved stability;

- dredge pond levels and groundwater levels will continue to be monitored biannually and remedial action taken as necessary until a hydrogeologist certifies that an equilibrium has been reached where the ongoing effects of the former sand mine will not exacerbate climatic variations to threaten the survival of Swamp Sclerophyll Forest vegetation or ecosystems;
- revegetation areas and the Conservation Area will continue to be monitored annually and remedial work undertaken until an ecologist certifies that the vegetation is sufficiently mature and stable that monitoring is no longer required.

6.11 ABORIGINAL HERITAGE

6.11.1 Performance Objective

Source	- Project approval: schedule 3, conditions 29 and 30 Aboriginal Heritage Management Plan (AHMP-Appendix G).
Requirement	- Protect and conserve Area A shown on <i>Figure 4-3</i> . Implement the requirements of the AHMP including: <ul style="list-style-type: none"> • protect Area A and part of Area B; • map and salvage or relocate archaeological relics on the site, including the shell midden in the south-western corner; • follow documented procedures if any new objects or relics are discovered; and • continue to consult Aboriginal communities when matters arise regarding conservation and management of Aboriginal cultural heritage
Verification	- Environmental audit to verify that areas A and B are adequately marked and protected and that appropriate documentation of salvage works exists.

6.11.2 Design Features

- The extraction area avoids Area A. Hence it will be protected entirely.
- The boundary of the extraction area passes through Area B. The part of Area B excluded from the site will be protected.

6.11.3 Management Procedures

- Clearly and permanently mark the boundaries of Area A and the portion of Area B to be conserved so that quarry staff remain aware of those areas.
- The locations where salvage is to take place are identified on *Figure 4-3*, being locations recommended in the AHMP with recorded sites and areas of identified cultural material. Prior to any soil disturbance at those locations, salvage operations are to take place, as follows:
 - salvage is to be undertaken by an archaeologist, in the presence of Aboriginal representatives;
 - salvage pits 1.0 metre by 1.0 metre are to be excavated using trowels and spades;
 - soil from each stratigraphic layer is to be sieved using nested 10 mm and 5 mm sieves;
 - if artefact density exceeds 10 artefacts in a single pit, or if distinct archaeological features are present, adjacent pits are to be excavated to complete salvage of the location;
 - full records including photographs are to be obtained and the pit backfilled.
- The archaeologist and Aboriginal representatives will collect the salvaged artefacts for off-site analysis;

- iv. Following analysis and reporting the objects will be reinterred near Area A in the Littoral Rainforest to be protected from further disturbance. The location will be recorded using a GPS and submitted to the EPA database;
- v. Aboriginal representatives are to be invited to be present to witness topsoil stripping for each new section of the sand quarry. An archaeologist is to be present for stripping in areas where sampling has shown a likely high concentration of artefacts, including stripping within 20 metres of the boundary of Area B;
- vi. If Aboriginal objects are discovered during stripping, work at that location is to stop while the objects are initially assessed by an archaeologist to determine if they are likely to be culturally significant. Resumption of work will be upon the advice of the archaeologist.
- vii. In the event that human remains are discovered at any time during the project, work at that location should cease and the following procedure implemented:
 - o inform the quarry manager, local police and EPA;
 - o arrange for an archaeologist to inspect the remains.
 - o if the remains are determined to be Aboriginal, local Aboriginal representatives should be informed of the discovery;
 - o excavation of the remains should be undertaken by a qualified archaeologist in the presence of Aboriginal representatives;
 - o Aboriginal representatives should be requested to determine where the remains are to be re-interred, which preferably would be within a part of the site to be conserved.

6.12 TRAFFIC AND TRANSPORT

6.12.1 Performance Objective

Source	- Project approval: schedule 3, conditions 31 to 34.
Requirement	- Confine truck movements to designated routes and designated times and improve safety at the site exit.
Verification	- Environmental site audit.

6.12.2 Design Features

- i. The existing internal access road connecting with Beach Road is the only permitted site access.
- ii. The intersection of the quarry access road and Beach Road is being upgraded to provide for basic left and right turns. The upgrade will be approved by Shoalhaven City Council.

6.12.3 Management Procedures

- i. Limit truck movements to or from the site as follows:
 - o 7.00 am to 6.00 pm Monday to Friday;
 - o 7.00 to 1.00 pm Saturdays;
 - o no trucks on Sundays or public holidays.
- ii. Trucks proceeding north from the site are to use the Princes Highway, accessed via Beach Road, Crooked River Road, Fern Street and Belinda Street.
- iii. Trucks proceeding south from the site are to use the Princes Highway, accessed via the same route as in (ii) above, except that trucks less than 3.4 metres in height may access the Princes Highway at Berry via Beach Road.

- iv. Quarry trucks may travel on Gerroa Road only when the destination is accessed from that road and there is no other practical route.
- v. The following restrictions are in place on roads in the area and will be observed:
 - o Beach Road – 3.4 metre height limit at the railway underpass;
 - o Gerroa Road – 5-tonne load limit.
- vi. The approved truck routes are shown on *Figure 6-2*.
- vii. All loaded vehicles entering or leaving the site are to have covered loads.
- viii. Prior to departure, all loaded vehicles leaving the site are to be cleaned of materials that might fall to the road.



Figure 6-2 Approved Truck Routes

6.13 WASTE MANAGEMENT

6.13.1 Performance Objective

Source	- Project approval: schedule 3, conditions 38 Statement of Environmental Effects.
Requirement	- To avoid the site becoming contaminated as a result of waste being disposed thereon. To minimise waste generation on the site
Verification	- Environmental site audit.

6.13.2 Management Procedures

- i. Waste of any type or quantity that requires a licence issued by EPA is not to be brought to the site.
- ii. Waste generated on the site shall be removed to a facility approved by EPA to receive the waste.
- iii. Waste generation on the site shall be minimised as far as practicable.
- iv. These procedures do not prevent VENM being brought to the site for the purposes of profiling extracted areas of the pond foreshore.

6.14 FUEL AND CHEMICALS

6.14.1 Performance Objective

Source	- Project approval: schedule 3, conditions 39 Statement of Environmental Effects.
Requirement	- Storage, handling and transport of dangerous goods are to be in accordance with the relevant Australian Standards, particularly AS1940 and AS1596 and the <i>Dangerous Goods Code</i> .
Verification	- Environmental site audit.

6.14.2 Design Features

- i. Calcium hydroxide and aglime will be stored at the site when required for managing acid sulfate soils.
- ii. Fuel stored on site will be in accordance with the requirements of *AS1940 Storage and Handling of Flammable and Combustible Liquids*;
- iii. Other small amounts of fuels and lubricants may be stored for maintenance purposes and for minor machinery, such as chain saws and lawn mowers. A container is used for storage of these small quantities of combustible or flammable liquids.

6.14.3 Management Procedures

- i. Ensure that items of mobile plant are refuelled away from the dredge pond where practicable.
- ii. Take particular care to avoid spillage when refuelling the dredge.
- iii. In the event of significant spillage external to the bunded area while refuelling, any affected sand will be excavated and removed from the site to a licensed disposal facility.

- iv. In the event of a leak or spill within a bunded area, a liquid waste contractor will remove any free liquid or contaminated water for disposal at a licensed facility.
- v. Spill kits will be held on site where fuel and other hydrocarbons are stored.

6.15 MAINTENANCE

Equipment maintenance takes place according to manufacturer's schedules or as required when repairs are needed. As far as practicable maintenance of a particular item of equipment is scheduled to take place at times when it is not required for service. There is built in redundancy for some items of equipment so that sand loading and delivery can continue with some equipment out of service.

Arrangements are in place with maintenance contractors who will service equipment at short notice to enable quick resumption of normal operations.

6.16 FLOODING

Other than remaining sand dunes near Crooked River Road, the site has a low and flat profile forming part of the flood storage area adjoining Foys Swamp. The operational area is bunded to a height of 3.2 metres AHD giving 0.5 metres freeboard above the predicted 100 year ARI flood level. The purpose of the bunding is to prevent ingress of external floodwater to the site.

6.16.1 Priorities

Should a major flood event occur external roads may be cut and the dredge pond may overflow to inundate the operational area. Under these circumstances actions will be prioritised in the following hierarchy:

- i. safety to personnel;
- ii. securing and protecting plant and equipment;
- iii. minimising pollution or other environmental damage;
- iv. maintaining sand production.

6.16.2 Management Procedures

When flood conditions are expected:

- i. cease dredging and processing;
- ii. check the flood bund for integrity and make any urgent repairs;
- iii. cancel delivery of any fuel or external saleable products expected for the site;
- iv. continue dispatch of saleable material to remove it from the site if possible;
- v. remove mobile machinery not required for emergency work, to higher ground. The elevated section of the access road where it forms part of the flood bund may be suitable for this purpose.

When the flood threatens:

- i. shut down and de-energise any electrical equipment likely to become inundated;
- ii. move small items of office and other equipment (computers) to a safe height;
- iii. close doors to the office to minimise floodwater entry;
- iv. evacuate staff should a threatening situation develop or when directed to do so by the State Emergency Services;

As flood waters recede:

- i. test electrical circuits and re-energise when proven safe;
- ii. return mobile plant and clean deposited debris from the roadway and operational area of the site;
- iii. test internal flood water and if quality criteria in *Table 6.1* are met, discharge from the site when the external level has dropped sufficiently;

Table 6.1 Discharge Water Quality Criteria

Analyte	Criterion
pH	Between 6.5 and 9.0
Dissolved Oxygen	> 6 mg/L
Total Suspended Solids	< 50 mg/L
Total Dissolved Solids	<1,500 mg/L
Oil and Grease	None visible

Source: Acid Sulphate Soils Management Plan (Appendix F)

- iv. record details of water testing and the duration/quantity of discharge;
- v. wait for flood water to contract back into the dredge pond before resuming dredging and processing;
- vi. inspect the flood bund to assess need for any repairs ;
- vii. restore any damage to the operational area and rehabilitation works as time permits.

6.17 BUSHFIRE

Remaining bushland on the site may be threatened by bushfire. In a major firestorm the office building, combustible liquids storage area and items of machinery will be at risk of being engulfed. The Rural Fire Service may request the company to use site machinery to assist in fire-fighting. All personnel should leave the site if ordered to do so by the police or Rural Fire Service.

6.17.1 Design Features

The following steps have been taken to minimise the risk of fire damage:

- i. Fire-fighting equipment is stored at the site;
- ii. Extinguishers are kept on all mobile plant;
- iii. Staff are trained in fire procedures;
- iv. The fuel storage area complies with the requirements of AS1940, and as such has appropriate fire and hazard warning signs.

6.17.2 Management Procedures

Site work instructions include a fire management strategy. This will be reviewed from time to time to ensure the following matters are included:

- procedures to follow in the event of fire;
- equipment available on the premises;
- responsibilities of personnel;
- fire brigade contact details;
- weekly visual check and quarterly testing of equipment;

- signposting for flammable storage and fire-fighting equipment;
- staff training for fire emergencies.

6.18 SECURITY

The following measures are in place to maintain security of the site:

- i. all personnel entering the site along the access road are required to report to the office;
- ii. vehicular access to the quarry from Beach Road is locked at times when the site is unattended;
- iii. a fence has been erected along the two road frontages of the site;
- iv. signs warning of the quarry excavation are displayed along the fence at 50 metre intervals.

7 COMPLAINTS MANAGEMENT

7.1 OVERVIEW

This complaints management system contains the following elements:

- advertised telephone number, postal address and email address for complaints;
- system for logging and investigating complaints;
- process for recording the outcome of investigations and action taken;
- feedback to complainants following investigation.

7.2 CONTACT DETAILS

7.2.1 Telephone Hot-line

The telephone number for emergency calls or for use by the public when making complaints is:

02 4275 1000

The number will be made known to the public by:

- i. publication on the Cleary Bros website;
- ii. inclusion on a sign at the property entrance; and
- iii. direct advice to councils, EPA and any persons who contact the company regarding a complaint by mail or using existing phone numbers.

The telephone number directs the caller to the Cleary Bros switchboard, where the caller will be transferred to the appropriate person to manage the caller's requests or concerns. Out of hours complaints will go to a message bank service which can be played back and the complainant contacted for further details.

7.2.2 Post and Email

Complaints may also be lodged to Cleary Bros by post or email as follows:

Gerroa Sand Complaints

Cleary Bros (Bombo) Pty Ltd

PO Box 210

PORT KEMBLA NSW 2505

email: ohs@clearybros.com.au

7.3 COMPLAINTS LOGGING

When a complaint is received by Cleary Bros, details will be recorded using the complaint management component of the Online WHS management system. Records of the complaints received will be available onsite via the Online WHS system and may be inspected by representatives of EPA or the DP&E.

7.4 COMPLAINTS INVESTIGATION

The following procedures will be followed whenever complaints are received:

- i. Every complaint is to be investigated as far as practicable, a response given to the complainant and a record created of the response.
- ii. The procedure for investigating complaints and responding is to be explained to the complainant at the time the complaint is recorded.
- iii. If the complaint is received by staff while an incident is claimed to be occurring, the location of the incident is to be visited, immediately if practicable, to verify and record details.
- iv. If the complaint is received after the incident when the grievance is no longer occurring, or if it is not practical to visit the location, the complainant is to be asked for more details.
- v. A record is to be made of the company's activities at the location of the incident during the period leading up to the time of the incident.
- vi. If the matter relates to dust or noise, the wind strength and direction is to be obtained from the weather station data for the period of about one hour prior to the incident.
- vii. The complainant is to be contacted within two working days of the complaint being lodged to provide details of the investigations and other action taken in response to the complaint.
- viii. The Complaint Report is to be completed to summarise all actions taken to investigate the complaint including:
 - time, date and location of incident;
 - nature of the incident;
 - name and address of complainant (if provided);
 - name of the person conducting the investigation;
 - activities at the location during the hour preceding the incident;
 - average wind strength and direction during hour preceding a noise or dust incident;
 - any observations as to the possible cause of the incident;
 - proposed corrective action to rectify damage and/or prevent a recurrence;
 - summary of information given to complainant in follow up call.
- ix. Anonymous complaints are to be recorded and investigated but in the absence of contact details, a response will usually not be possible.

8 ENVIRONMENTAL MONITORING PROGRAM

Monitoring will be carried out as required by the project approval and environment protection licence applying to the site (refer to appendices A and B). These documents require monitoring of meteorology, noise, air quality, surface water, groundwater, acid sulphate soils, rehabilitation, and vegetation management.

8.1 BOUNDARY MONITORING

Source	- Condition 19(c) in schedule 3 of the project approval requires a program to monitor that the defined boundary of the quarry extension area is maintained and not compromised during operations.
Frequency	- The boundary of the quarry extension including the boundary markers shall be inspected every three months.
Method	- The inspection shall be carried out either on foot or from a vehicle, where vehicular access adjacent to the boundary is possible. The survey plan of the approved extension area shall be the reference for boundary monitoring.
Performance targets	<p>- The boundary must remain clearly marked at least at every change of direction and at intervals of not more than 50 metres where there are no changes of direction. Where boundary marking is indicated or supported by fencing, the fencing is to remain intact, as personnel may rely on the fence to indicate the limits of operation.</p> <p>There must be no evidence of any activity associated with sand quarry operations extending beyond the marked boundary and no threat of the boundary being breached by natural forces such as eroding batters.</p>
Responsibility and corrective action	- The Quarry Manager is responsible for ensuring that the boundary is inspected and that any corrective action is taken. Such action may include replacing boundary markers that are lost or damaged, repairing fencing, attending to batter creep, repairing any damage beyond the boundary and/or reminding personnel of the need to confine activities to within the boundary. Corrective action should be taken whenever the Quarry Manager becomes aware of a boundary issue, rather than waiting for a programmed inspection.
Review and reporting	- The Quarry Manager will ensure that a written record is made to verify that the boundary inspection has taken place. The Environmental Officer will review monitoring information submitted from the quarry to confirm that boundary inspection is taking place.

8.2 METEOROLOGICAL MONITORING

Source	- Condition 8 in schedule 3 of the project approval requires that meteorological monitoring be undertaken during the project.
Location	- The location of the weather station is shown on <i>Figure 8-1</i> .
Frequency	- The data are continuously recorded and averaged over one-hour intervals.
Method	- The site weather station was set up in 2003 to monitor temperature, wind and rainfall as detailed in <i>Table 8.1</i> .

Table 8.1 Meteorological Monitoring Parameters

Parameter	Units
Temperature at 2 metres	°C
Temperature at 10 metres	°C
Wind direction at 10 metres	degrees
Wind speed at 10 metres	m/s
Sigma theta at 10 metres	degrees
Rainfall	mm/hr

- Performance targets - The weather station shall produce continuous records. Meteorological monitoring must satisfy the requirements in the *Approved Methods for Sampling Air Pollutants in New South Wales* publication.
- Responsibility and corrective action - The Environmental Officer is responsible for operation of the weather station, including downloading data and ensuring that data is continuous. Any malfunction of the weather station shall be rectified as soon as possible.
- Review and reporting - Meteorological data should be retained in the form of a digital file but shall be accessible on request from representatives of the EPA or the DP&E. A summary of meteorological data collected at the site during the year shall appear in the Annual Environmental Management Report (refer to section 9) together with progressive long term averages. Auditors should verify that data collection is ongoing and review any electronic failures to ensure corrective action has been taken.

8.3 NOISE MONITORING

- Source - The project approval requires preparation of a noise monitoring program for the project (schedule 3, condition 4). This section presents the noise monitoring program.
- Location - Noise monitoring locations are shown on *Figure 2-4* and are as follows:
- 670 Beach Road;
 - 11 Bangarra Street; and
 - the Coralea property
- Frequency - Initial noise monitoring is to be undertaken within three months of the commencement of operations on the extension site. Subsequent noise monitoring will only be required if there are exceedences or a significant change to operations or machinery likely to have noise implications.
- Method - Operator attended measurements will be taken to quantify the maximum (L_{Amax}) and the average (L_{Aeq15min}) intrusive noise from quarrying over a 15 minute measuring period. Measurements are to be taken during the daytime while the site is in normal operation.
- Measurement is to be made with acoustic instrumentation carrying current NATA or manufacturer calibration certificates. Instrument calibration will be checked before and after each measurement survey.
- Noise measurement is to be undertaken at the most affected point within the receptor boundary or, where the dwelling is more than 30 metres from the boundary, within 30

metres of the dwelling. Where applicable the modification factors in Section 4 of the NSW Industrial Noise Policy shall be applied to the measured noise level (these factors refer to noise that is tonal, impulsive, intermittent, irregular or with dominant low frequencies).

All noise measurements will be accompanied by qualitative and quantitative measurements of prevailing local weather conditions. The operator shall record any significant sand quarry generated noise sources and obtain the operating logs for quarry plant and equipment during the measurement period.

- Performance targets - The performance targets are fully described in section 6.2 of this QEMP. *Table 8.2* summarises the noise goals at the monitoring locations.

Table 8.2 Noise Goals at Monitoring Sites

Location	L _{Aeq} (15 min) dB(A)
670 Beach Road	41
11 Bangarra Street	40
Coralea Property	43

- Responsibility and corrective action - The Environmental Officer is responsible for arranging for acoustic consultants to visit the site and undertake monitoring. Should noise monitoring identify an exceedence, the Environmental Officer shall implement notification as described in *Section 10.3* and arrange further noise monitoring, including measuring the noise emission from individual items of quarry plant to assist in identifying the source.

The Quarry Manager will then develop and implement appropriate corrective action.

Follow-up noise monitoring may be undertaken to confirm the validity of any suspect results or to test the effectiveness of corrective action.

- Review and reporting - The results of noise monitoring will be compiled in a report stating whether compliance has been achieved and referred to the Environmental Officer for review.

The Environmental Officer will ensure that all noise monitoring reports and details of any corrective action are forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.

8.4 AIR QUALITY MONITORING

- Source - The project approval requires preparation of an air quality monitoring program for the project (schedule 3, condition 7). This section presents the air quality monitoring program.
- Location - Dust monitoring gauges have been set up at the locations shown on *Figure 8-1*. The most northerly gauge has been installed as part of the proposed extension to the sand mine.
- Frequency - The contents of dust gauges are to be collected as near as possible to the same day each month and analysed for particulate matter.
- Method - The method to be used for dust sampling and analysis involves collection and analysis of insoluble solids as defined in Australian Standard AS 3580.10.1-2003 – Methods for Sampling and Analysis of Ambient Air – Determination of Particulates - Deposited Matter - Gravimetric Method. The monthly results are to be given in grams per square metre for averaging over a 12-month period.

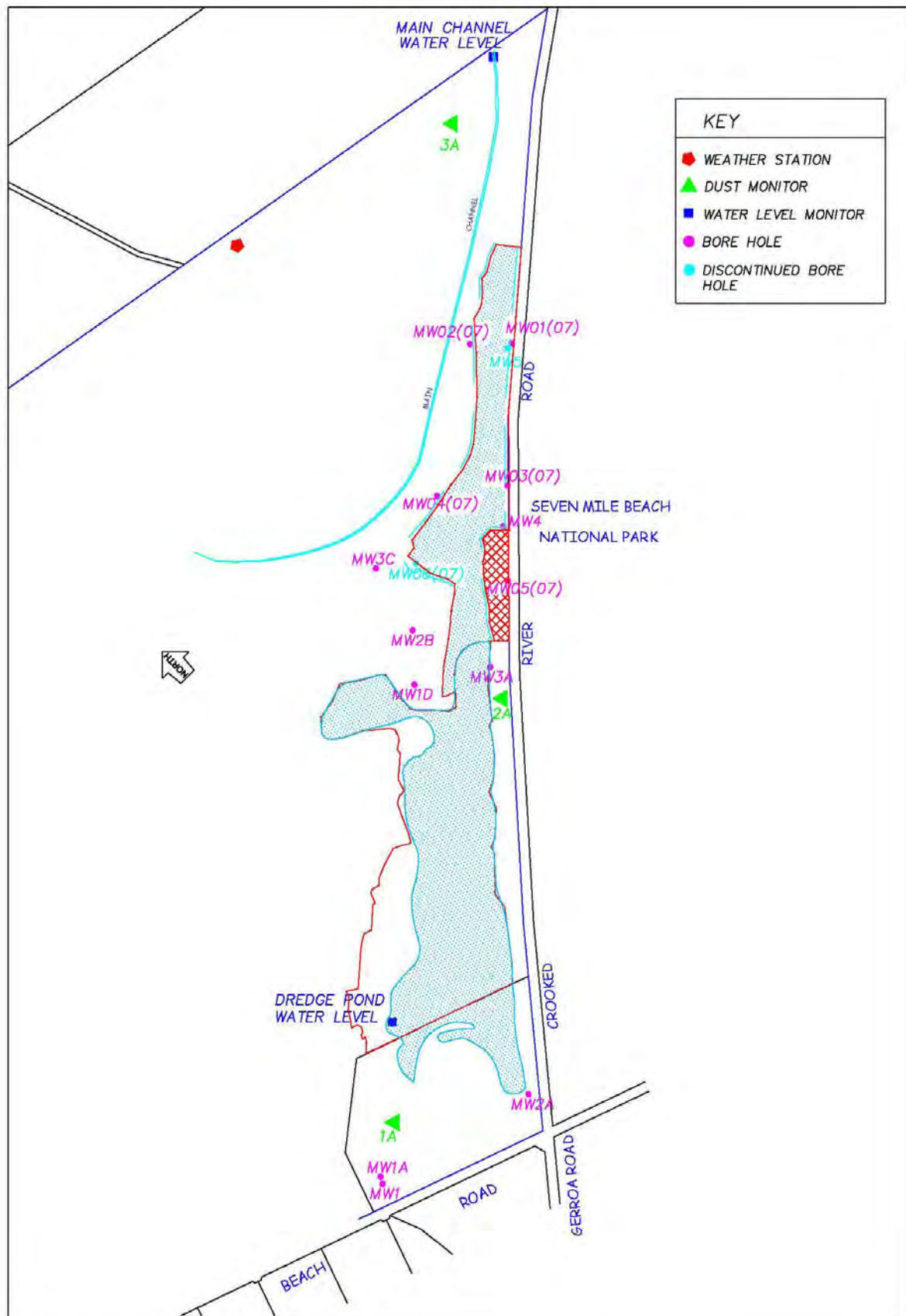


Figure 8-1 Location of Monitoring Devices

- Performance targets - The performance targets are fully described in section 6.3 of this QEMP. Numerical limits for dust deposition are reproduced in *Table 8.3*.

Table 8.3 Dust Deposition Limits

Criterion	Limit
Maximum increase in deposited dust level	2 g/m ² /mth
Maximum total deposited dust level	4 g/m ² /mth

The maximum dust deposition limit of 4 grams per square metre per month (annual average) applies at the nearest residence. In the absence of dispersion modelling, 4 g/m²/mth recorded at the dust collection gauges will be adopted as the trigger level for investigation.

- Responsibility and corrective action - The Environmental Officer is responsible for arranging for dust gauges to be attended and their contents analysed.
- Should the results indicate a trend towards non-compliance on an annual average basis, the Quarry Manager will be notified and an investigation into the root cause of the increased dust levels will be undertaken, including the adequacy of the controls presented in Section 6.3.3. In the event that the increased dust levels are attributed to site operations, measures to control the specific cause of dust generation will be reviewed and implemented where practical.
- Review and reporting - Results from dust monitoring will be reviewed by the Quarry Manager, Divisional Manager Quarries and the Environmental Officer.
- If the trigger level is exceeded at the dust collection gauges on an annual average basis the company will notify the DP&E and investigate the cause of the exceedance as above.
- The Environmental Officer will ensure that all air quality monitoring reports and details of any corrective action are recorded, forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.

8.5 SURFACE WATER MONITORING

- Source - The project approval requires preparation of a surface water monitoring program for the project (schedule 3, conditions 11 and 13). This section presents the surface water monitoring program.
- Baseline data - Details of previous recordings of surface water quality in the main channel leading to Blue Angle Creek and Foy's Swamp are included in *Appendix E*.
- Monitoring Protocols - There are four monitoring regimes in the surface water monitoring program, with differing purposes, frequencies of monitoring and targets:
- dredge pond level and basic condition;
 - dredge pond detailed water quality; and
 - main channel level; and
 - bank, bed and erosion monitoring.

Monitoring parameters for surface water are in *Table 8.4* below

Table 8.4 Surface Water Monitoring Protocols

		Dredge Pond Level and Basic Condition	Dredge Pond Detailed Water Quality	Main Channel Level
Location	-	At the locations shown on <i>Figure 8-1</i>		
Parameters	-	Water level, pH, conductivity	List of analytes in section 6.4 and water level.	Water level
Frequency	-	Every week and monthly on the same day that ground-water levels are being taken in monitoring bores. Additional monitoring immediately following extreme wet weather.	Every three months on the same day that groundwater quality samples are being taken in monitoring bores. Frequency may be reduced later with DG approval.	Every month on the same day that ground-water levels are being taken in monitoring bores.
Method	-	Water level measured by reference to a permanent surveyed scale. Field measurement for conductivity and pH.	Water samples collected by specialists and transported according to QA/QC protocols for analysis at a NATA certified lab.	Water level measured by reference to a permanent surveyed scale.
Performance targets	-	No targets. Purpose is to accumulate data of normal variability in the pond.	Water quality objectives are summarised in section 6.4 of this QEMP.	No targets. Purpose is to accumulate data of natural variability in the channel.
Bank, Bed and Erosion Monitoring	-	At three-monthly intervals the foreshores and batters around the full perimeter of the working area are to be inspected for evidence of instability, as well as the adequacy of the current sediment and erosion controls. The inspection will be undertaken on foot and the date of the inspection recorded		
Responsibility and corrective action	-	<p>The Quarry Manager is responsible for monthly monitoring of levels in the dredge pond and main channel, basic water quality testing in the dredge pond and inspection of foreshores and batters.</p> <p>The Environmental Officer is responsible for arranging for sampling and laboratory testing of dredge pond water on a three monthly basis.</p> <p>Should the results indicate a significantly deteriorating trend in surface water quality, the Quarry Manager will seek advice from a suitable professional as to the likely cause, either natural or related to the sand extraction operation. If the deterioration is related to operations, the DP&E will be informed, and advice of appropriate corrective action will be sought for implementation.</p> <p>If significant soil instability or erosion is apparent in the foreshores or batters, the Quarry Manager shall arrange for corrective action to be implemented. This will involve repairing any damage that has occurred and installing preventive measures in accordance with the erosion and sediment control plan (see <i>Appendix C</i>).</p>		

- Review and reporting
- Surface water quality monitoring results are to be reviewed by the Quarry Manager, Divisional Manager Quarries and the Environmental Officer to compare with the objectives in section 6.4 and the baseline data in *Appendix E*.

The Environmental Officer will ensure that all surface water monitoring results and reports and details of any corrective action are recorded, forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.

8.6 GROUNDWATER MONITORING

- Source
- The project approval requires preparation of a groundwater monitoring program for the project (schedule 3, conditions 11 and 14). This section presents the groundwater monitoring program.

- Baseline data
- An analysis of previous recordings of groundwater levels and quality in boreholes surrounding the excavation area and correlation with water levels in the dredge pond is included in *Appendix E*.

- Location
- Existing groundwater monitoring bores are shown on *Figure 8-1* together with three additional bores now installed to enable groundwater levels in the Swamp Sclerophyll Forest and hydraulic conductivity between the dredge pond and the forest to be measured. Groundwater dependent ecosystems subject to monitoring include any naturally vegetated area surrounding the dredge pond, particularly the Swamp Sclerophyll Forest on the western side.

- Frequency
- Water levels in boreholes are to be monitored at not less than monthly intervals and on the same day that surface water levels are monitored in the dredge pond and in the main drain.
- Water samples shall be taken from boreholes for off-site analysis of listed analytes every three months on the same day that samples are taken from the dredge pond. With the approval of the DP&E, this frequency may be reduced after the first year should results continue to show that the concentrations of water quality analytes are relatively constant.

- Method
- The water level, pH and conductivity shall be determined in each monitoring bore. The reduced level of each bore collar has been established by survey so that water levels can be converted to Australian Height Datum. Conductivity and pH shall be determined by field measurement.

Water sampling shall be undertaken by specialists and transported according to QA/QC protocols for offsite analysis in a NATA certified laboratory.

The effect of groundwater changes on groundwater dependent ecosystems and vegetation is to be monitored by inspection by the ecological consultant (see section 8.8).

Hydraulic conductivity of in situ material and completed sections of pond foreshore is to be determined by a hydrogeologist based on analysis of monitoring data following completion of landscaping each 20 metre wide extraction zone.

- Performance targets
- The purpose of groundwater monitoring is to establish the effect of sand extraction on groundwater surrounding the operational area that has the potential to influence the health and vitality of the ecosystems dependent upon groundwater, including the Swamp Sclerophyll Forest.

The target for **groundwater level** is that the level in any bore should not move outside the range of two standard deviations from its mean level for more than six months, except when following a trend attributable to climatic effects, as evident in other monitoring bores.

Objectives for **groundwater quality** are presented in section 6.4.1.

The target for **groundwater dependent ecosystems** is no discernible deterioration of ecosystems or vegetation, attributable to measured changes in groundwater levels or quality.

The target for **hydraulic conductivity** along the dredge pond banks is to replicate as closely as practicable the hydraulic regime existing before the dredge pond was created. At the northern end of the extraction area, due regard is to be given to the proximity of the dredge pond to the main drain.

Responsibility and corrective action - The Environmental Officer is responsible for arranging for boreholes to be monitored, data recorded, samples collected and analysed, hydraulic conductivity determined and groundwater dependent ecosystems to be inspected. The Environmental Officer is responsible for notifying the Quarry Manager when corrective action is required.

Upon being notified that the **groundwater level** in any bore is outside the above performance target, the Quarry Manager is to implement the following actions (condition 21(e)):

- sand extraction shall be suspended while further investigations and any necessary remedial action is undertaken;
- additional water level measurements shall be taken in temporary bores established in the vicinity of the affected bore to confirm groundwater levels in that locality;
- a qualified hydrogeologist shall assess the significance of the variance from expected behaviour and if the hydrogeologist considers that action is necessary to maintain the pre-existing groundwater regime in the vicinity of the Swamp Sclerophyll Forest, he shall prepare an appropriate remedial action plan;
- the remedial action plan shall be submitted to the DP&E for approval and implemented upon receipt of that approval.

Upon being notified of a significantly deteriorating trend in **groundwater quality** results, the Quarry Manager will seek advice from a hydrogeologist as to the likely cause, either natural or related to the sand extraction operation. If the deterioration is related to operations, the Quarry Manager will implement any remedial actions proposed by the hydrogeologist.

Upon being notified that the **hydraulic conductivity** along the side of a completed section of dredge pond is significantly at variance with that existing prior to sand mining, the Quarry Manager will arrange for the conductivity to be adjusted by appropriate measures, such as placing a greater number of panels of higher or lower conductivity material below the waterline in place of existing bed material.

Review and reporting - Each month the Environmental Officer will review the groundwater level monitoring results and notify the Quarry Manager if the performance target is not being met.

The Environmental Officer will examine groundwater quality monitoring results to compare with the objectives in section 6.4.1 and the baseline data in Appendix E. Should the results indicate a significantly deteriorating trend for any parameter, the Quarry Manager will be notified.

The Environmental Officer will ensure that all groundwater monitoring results and reports and details of any corrective action are forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.

8.7 ACID SULPHATE MONITORING

Source	- The Acid Sulphate Soils Management Plan (see <i>Appendix F</i>) has been prepared in accordance with the project approval (schedule 3, conditions 15). Monitoring requirements within the plan are detailed below.
Location	- In situ material shall be monitored ahead of the mining face. Washed sand product stockpiles and leachate flowing from them.
Frequency	- In situ material shall be sampled and tested at various depths prior to the sand mine progressing into new strata. All stockpiles from which leachate is weeping shall be monitored weekly. This shall continue until leachate flow has ceased. The pH of runoff from stockpiles should be checked after any rain that promotes runoff and on Mondays to test for the effects of any weekend rain. Sand ready for dispatch shall be progressively sampled and analysed. Where pre-extraction monitoring indicates a risk of significant pyrite content then sampling shall be at the rate of one sample per 1000 cubic metres or more frequently if validation is required for use as a concrete aggregate. Where risk of significant pyrite content is low, then sampling shall be undertaken once every month.
Method	- Leachate obtained within stockpiles or flowing from stockpiles shall be tested for pH. Samples of sand shall be analysed in a NATA registered laboratory to determine the total oxidisable sulphur. These tests can take 5 to 10 working days.
Performance targets	- The pH of leachate sampled from stockpiles is to remain within the range 6.5 to 9. The total oxidisable sulphur level in the washed sand product dispatched from the site shall aim to be no greater than 0.03 per cent.
Responsibility and corrective action	- The Quarry Manager is responsible for arranging for the pH of leachate from sand stockpiles to be tested. The Acid Sulphate Soils Management Plan requires that where leachate is outside the performance targets it should be intercepted and neutralised by addition of calcium hydroxide solution, prepared either from quicklime (CaO) or slaked lime (CaOH). The neutralising solution should be pumped or sprayed onto the standing leachate in small amounts until the pH is brought within the acceptable range. The Quarry Manager will arrange for product sand to be tested at the required frequency. Should tested sand be found to contain total oxidisable sulfur above the target level, it is to be re-processed and additional tests commissioned. Where these corrective actions fail to achieve the performance targets described above, the DP&E will be notified.
Review and reporting	- The Quarry Manager shall review each week the pH measurements of leachate flowing from sand stockpiles.

The Quarry Manager, Divisional Manager Quarries and Environmental Officer will review each set of sand analysis results as they come to hand and formulate any corrective action is required.

The Environmental Officer will ensure that all acid sulphate monitoring results and reports and details of any corrective action are forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.

8.8 REHABILITATION AND VEGETATION MONITORING

- Source** - The Landscape and Rehabilitation Management Plan (see *Appendix D*) has been prepared in accordance with the project approval (schedule 3, conditions 21, 21A and 22). Monitoring requirements within the plan are detailed below.
- Location** - Monitoring is to include all planted areas and conserved vegetation within the project site and the Conservation Area shown in *Figure 4-1*.
- Frequency** - Cleary Bros staff and/or contractors involved in managing the vegetation and rehabilitation works will monitor the relevant areas on a day to day basis as part of normal work. All areas subject to planting or conservation are to be inspected at least once every three months to assess progress and determine if remedial works are required.

A qualified ecologist will monitor the entire area annually.

- Method** - Day to day monitoring by Cleary Bros staff and/or contractors will involve inspection on an opportunistic basis associated with landscape management work, with the proviso that all areas are visited over a period of three months.

Monitoring by an ecologist is to include specific measures for the various forest types as described in section 8.3 of the Landscape and Rehabilitation Management Plan. Such measures include:

- permanent plots and/or transects in retained forest;
- weed surveys including areas where weed control has been undertaken;
- general fauna observations;
- general observations on the condition of the forest and forest edges;
- photographic history of critical elements;
- permanent fauna sample sites and/or timed transects in revegetation zones;
- feral animal surveys.

In addition to the above, during the period preceding severing the east- west link, monitoring by an ecologist will specifically target the prerequisites for severing the east-west link set out in schedule 3 conditions 23, 24 and 25 of the project approval, repeated below.

- Performance targets** - General performance targets for landscape and rehabilitation management are set out in section 8.3 of the LRMP under several categories and are summarised in *Table 8.5* below.

Table 8.5 Landscape and Rehabilitation Targets

Area of Monitoring	Performance Target
Existing forest within the	<ul style="list-style-type: none"> • no incursion of quarry activities or effect from quarry clearing; • no obvious negative impact on forest (die back, weed invasion, major species change);

Conservation Area	<ul style="list-style-type: none"> weed growth reduced over time and not negatively impacting on habitat; fauna use not diminished and populations being maintained.
Revegetation areas	<ul style="list-style-type: none"> majority of plantings, or their replacements, have survived; natural regeneration is occurring, including through manually spread seeds; plant diversity is increasing over time; use by native animals is increasing; succession to second generation plants is occurring.
Fauna populations	<ul style="list-style-type: none"> habitat features have been created and are being used by fauna; natural regeneration is increasing habitat complexity; fauna species diversity is increasing over time; use of the habitat by fauna is increasing over time.
Weed control	<ul style="list-style-type: none"> key weeds are reduced in extent and abundance and are moving towards being eliminated from the site; weeds are not significantly hindering natural regeneration; noxious weeds are adequately controlled on the land.
Feral animals	<ul style="list-style-type: none"> feral animals are not having a detrimental effect upon the forest or revegetation areas; rabbits, foxes and feral cats are controlled on the land.

The project approval includes specific performance targets to be met before the northern corridor would be considered “successful” and before the east-west link could be approved for severance (schedule 3 conditions 23 to 25). These prerequisites are included in *Table 8.6* below.

Table 8.6 Prerequisites for Severing the East-West Link

Requirement	Criteria
Successful establishment of the Northern Corridor	<ul style="list-style-type: none"> a) presence of native flora species; b) a majority of the flora species recorded from the removed forest occur in the area; (e.g. 60% of flora species recorded in removed forest are present); c) species from all four layers have been planted and at least 50% of the projected cover has been achieved for each of the shrub and ground cover layers; d) self-sustaining native plant populations (e.g regeneration of a second generation); e) no dominance by single flora species (e.g Bracken); f) weeds are not significantly impacting on the native vegetation; g) weeds do not represent a majority of the flora species or a higher percentage cover than the native flora species; and h) impacts such as grazing are excluded from the area.
Successful establishment of fauna habitat in the Northern Corridor	<ul style="list-style-type: none"> a) presence of species; b) a majority of the resident species recorded from the removed forest occur in the area; c) fauna populations are resident in the area; d) pest animals are controlled and not impacting upon the fauna or its habitat; and e) impacts such as grazing are excluded from the area.
Verification that the Northern	<ul style="list-style-type: none"> a) determine the presence of species in both the east- west link and northern corridor by conducting standard animal survey

	Corridor is functional as a replacement corridor between the Conservation Area and the National Park	<p>techniques at least twice in the first year (eg. Eliot trapping for small mammals, pitfall trapping for reptiles, observational surveys for frogs and birds, and spotlighting transects for arboreal animals);</p> <p>b) determine whether a majority of animal species (particularly those determined to be likely to be impacted by fragmentation) utilising the corridor in the east-west link are present in the conservation area and the northern corridor and the re-created link at the northern boundary; and</p> <p>c) conduct genetic analysis for a number of key species for whom genetic markers have already been developed (e.g. Brown Antechinus, Bush Rat and at least two skink species) to establish that genetic relatedness exists between individuals within the two corridors, the Conservation Area and National Park).</p>
		<p>If genetic relatedness exists between individuals in the northern corridor, Conservation Area and the National Park, but not in the east-west link, then this demonstrates that the east-west link is not functional, but the northern corridor is and therefore, the east-west link can be severed without creating additional fragmentation to animal populations.</p> <p>If genetic relatedness exists between individuals in the Conservation Area, the east-west link and the National Park, but not the northern corridor, then this demonstrates that the northern corridor is not functional and the east-west link cannot be severed until there is compliance with Conditions 23 and 24.</p>
Responsibility and corrective action	-	<p>Corrective action shall be implemented where the Quarry Manager considers it necessary to maintain adequate progress towards the achieving the key objectives for Retained Forest and Planted areas in sections 5 and 6 of the Landscape and Rehabilitation Management Plan.</p> <p>The Quarry Manager is responsible for implementing corrective action where this is required to rectify matters revealed in the ecologist's report.</p> <p>The Environmental Officer will arrange for the ecologist to examine the site annually and prepare a detailed report.</p>
Review and reporting	-	<p>The Quarry Manager shall review progress of rehabilitation and vegetation management work at least once every three months. This review function involves regular discussion with staff and/or contractors undertaking the work and personal inspection of all areas subject to planting or conservation at least quarterly.</p> <p>The Environmental Officer will review the report submitted by the ecologist engaged to undertake annual monitoring of implementation of the Landscape and Rehabilitation Management Plan and advise the Quarry Manager of any recommendations requiring corrective action.</p> <p>The Environmental Officer will ensure that all landscape monitoring results and reports and details of any corrective action are forwarded to the CCC, included in the Annual Environmental Management Report and available for inspection by environmental auditors.</p>

9 AUDITING AND REPORTING

9.1 INDEPENDENT ENVIRONMENTAL AUDIT

(Schedule 5, condition 5, 6 and 7)

Independent environmental audits shall be carried out every third year from 2010. Independent Environmental Audits will be undertaken in accordance with Schedule 5 Condition 5 of the Consent. The name of the nominated auditor must be submitted to the DP&E for approval prior to the audits commencing. Should a different auditor be proposed for any subsequent audit, the name must again be submitted for approval. The person (or team) must have expertise in flora and fauna assessment as well as quarry rehabilitation.

The audit is to include the following actions:

- include consultation with EPA, Kiama Council and Shoalhaven Council;
- assess the environmental performance of the quarry and its effects on the surrounding environment;
- assess whether the quarry is complying with the relevant standards, performance measures, and statutory requirements;
- review the adequacy of this Quarry Environmental Management Plan; and, if necessary,
- recommend measures or actions to improve the environmental performance of the quarry, and/or this QEMP and its inclusions.

An audit report is to be prepared and submitted to the DP&E, EPA, Kiama Council, Shoalhaven Council and the CCC within one month of completing the audit. The submission is to contain the company's response to any recommendations contained in the audit report.

Within three months of submitting an environmental audit report to the DP&E the following aspects of this QEMP shall be reviewed and if necessary, revised and re-issued:

- Noise Monitoring Program;
- Air Quality Monitoring Program;
- Erosion And Sediment Control Plan;
- Surface Water Monitoring Program;
- Groundwater Monitoring Program;
- Acid Sulfate Soils Management Plan;
- Landscape and Rehabilitation Management Plan;
- Long Term Management Strategy;
- Aboriginal Heritage Management Plan;
- Environmental Management Plan;
- Environmental Monitoring Program

Any amendment to the QEMP must be approved by the DP&E before it may be issued for implementation.

9.2 REPORTING

9.2.1 Annual Environmental Management Report

(Schedule 5, condition 4)

Each year on or before the anniversary of the project approval (2 September) an Annual Environmental Management Report shall be prepared and submitted to the DP&E, EPA, Kiama Council, Shoalhaven Council and the CCC.

The Annual Environmental Management Report is to respond to the following requirements (schedule 5, condition 4):

- i. identify the standards and performance measures that apply to the project;
- ii. describe the works carried out in the last 12 months;
- iii. describe the works that will be carried out in the next 12 months;
- iv. include a summary of the complaints received during the past year, and compare this to the complaints received in previous years;
- v. include a summary of the monitoring results for the project during the past year;
- vi. include an analysis of these monitoring results against the relevant:
 - o impact assessment criteria or limits;
 - o monitoring results from previous years; and
 - o predictions in the environmental assessment (EA);
- vii. include an evaluation of the effectiveness of the environmental protection requirements and procedures;
- viii. identify any trends in the monitoring results over the life of the project;
- ix. identify any non-compliance during the previous year; and
- x. describe what actions were, or are being, taken to ensure compliance.

9.2.2 Incident Reports

(Schedule 5, condition 3)

Where it becomes known that an exceedence of any performance criterion specified in the project approval has occurred, or an incident has occurred causing or likely to cause material harm to the environment, notification is to be given to the DP&E and where relevant, EPA, Kiama Council and/or Shoalhaven Council. The notification must be given within seven days and include the following information:

- i. describe the date, time and nature of the exceedence/incident;
- ii. identify the cause or likely cause of the exceedence/incident;
- iii. describe what action has been taken to date;
- iv. describe the proposed measures to address the exceedence/incident.

10 COMMUNITY RELATIONS

10.1 COMMUNITY CONSULTATIVE COMMITTEE

(Schedule 5, conditions 8 and 9)

10.1.1 Purpose

The purpose of the community consultative committee (CCC) is to review and provide advice regarding the environmental performance of the quarry. In particular the committee has the following functions:

- review environmental management of the quarry and community relations;
- undertake regular inspections of quarry operations;
- review community concerns or complaints about quarry operations and the complaints handling procedures;
- provide advice as follows:
 - to Cleary Bros on improved environmental management and community relations, including provision of information to the community and identification of community initiatives to which Cleary Bros could contribute;
 - to the DP&E regarding conditions of the project approval; and
 - to the general community on performance of the quarry with respect to environmental management and community relations.

10.1.2 Membership

The committee membership is as follows:

- two Cleary Bros representatives, one of whom is the Environmental Officer;
- one representative from Kiama Council (if available);
- one representative from Shoalhaven Council (if available);
- one representative of the Gerroa Environment Protection Society (if available);
- two representatives from the local community; and
- an independent chairman.

The project approval requires appointment of all members, including any replacements for members who resign, to be approved by the DP&E. In practical terms this would apply to community representatives and the chairman as organisations such as the councils and Cleary Bros may substitute staff from time to time. It is the responsibility of Cleary Bros to establish the committee, invite membership including any replacement or additional members and obtain the DP&E's approval for the nominees.

The membership of the committee should be reviewed on a regular basis, about every three years. If possible an alternate member should be appointed (and approved) for each of the local community representatives.

10.1.3 Meetings

The CCC meets at least twice per year, including one meeting to be held shortly after the AEMR is submitted to the CCC members. Cleary Bros has the following responsibilities with respect to committee meetings:

- provide the venue and secretarial support to produce agendas and minutes;

- ensure that two company representatives attend each meeting;
- arrange site inspections when warranted;
- provide regular information to the CCC on the performance of the sand quarry including a copy of the AEMR when it is submitted to the DP&E;
- respond to advice or recommendations from the committee regarding environmental management or community relations; and
- forward to the DP&E a copy of the minutes of each meeting and display a copy of the minutes on the company's web site.

10.2 COMMUNITY INFORMATION

(Schedule 5, conditions 10 and 11)

The following information regarding the quarry is to be made available to the community:

- this QEMP and any plan, strategy or program required under the project approval which has been produced as a separate document and approved by the DP&E;
- any revision to the above documents;
- reports from independent audits;
- each Annual Environmental Management Report;
- a summary of the results of all monitoring required under the project approval, updated at least every three months;

The above documents are to be made available within one month of approval, or where approval is not required, within one month of being created. The means of making the material available is as follows:

- provide a copy to the CCC;
- provide a copy to EPA, Kiama Council and Shoalhaven Council;
- make a copy available for inspection by the public at the quarry;
- place a copy on the web site for the quarry.

10.3 NOTIFICATION OF LANDOWNERS

(Schedule 4, condition 1)

Should the results of monitoring indicate that performance criteria (for example noise limits) specified in the project approval are being exceeded, notification shall be given to any affected landowner and/or tenant and the DP&E shall be notified. The notification shall include copies of monitoring results showing the exceedence. Further quarterly monitoring results shall be given to the landowners/tenants until the results show that the project is achieving compliance.

10.4 INDEPENDENT REVIEW

(Schedule 4, conditions 2 to 5)

The DP&E may initiate the independent review process after considering a written request from a landowner. This would occur if the landowner believed that the performance goals specified in the development consent and reproduced in section 6 of this QEMP were being exceeded.

If requested by the DP&E, within three months Cleary Bros is to consult with the landowner, commission an independent review and submit the outcome to the DP&E and the landowner. The review is to be conducted by an independent expert approved by the DP&E. The expert is to conduct monitoring to determine if the performance criteria are being met and if not, the source of the exceedence. Having regard to the possibility of cumulative impacts from more than one source, the expert is also required to ascertain the contribution from Cleary Bros' quarry to the exceedence.

If the criteria are found not to be exceeded the independent review can be discontinued with the approval of the DP&E. If exceedence is confirmed then Cleary Bros is to take all practicable measures to bring the quarry into compliance and conduct further monitoring to confirm that this has been achieved or enter a written agreement with the landowner allowing the exceedence to continue to the satisfaction of the DP&E. If agreement cannot be reached either party may refer the matter to the DP&E for resolution.

10.5 DISPUTE RESOLUTION

Should the DP&E be unable to resolve a dispute within 21 days then the DP&E is to refer the matter to an independent dispute resolution process for which an indicative outline appears in Appendix 9 of the project approval.

11 APPENDICES

Appendix A

2008 PROJECT APPROVAL

In the Land and Environment Court of New South Wales

No. 10801 of 2007

**Gerroa Environmental
Protection Society**
Applicant

Minister for Planning
First Respondent

Cleary Bros (Bombo) Pty Ltd
Second Respondent

Order

The Court makes the following orders:

1. The appeal is upheld.
2. Approval is granted to application 05/0099 for extraction and processing operations on land comprising Lot A DP 185785 and part of the land in Certificate of Title Vol 5841 Folio 139 subject to the conditions in Annexure A.
3. Exhibits may be returned.

Ordered: 2 September 2008

By the Court

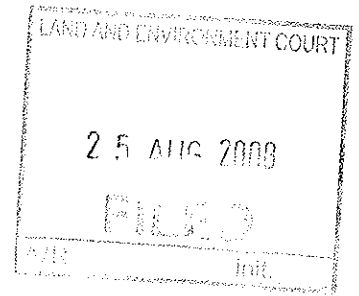
Susan Dixon

Registrar



**IN THE LAND AND ENVIRONMENT COURT OF
NEW SOUTH WALES**

No. 10801 of 2007



GERROA ENVIRONMENT PROTECTION SOCIETY INC
Applicant

MINISTER FOR PLANNING
First Respondent

CLEARY BROS (BOMBO) PTY LTD
Second Respondent

**CONSOLIDATED
CONDITIONS OF APPROVAL**

25 August 2008

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DEFINITIONS

AEMR	Annual Environmental Management Report
CCC	Community Consultative Committee
Compensatory Planting	The Compensatory Planting marked 2A.1, 2A.2, 2A.3, 2B.1, 2B.2, 2C.1, 2C.2, 2D, 2E, 5C.1 on the figure in Appendix 3
Conservation Area	The Vegetation Conservation Area shown in the figure in Appendix 4
DECC	Department of Environment and Climate Change
Department	Department of Planning
Director-General	Director-General of the Department of Planning, or delegate
DPI	Department of Primary Industries
DWE	Department of Water and Energy
EA	Environmental Assessment for the project titled <i>Gerroa Sand Quarry Proposed Extension Environmental Assessment</i> Volumes 1 and 2, dated October 2006, prepared by Perram & Partners
East-West Link	Area shown cross-hatched on the figure in Appendix 3
EMP	Environmental Management Plan
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPL	Environment Protection Licence issued under the <i>Protection of the Environment Operations Act 1997</i>
Extraction Area	The extraction area as shown in the figure in Appendix 1
Land	Land means the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this approval
Landscape and Rehabilitation Management Plan	The Plan approved by the Director-General under condition 21
Minister	Minister for Planning, or delegate
National Park	Seven Mile Beach National Park
Northern Corridor	Area shown stippled on the figure in Appendix 3
Privately owned land	Land not owned by a public agency or the Proponent or its related companies
Project	The extension and continued operation of the Gerroa Sand Quarry as described in the EA
Project Area	As defined in Vegetation Management Area and Site Plan shown in the figure in Appendix 1
Proponent	Cleary Bros (Bombo) Pty Ltd, or its successors
Relevant Agencies	DECC, Shoalhaven Council and Kiama Council
RTA	Roads and Traffic Authority
Site	Land to which the project application applies
SSF	Swamp Sclerophyll Forest vegetation
Statement of Commitments	The commitments in Appendix 2
Southern Rehabilitation Area	Zones 1.2, 1.3 and 2A.2 on the figure in Appendix 3



SCHEDULE 2 ADMINISTRATIVE

Obligation to Minimise Harm to the Environment

1. The Proponent shall implement all practicable measures to prevent or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the project.

Terms of Approval

2. The Proponent shall carry out the project in accordance with the:
 - (a) EA;
 - (b) Statement of Commitments; and
 - (c) conditions of this approval.

Note: The layout of the project is shown in the figure in Appendix 1.

3. If there is any inconsistency between the EA, Statement of Commitments and conditions of this approval, the conditions shall prevail to the extent of the inconsistency.
4. The Proponent shall comply with any reasonable requirement/s of the Director-General arising from the Department's assessment of:
 - (a) any reports, plans, programs or correspondence that are submitted in accordance with this approval; and
 - (b) the implementation of any actions or measures contained in these reports, plans, programs or correspondence.

Limits on Approval

5. Extraction and processing operations may take place until 31 July 2023.
- 5A. Under this approval, the Proponent is required to rehabilitate the site to the satisfaction of the Director-General. Consequently this approval will continue to apply in all other respects other than the right to conduct extraction and processing operations until the site has been rehabilitated to a satisfactory standard. Inter alia, to avoid doubt, the site has not been rehabilitated to a satisfactory standard unless Conditions 16 and 17 of this approval have been complied with.
6. The Proponent shall not transport more than 80,000 tonnes of product from the site in a year.

Note: This condition applies to the combined production of quarry products from the existing quarry and the quarry extension, and does not include the ancillary extractive material that would be imported onto the site and dispatched with the quarry's products.

Surrender of Consents

7. Within 3 months of the date of this approval, the Proponent shall surrender all existing development consents associated with the Gerroa Sand Quarry, in accordance with clause 97 of the EP&A Regulation.

Note: This approval will apply to all phases and components of the quarry from the date of this approval.

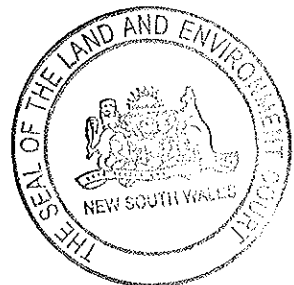
Operation of Plant and Equipment

8. The Proponent shall ensure that all plant and equipment used at the site is:
 - (a) maintained in a proper and efficient condition; and
 - (b) operated in a proper and efficient condition.

Section 94 Contributions

9. The Proponent shall pay a contribution of:
 - (a) 30 cents per tonne of material hauled from the site to Shoalhaven City Council; and
 - (b) 20 cents per tonne of material hauled from the site to Kiama Council,for the maintenance/repair of public roads in accordance with Shoalhaven City Council's *Section 94 Contributions Plan 1993 - Amendment No.71 Berry*, to the satisfaction of the Director-General.

Note: These contribution rates shall be paid and indexed in accordance with the applicable Contributions Plan.



SCHEDULE 3 ENVIRONMENTAL PERFORMANCE

GENERAL EXTRACTION AND PROCESSING PROVISIONS

Identification of Boundaries

1. Within 3 months of the date of this approval, or as otherwise agreed by the Director-General, the Proponent shall.
 - (a) engage an independent registered surveyor to survey the boundaries of the approved limit of extraction;
 - (b) submit a survey plan of these boundaries to the Director-General; and
 - (c) ensure that these boundaries are clearly marked at all times in a permanent manner that allows operating staff and inspecting officers to clearly identify those limits.

Note: The limit of extraction is shown conceptually on the plan in Appendix 1.

NOISE

Impact Assessment Criteria

2. The Proponent shall ensure that the noise generated by the project does not exceed the noise impact assessment criteria in Table 1.

Location	<i>L</i>_{Aeq} (15 min) dB(A)
670 Beach Road	41
11 Bangarrai Street	40
Seven Mile Beach Holiday Park	36
Coralea Property	43
Picnic Area 1	46
Picnic Area 2	43

Table 1: Noise Impact Assessment Criteria

Notes:

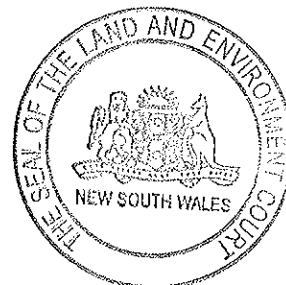
- *To determine compliance with these noise limits, noise from the project is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary. Where it can be demonstrated that direct measurement of noise from the project is impractical, the DECC may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level where applicable.*
- *The noise limits apply under meteorological conditions of wind speed up to 3m/s at 10 metres above ground level.*
- *The noise limits do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement*

Hours of Operation

3. The project shall only operate:
 - (a) between 7.00am and 6.00pm Monday to Friday;
 - (b) between 7.00am and 1.00pm on Saturdays; and
 - (c) at no time on Sundays or Public Holidays.

Noise Monitoring

4. The Proponent shall prepare and implement a Noise Monitoring Program for the project to the satisfaction of the Director-General. This program must:
 - (a) be submitted to the Director-General within 3 months of the date of this approval;
 - (b) be prepared in consultation with the DECC; and
 - (c) include details of how the noise performance of the project would be monitored, and include a noise monitoring protocol for evaluating compliance with the relevant noise limits in this approval.



AIR QUALITY

Impact Assessment Criteria

5. The Proponent shall ensure that dust generated by the project does not cause additional exceedances of the criteria listed in Table 2 at any residence on privately owned land, or on more than 25 percent of any privately owned land.

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m ² /month	4 g/m ² /month

Table 2: Long Term Impact Assessment Criteria for Deposited Dust

Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS/NZS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

Operating Conditions

6. The Proponent shall ensure any visible air pollution generated by the project is assessed regularly, and that quarrying operations are relocated, modified, and/or stopped as required to minimise air quality impacts on privately owned land.

Air Quality Monitoring

7. The Proponent shall prepare and implement an Air Quality Monitoring Program for the project to the satisfaction of the Director-General. This program must:
- (a) be submitted to the Director-General within 3 months of the date of this approval;
 - (b) be prepared in consultation with DECC; and
 - (c) include details of how the air quality performance of the project would be monitored, and include a protocol for evaluating compliance with the relevant air quality criteria in this approval.

METEOROLOGICAL MONITORING

8. During the project, the Proponent shall maintain a suitable meteorological station on (or in close proximity to) the site to the satisfaction of the DECC and the Director-General. This station must satisfy the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* publication.

SURFACE AND GROUND WATER

Discharges

9. The Proponent shall not discharge any water from the quarry or its associated operations except for the purpose of restoring normal pond level after significant rainfall. Any such discharge shall be in accordance with an EPL.

Water Quality Objectives

10. Unless otherwise approved by the Director-General, the Applicant shall aim to meet the water quality objectives in Table 3 for water in the dredge pond and in ground water adjacent the dredge pond.



Pollutant	Unit of Measure	Water Quality Objective
Turbidity	NTU	5-20
pH	pH	6- 8.5
Salinity	µS/cm	<1,500
Dissolved oxygen	mg/L (saturation)	>6 (>80-90%)
Total phosphorus	µg/L	<30
Total nitrogen	µg/L	<350
Chlorophyll-a	µg/L	<5
Faecal coliforms	Median No./100mL	<1000

Pollutant	Unit of Measure	Water Quality Objective
Enterococci	Median No./100mL	<230
Algae and blue-green algae	No.cells/mL	<15,000
Sodium	mg/L	<400
Potassium ion	mg/L	<50
Magnesium ion	mg/L	<50
Chloride ion	mg/L	<300
Sulphate ion	mg/L	<250
Bicarbonate ion	mg/L	<750
Soluble Iron ion	mg/L	<6
Ammonium ion	mg/L	<20

Table 3: Water Quality Objectives

Notes:

- The objectives for dissolved oxygen, turbidity and algae are relevant to surface water only;
- The Department acknowledges that short term exceedances of these objectives may occur during natural events such as heavy rainfall or tidal saline water inflow.

Management and Monitoring

11. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must:

- be submitted to the Director-General within 3 months of the date of this approval;
- be prepared in consultation with the DWE and DECC; and
- include a:

- Erosion and Sediment Control Plan;
- Surface Water Monitoring Program;
- Ground Water Monitoring Program; and
- Acid Sulfate Soils Management Plan.

include a strategy for the placement of high hydraulic conductivity material progressively during the works. High conductivity material is to be placed at intervals along the length of the pond extension. This material is to be of a hydraulic conductivity, and placed at such intervals and in such places, that will maintain comparable typical groundwater flow through to the Swamp Sclerophyll Forest as existed prior to the proposed excavation. The existing and comparable typical groundwater flow is to be determined in accordance with the calculation based on the existing typical hydraulic gradient and the hydraulic conductivity of the *in situ* strata provided for in condition 14(c) below.

12. The Erosion and Sediment Control Plan shall:

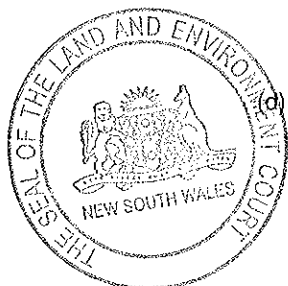
- be consistent with the requirements of *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition, 2004* (Landcom);
- identify activities that could cause soil erosion and generate sediment;
- describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;
- describe the location, function, and capacity of erosion and sediment control structures; and
- describe what measures would be implemented to maintain (and if necessary decommission) the structures over time.

13. The Surface Water Monitoring Program shall include:

- detailed baseline data on surface water quality in the main channel in Foys Swamp;
- surface water impact assessment criteria;
- a program to monitor surface water quality;
- a program to monitor bank and bed stability of the dredge pond;
- a protocol for the investigation, notification and mitigation of identified exceedances of the surface water impact assessment criteria; and
- a program to monitor the effectiveness of the Erosion and Sediment Control Plan.

14. The Ground Water Monitoring Program shall include:

- a statistical analysis of baseline ground water level and water quality data;
- ground water impact assessment criteria, including criteria for assessing any impacts on ground water dependent ecosystems and vegetation;
- a program to monitor:
 - hydraulic conductivity – upon the completion of the landscaping of each 20 metre wide



extraction zone, tests shall be conducted to ensure that the hydraulic conductivity following the placement of material is similar to the conditions prevailing prior to excavation commencing;

- impacts on ground water dependent ecosystems and vegetation (from at least 6 boreholes at the edge of the dredge pond); and
 - water levels (at no less than monthly intervals and taken on the same day) in the dredge pond, the drain at the flood gates, monitoring bores WM1, WM1A, WM2A, WM3A, WM4, WM5, 1/Aug07, 2/Aug07, 3/Aug07, 4/Aug07, 5/Aug07 and 6/Aug07 (locations shown on Drawing 6198/208bh Revision A prepared by KF Williams & Associates, 15/2/08), and any additional bores installed at the edge of the dredge pond;
 - the in situ strata at the perimeter of the dredge pond for its current hydraulic conductivity; and
 - groundwater levels under the SSF.
- (d) monthly review of the results of the ground water monitoring by the Proponent's Environmental Officer;
- (e) a protocol for the investigation, notification and mitigation of any identified exceedances of the ground water impact assessment criteria. The protocol shall include the following measures to be undertaken in the event that the water level in any bore lies outside the range of two standard deviations from the mean for more than 6 months and does not follow a trend that can be attributed to climatic effects, as evident in other monitoring bores, undertake the following actions:
- sand extraction shall be halted immediately while further investigations and any necessary remedial action are undertaken;
 - additional water level measurements shall be taken in temporary bores in the vicinity of the affected bore to confirm the ground water levels in that locality;
 - a qualified hydrogeologist shall be engaged to assess the significance of the variance from expected ground water behaviour;
 - if the review of the hydrogeologist considers that action is necessary to maintain the pre-existing ground water regime in the vicinity of the SSF he/she shall be requested to recommend an appropriate remedial action plan. This plan may include adjustment to the placement strategy for panels of high hydraulic conductivity material required by Condition 11(d); and
 - the recommended remedial action plan shall be submitted for the Director-General's approval and subsequently implemented by the Proponent;
- (f) include measures to mitigate, remediate and/or compensate any identified ground water impacts.
15. The Acid Sulfate Soils Management Plan shall:
- (a) be prepared in accordance with the *Acid Sulphate Soils Assessment and Management Guidelines*;
- (b) describe the measures to manage acid sulfate soils;
- (c) include an acid sulfate soils sampling and monitoring program.

LANDSCAPE MANAGEMENT

Planning Agreement

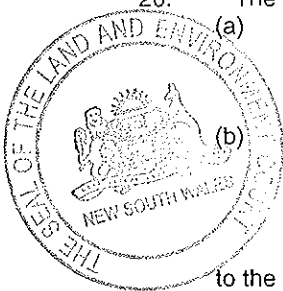
16. Within 3 months of the date of this approval, the Proponent shall:
- (a) enter into a Planning Agreement with the Minister under section 93F of the EP&A Act. This Agreement must be generally consistent with commitments in the terms of the offer made by the Proponent to the Minister on 1 May 2007, and must specifically provide for the:
- (i) implementation of the Compensatory Planting shown in the plan in Appendix 3;
 - (ii) protection of the vegetation in the area shown in Appendix 4 (*Conservation Area*);
 - (iii) identification by survey plan of the Conservation Area shown in the plan titled Vegetation Conservation Area (shown conceptually in Appendix 4);
 - (iv) implementation of the Landscape and Rehabilitation Management Plan for the site; and
 - (v) insurance of the Conservation Area against the impact of fire or vandalism;
- (b) register the Planning Agreement on the title of the land in accordance with the Real Property Act 1900.

Landscaping and Rehabilitation

17. The Proponent shall:
- (a) progressively rehabilitate the site in a manner that is generally consistent with the rehabilitation objectives in Chapter 3.8 of the EA (see Appendix 5);
- (b) ensure that within 4 years of the date of this approval, the additional plantings in the Northern Corridor and Southern Rehabilitation Area are comprised of at least 60% of the plant species recorded for the representative plant communities in the quarry extension area, such as Bangalay Sand Forest and Littoral Rainforest;



- (c) implement the Compensatory Planting in a manner that is consistent with the Landscape and Rehabilitation Management Plan referred to in Condition 21, including the:
- establishment, conservation and maintenance of approximately 23.99 hectares of native vegetation;
 - enhance 5.25 hectares of the vegetation in Areas 4 and 5; and
 - conservation and maintenance of approximately 46.25 hectares of the remnant vegetation on the site (shown conceptually in Appendix 3); and the best practice guidelines set out in:
 - *Bringing the bush back to Western Sydney: Best practice guidelines for bush regeneration on the Cumberland Plain* Department of Infrastructure, Planning and Natural Resources (2003) ("DIPNR (2003)"); and
 - *Recovering bushland on the Cumberland Plains: Best practice guidelines for the management and restoration of bushland* Department of Environment and Conservation (2005) ("DEC (2005)");
 to the satisfaction of the Director-General.
18. Within 12 months of the date of this approval, the Proponent shall densely plant *Banksia Integrifolia* along the 5 metre setback zones to the Littoral Rainforest vegetation and these areas shall thereafter be planted with species as may be specified in the Landscape and Rehabilitation Management Plan.
19. The Proponent shall:
- (a) clearly identify the boundary of the extension area in consultation with a suitably qualified ecologist prior to the commencement of any construction works to ensure that an adequate buffer distance is maintained from the dredging activities/quarry operations to the Conservation Area and SSF;
 - (b) ensure that all dredging activities and associated quarry operations remain within the defined boundary of the Project Area (shown on the plan in Appendix 1);
 - (c) develop a monitoring program and document it in the EMP to demonstrate that the defined boundary of the quarry extension area is maintained and not compromised during operations; and
 - (d) revegetate the buffer area with appropriate native species and be subject to the Landscape and Rehabilitation Management Plan for inclusion in the EMP for its long term restoration and management and be not less than 5 metres wide.
20. The Proponent shall:
- (a) commence the Compensatory Planting and the vegetation screen along the Crooked River Road frontage north of the east-west link (as shown conceptually in Appendix 3), within 12 months of the date of this approval or when sufficient propagation material has been collected; and
 - (b) not sever the east-west link until it can be demonstrated to the satisfaction of the Director General that the established communities represented in the Northern Corridor comprise at least 60% of the native flora species as set out in Appendix 6 and the Northern Corridor is successful according to the criteria in Condition 25;
- to the satisfaction of the Director-General.



In this Condition, "**not sever**" means that no works of clearing, tree removal or other habitat removal shall take place which will reduce or impede the function of the East-West Corridor to provide connectivity to the National Park from Zone 1.1 as measured by Condition 25(b).

Restriction on clearing of certain land

- 20A Within the area marked "X" on Appendix 1, a person shall not clear any of the land of vegetation or trees without the consent of the Director-General.

Landscape and Rehabilitation Management Plan

- 21 The Proponent shall prepare and implement a Landscape and Rehabilitation Management Plan for the project to the satisfaction of the Director-General.

This plan must:

- (a) be submitted to the Director-General for approval within 3 months of the date of this approval;
- (b) be generally in accordance with the draft Landscape and Rehabilitation Management Plan, dated 20 August 2008 prepared by Kevin Mills & Associates and accepted by the Land and Environment Court as appropriate;
- (c) be prepared in consultation with the DECC by suitably qualified expert/s approved by the Director-General;
- (d) clearly identify the biological purpose of the linkage and describe how its design, dimensions and management will achieve this purpose;

- (e) collect baseline data for the Project Area including flora species, fauna species and ecological function parameters;
- (f) include a figure showing the location, extent and size of areas to be planted/regenerated for each community to be impacted;
- (g) identify strategies to use the natural resources of the impacted areas to their full potential, including:
 - all plant material to be used as a primary source for restoration and rehabilitation should be collected and propagated from relevant communities prior to clearing;
 - all areas proposed for replanting should be assessed initially for their regeneration potential appropriate restoration strategies should follow best practice guidelines as described in DIPNR (2003) and DEC (2005);
- (h) describe in general the short, medium and long-term measures that would be implemented to:
 - rehabilitate the site;
 - implement the Compensatory Planting shown in Appendix 3;
 - manage the remnant vegetation and habitat on the site, including the areas of Bangalay Sand Forest to be retained (shown conceptually in Appendix 3);
 - landscape the site (including the bunds) to mitigate visual impacts of the project; and
 - Upgrade and protect the remaining area of Littoral Rainforest on the eastern side of the pond extension
- (i) describe in detail the measures that would be implemented over the first 5 years and every subsequent 5 year period, to rehabilitate and manage the landscape and vegetation on the site, including
 - setting clear targets to the satisfaction of the Director-General to determine the level of success and make timely changes to management strategies, as necessary;
 - monitoring each vegetation type separately;
- (j) set completion criteria for the rehabilitation of the site (i.e. when plantings are self-sustaining);
- (k) describe how the performance of these measures would be monitored over time; and
- (l) include a Long Term Management Plan.

- 21A The Proponent shall engage a qualified ecologist, bush regeneration or providence nursery group who will develop a program consistent with the objectives and procedures set out in the draft Landscape and Rehabilitation Management Plan and this program will address the following issues:
- (a) soil testing;
 - (b) on site collection of seed and other propagation material;
 - (c) an assessment of the need to develop plants on the site;
 - (d) a program of successional plantings and management that will achieve the agreed purposes of the planting;
 - (e) targets for short term, medium term and long term planting and management;
 - (f) monitoring requirements;
 - (g) reporting frequency and methodology;
 - (h) consultation with the relevant government agencies;
 - (i) water quality monitoring; and
 - (j) quantitative vegetation monitoring;
- unless otherwise incorporated in the draft Landscape and Rehabilitation Management Plan.



22. The Landscape and Rehabilitation Management Plan must include:
- (a) the objectives for the rehabilitation of the site and implementation of the Compensatory Planting and the vegetation screen along the Crooked River Road frontage north of the east-west link;
 - (b) a description of how the rehabilitation of the site and implementation of the Compensatory Planting and how the vegetation screen along the Crooked River Road frontage would be integrated with the surrounding vegetation to provide a comprehensive strategic framework for the restoration and enhancement of the landscape over time;
 - (c) a description of the short, medium, and long-term measures that would be implemented to:
 - rehabilitate the site;
 - implement the Compensatory Planting;
 - manage the remnant vegetation and habitat on the site; and
 - landscape the site (including the bunds) to mitigate visual impacts of the project;
 - (d) a detailed description of the performance and completion criteria for the rehabilitation of the site and implementation of the Compensatory Planting and the vegetation screen along the Crooked River Road frontage;
 - (e) a detailed description of what measures would be implemented over the next 5 years to rehabilitate the site, and implement both the Compensatory Planting and the vegetation screen along the Crooked River Road frontage, including the procedures for:
 - undertaking pre-clearance surveys;
 - conserving and reusing topsoil;
 - collecting and propagating seed for rehabilitation works;
 - salvaging and reusing material from the site for habitat enhancement, particularly tree hollows;
 - controlling weeds and feral pests;
 - controlling access;

- bushfire management;
 - managing any potential conflicts between the proposed rehabilitation of the site and implementation of the Compensatory Planting and any Aboriginal cultural heritage values in those areas;
 - progressively rehabilitate the areas disturbed by sand extraction;
 - implementing revegetation and regeneration within the disturbed and compensatory planting areas, including the establishment of canopy, sub-canopy (if relevant), understorey and ground cover vegetation;
 - reducing the visual impacts of the project; and
 - protecting areas outside the disturbance areas;
- (i) a detailed program to monitor the performance of the rehabilitation of the site and implementation of the Compensatory Planting and the vegetation screen along the Crooked River Road frontage against the relevant objectives and performance and completion criteria (see above);
- (j) 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; and
- (k) details of who is responsible for monitoring, reviewing, and implementing the plan.
23. Successful establishment of the Northern Corridor shall be measured by the following criteria:
- (a) presence of native flora species;
 - (b) a majority of the flora species recorded from the removed forest occur in the area; (e.g. 60% of flora species recorded in removed forest are present);
 - (c) species from all four layers have been planted and at least 50% of the projected cover has been achieved for each of the shrub and ground cover layers;
 - (d) self-sustaining native plant populations (e.g. regeneration of a second generation);
 - (e) no dominance by single flora species (e.g. Bracken);
 - (f) weeds are not significantly impacting on the native vegetation;
 - (g) weeds do not represent a majority of the flora species or a higher percentage cover than the native flora species; and
 - (h) impacts such as grazing are excluded from the area.
24. Successful establishment of fauna habitat in the Northern Corridor would be measured by:
- (a) presence of species;
 - (b) a majority of the resident species recorded from the removed forest occur in the area;
 - (c) fauna populations are resident in the area;
 - (d) pest animals are controlled and not impacting upon the fauna or its habitat; and
 - (e) impacts such as grazing are excluded from the area.
25. Prior to the severance of the East-West Link the Proponent shall:
- (a) determine the presence of species in both the east-west link and northern corridor by conducting standard animal survey techniques at least twice in the first year (eg. Elliot trapping for small mammals, pitfall trapping for reptiles, observational surveys for frogs and birds, and spotlighting transects for arboreal animals);
 - (b) determine whether a majority of animal species (particularly those determined to be likely to be impacted by fragmentation) utilising the corridor in the east-west link are present in the conservation area and the northern corridor and the re-created link at the northern boundary; and
 - (c) conduct genetic analysis for a number of key species for whom genetic markers have already been developed (e.g. Brown Antechinus, Bush Rat and at least two skink species) to establish that genetic relatedness exists between individuals within the two corridors, the Conservation Area and National Park).
- If no genetic relatedness exists between individuals in the Conservation Area, northern corridor, east-west link and the National Park, then this demonstrates that neither the east-west link nor the northern corridor is functional and therefore the east-west link can be severed without creating additional fragmentation to animal populations.
- If genetic relatedness exists between individuals in the northern corridor, Conservation Area and the National Park, but not in the east-west link, then this demonstrates that the east-west link is not functional, but the northern corridor is and therefore, the east-west link can be severed without creating additional fragmentation to animal populations.
- If genetic relatedness exists between individuals in the Conservation Area, the east-west link and the National Park, but not the northern corridor, then this demonstrates that the northern corridor is not functional and the east-west link cannot be severed until there is compliance with Conditions 23 and 24.
26. The Long Term Management Strategy must be prepared in consultation with Shoalhaven Council, Kiama Council, DECC, DPI-Fisheries and the CCC, and must:
- (a) define the objectives and criteria for quarry closure and post-extraction management;
 - (b) investigate options for the future use of the site;



- (c) describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the development; and
- (d) describe how the performance of these measures would be monitored over time.

Note: The Department accepts that the initial Long Term Management Strategy may not contain detailed information on post-extraction management.

Landscape and Rehabilitation Bond

- 27. Within 6 months of the date of this approval, the Proponent shall lodge a rehabilitation bond for the project with the Director-General. The sum of the bond shall be calculated at:
 - (a) \$2.50/m² for the total area to be disturbed by the proposed dredge pond as shown in Appendix 1; and
 - (b) \$1.00/m² for the total area of land to be rehabilitated consisting of Zones 2A.1, 2A.2, 2A.3, 2B.1, 2B.2, 2C.1, 2C.2, 2D and 2E of Appendix 3;
 or as otherwise directed by the Director-General.
- 28A. The rehabilitation bond shall continue to be retained after completion of the Compensatory Planting to ensure that there shall be a continuation of the Planning Agreement; and
- 28B. The Director-General may at his or her discretion and on advice from an independent environmental auditor release or vary the rehabilitation bond where conditions permit. If the rehabilitation is not completed to the satisfaction of the Director General, the Director General will call in all or part of the rehabilitation bond, and arrange for the satisfactory completion of the relevant works.
- 28C. The bond may be in the form of a Bank Guarantee or as directed by the Director-General.

ABORIGINAL HERITAGE

Aboriginal Site Conservation

- 29. The Proponent shall protect and conserve Area A, as described in the EA (as shown on the plan in Appendix 8, to the satisfaction of the Director-General.

Aboriginal Heritage Management Plan

- 30. The Proponent shall prepare and implement an Aboriginal Heritage Management Plan for the project to the satisfaction of the Director-General. This plan must:
 - (a) be submitted to the Director-General within 3 months of the date of this approval and prior to disturbance of any identified Aboriginal object;
 - (b) be prepared in consultation with the DECC and relevant Aboriginal communities; and
 - (c) include a:
 - description of the measures that would be implemented to protect Area A and that part of Area B proposed to be conserved, as described in the EA (as shown on the plan in Appendix 8);
 - description of the measures that would be implemented for the mapping and salvage or relocation of the archaeological relics in the site including the shell midden deposit situated at the South Western corner of the Extraction Area (as shown on the plan in Appendix 8);
 - description of the measures that would be implemented if any new Aboriginal objects or relics are discovered during the project; and
 - protocol for the ongoing consultation and involvement of the Aboriginal communities in the conservation and management of Aboriginal cultural heritage on the site.

TRAFFIC AND TRANSPORT

Transport Routes

- 31. The Proponent shall ensure that all truck movements travelling to or originating from areas:
 - (a) south of the site use the Princes Highway, via Beach Road (except as provided for by condition 32 below); and
 - (b) north of the site use the Princes Highway, via Beach Road, Crooked River Road, Fern Street and Belinda Street.
- 32. The Proponent shall ensure that no trucks associated with the project use Gerroa Road, except where the destination lies along or adjacent to that road.



Haul Road

33. Within 3 months of the date of this approval, the Proponent shall upgrade the internal haul road and Beach Road intersection to a sealed Type BAL left turn and sealed Type BAP right turn configuration, in accordance with the RTA's Road Design Guide.

Road Haulage

34. The Proponent shall ensure that:
- (a) all loaded vehicles entering or leaving the site are covered; and
 - (b) all loaded vehicles leaving the site are cleaned of materials that may fall on the road, before they leave the site.

VISUAL

Visual Amenity

35. The Proponent shall minimise the visual impacts of the project to the satisfaction of the Director-General.

Lighting Emissions

36. The Proponent shall:
- (a) take all practicable measures to mitigate off-site lighting impacts from the project; and
 - (b) ensure that all external lighting associated with the project complies with Australian Standard AS4282 (INT) 1995 – *Control of Obtrusive Effects of Outdoor Lighting*, to the satisfaction of the Director-General.

Advertising

37. The Proponent shall not erect or display any advertising structure(s) or signs on the site without the written approval of the Director-General.

Note: This does not include traffic management and safety or environmental signs.

WASTE MANAGEMENT

Waste Minimisation

38. The Proponent shall minimise the amount of waste generated by the project to the satisfaction of the Director-General.

EMERGENCY AND HAZARDS MANAGEMENT

Dangerous Goods

39. The Proponent shall ensure that the storage, handling, and transport of dangerous goods are conducted in accordance with the relevant Australian Standards, particularly AS1940 and AS1596, and the Dangerous Goods Code.

Safety

40. The Proponent shall secure the project to ensure public safety to the satisfaction of the Director-General.

Bushfire Management

41. The Proponent shall:
- (a) ensure that the project is suitably equipped to respond to any fires on-site; and
 - (b) assist the rural fire service and emergency services as much as possible if there is a fire on-site.

PRODUCTION DATA

42. The Proponent shall:
- (a) provide annual production data to the DPI using the standard form for that purpose; and
 - (b) include a copy of this data in the AEMR.



SCHEDULE 4 ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS

1. If the results of monitoring required in Schedule 3 identify that impacts generated by the project are greater than the relevant impact assessment criteria, then the Proponent shall notify the Director-General and the affected landowners and/or existing or future tenants (including tenants of quarry owned properties) accordingly, and provide quarterly monitoring results to each of these parties until the results show that the project is complying with the relevant criteria.

INDEPENDENT REVIEW

2. If a landowner of privately owned land considers that the operations of the quarry are exceeding the impact assessment criteria in Schedule 3, then he/she may ask the Proponent in writing for an independent review of the impacts of the project on his/her land.

If the Director-General is satisfied that an independent review is warranted, the Proponent shall within 3 months of the Director-General advising that an independent review is warranted:

- (a) consult with the landowner to determine his/her concerns;
 - (b) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Director-General, to conduct monitoring on the land, to determine whether the project is complying with the relevant criteria in Schedule 3, and identify the source(s) and scale of any impact on the land, and the project's contribution to this impact; and
 - (c) give the Director-General and landowner a copy of the independent review.
3. If the independent review determines that the quarrying operations are complying with the relevant criteria in Schedule 3, then the Proponent may discontinue the independent review with the approval of the Director-General.
 4. If the independent review determines that the quarrying operations are not complying with the relevant criteria in Schedule 3, and that the quarry is primarily responsible for this non-compliance, then the Proponent shall:
 - (a) implement all reasonable and feasible measures, in consultation with the landowner, to ensure that the project complies with the relevant criteria; and
 - (b) conduct further monitoring to determine whether these measures ensure compliance; or
 - (c) secure a written agreement with the landowner to allow exceedances of the relevant criteria in Schedule 3,to the satisfaction of the Director-General.

If the additional monitoring referred to above subsequently determines that the quarrying operations are complying with the relevant criteria in Schedule 3, then the Proponent may discontinue the independent review with the approval of the Director-General.

If the Proponent is unable to finalise an agreement with the landowner, then the Proponent or landowner may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process (see Appendix 9).

5. If the landowner disputes the results of the independent review, either the Proponent or the landowner may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process (see Appendix 9).



SCHEDULE 5 ENVIRONMENTAL MANAGEMENT, MONITORING, REPORTING & AUDITING

ENVIRONMENTAL MANAGEMENT PLAN

1. The Proponent shall prepare and implement an Environmental Management Plan for the project to the satisfaction of the Director-General. This plan must:
 - (a) be submitted to the Director-General within 6 months of the date of this approval;
 - (b) be prepared in consultation with the Relevant Agencies;
 - (c) provide the strategic context for environmental management of the project;
 - (d) identify the statutory requirements that apply to the project;
 - (e) describe in general how the environmental performance of the project would be monitored and managed;
 - (f) describe the procedures that would be implemented to:
 - keep the local community and Relevant Agencies informed about the construction, operation and environmental performance of the project;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the life of the project;
 - respond to any non-compliance;
 - manage cumulative impacts; and
 - respond to emergencies; and
 - (g) describe the role, responsibility, authority, and accountability of the key personnel involved in the environmental management of the project.

ENVIRONMENTAL MONITORING PROGRAM

2. The Proponent shall prepare an Environmental Monitoring Program for the project to the satisfaction of the Director-General. This program must be submitted to the Director-General within 6 months of the date of this approval, and consolidate the various monitoring requirements in Schedule 3 of this approval into a single document.

- 2A. Within 3 months of the date of this approval, the Proponent shall nominate a suitably qualified and experienced Environmental Officer(s) to perform environmental management duties. The Environmental Officer(s) shall be:
- (a) responsible for reviewing the monitoring programs required under this consent; and
 - (b) responsible for considering and advising on matters specified in the conditions of this consent, and all other licences and approvals related to the environmental performance and impacts of the development.

The Proponent shall notify the Director-General, and Relevant Agencies of the name and contact details of the Environmental Officer, and any changes to that appointment that may occur from time to time.

Note: the Environmental Officer(s) duties need not necessarily be limited to environmental management and may be an existing employee with appropriate qualifications.

INCIDENT REPORTING

3. Within 7 days of detecting an exceedance of the goals/limits/performance criteria in this approval or an incident causing (or threatening to cause) material harm to the environment, the Proponent shall report the exceedance/incident to the Department and any Relevant Agencies. This report must:
 - (a) describe the date, time, and nature of the exceedance/incident;
 - (b) identify the cause (or likely cause) of the exceedance/incident;
 - (c) describe what action has been taken to date; and
 - (d) describe the proposed measures to address the exceedance/incident.

ANNUAL REPORTING

4. Within 12 months of the date of this approval, and annually thereafter, the Proponent shall submit an AEMR to the Director-General, Relevant Agencies and CCC.

This report must:

- (a) identify the standards and performance measures that apply to the project;
- (b) describe the works carried out in the last 12 months;
- (c) describe the works that will be carried out in the next 12 months;
- (d) include a summary of the complaints received during the past year, and compare this to the complaints received in previous years;
- (e) include a summary of the monitoring results for the project during the past year;
- (f) include an analysis of these monitoring results against the relevant:
 - impact assessment criteria/limits;
 - monitoring results from previous years; and

- predictions in the EA;
 - (g) include an evaluation of the effectiveness of the environmental protection requirements and procedures in the AEMR;
 - (h) identify any trends in the monitoring results over the life of the project;
 - (i) identify any non-compliance during the previous year; and
 - (j) describe what actions were, or are being, taken to ensure compliance.
5. Within 12 months of the date of the commencement of the project, and every 3 years thereafter, unless the Director-General directs otherwise, the Proponent shall commission and pay the full cost of an Independent Environmental Audit of the project. This audit must:
- (a) be conducted by a suitably qualified, experienced, and independent person(s) whose appointment has been approved by the Director-General;
 - (b) include consultation with the Relevant Agencies;
 - (c) assess the environmental performance of the project, and its effects on the surrounding environment;
 - (d) assess whether the project is complying with the relevant standards, performance measures and statutory requirements;
 - (e) review the adequacy of any strategy/plan/program required under this approval; and, if necessary,
 - (f) recommend measures or actions to improve the environmental performance of the project, and/or any strategy/plan/program required under this approval.
- Note: The person(s) conducting the audit must have expertise in flora and fauna assessment as well as quarry rehabilitation.*
6. Within 1 month of completion of each Independent Environmental Audit, the Proponent shall submit a copy of the audit report to the Director-General, Relevant Agencies and CCC, with a response to any of the recommendations in the audit report.
7. Within 3 months of submitting a copy of the audit report to the Director-General, the Proponent shall review and if necessary revise:
- (a) each of the environmental management and monitoring strategies/plans/programs in Schedules 3 and 5; and
 - (b) the sum of the Landscape and Rehabilitation Bond (see Schedule 3). This review must consider:
 - the effects of inflation;
 - any changes to the total area of disturbance; and
 - the performance of the rehabilitation against the completion criteria of the Landscape and Rehabilitation Management Plan,
 to the satisfaction of the Director-General

COMMUNITY CONSULTATIVE COMMITTEE

8. Within 3 months of the date of this approval, the Proponent shall establish a Community Consultative Committee (CCC) for the project. The CCC shall:
- (a) be comprised of:
 - 2 representatives from the Proponent, one of which will be the Environmental Officer nominated under Condition 2A of Schedule 5;
 - representatives of both Kiama Council and Shoalhaven Council (if available);
 - 1 representative of the Gerroa Environment Protection Society (if available); and
 - at least 2 representatives from the local community, whose appointment has been approved by the Director-General;
 - (b) be chaired by an independent chairperson, whose appointment has been approved by the Director-General;
 - (c) meet at least twice a year, including one meeting shortly after submission of the AEMR under Condition 4 of Schedule 5;
 - (d) review the Proponent's performance with respect to environmental management and community relations;
 - (e) undertake regular inspections of the quarry operations;
 - (f) review community concerns or complaints about the quarry operations, and the Proponent's complaints handling procedures; and
 - (g) provide advice to:
 - the Proponent on improved environmental management and community relations, including the provision of information to the community and the identification of community initiatives to which the Proponent could contribute;
 - the Department regarding the conditions of this approval; and
 - the general community on the performance of the quarry with respect to environmental management and community relations.

Notes:



- *The CCC is an advisory committee. The Department and other Relevant Agencies are responsible for ensuring that the Proponent complies with this approval.*
- *The membership of the CCC should be reviewed on a regular basis (every 3 years).*
- *If possible, an alternate member should be appointed for each of the representatives from the local community.*

9. At its own expense, the Proponent shall:
- ensure that 2 of its representatives attend CCC meetings;
 - provide the CCC with regular information on the environmental performance of the project, including a copy of the AEMR;
 - provide meeting facilities for the CCC;
 - arrange site inspections for the CCC, if necessary;
 - respond to any advice or recommendations the CCC may have in relation to the environmental management or community relations;
 - take minutes of the CCC meetings; and
 - forward a copy of these minutes to the Director-General, and put a copy of these minutes on its website.

ACCESS TO INFORMATION

10. Within 1 month of the approval of any plan/strategy/program required under this approval (or any subsequent revision of these plans/strategies/programs), or the completion of the audits or AEMR required under this approval, the Proponent shall:
- provide a copy of the relevant document/s to the Relevant Agencies and the CCC; and
 - ensure that a copy of the relevant document/s is made publicly available on its website and at the quarry.
11. During the project, the Proponent shall:
- make a summary of monitoring results required under this approval publicly available on its website and at the quarry; and
 - update these results on a regular basis (at least every 3 months).

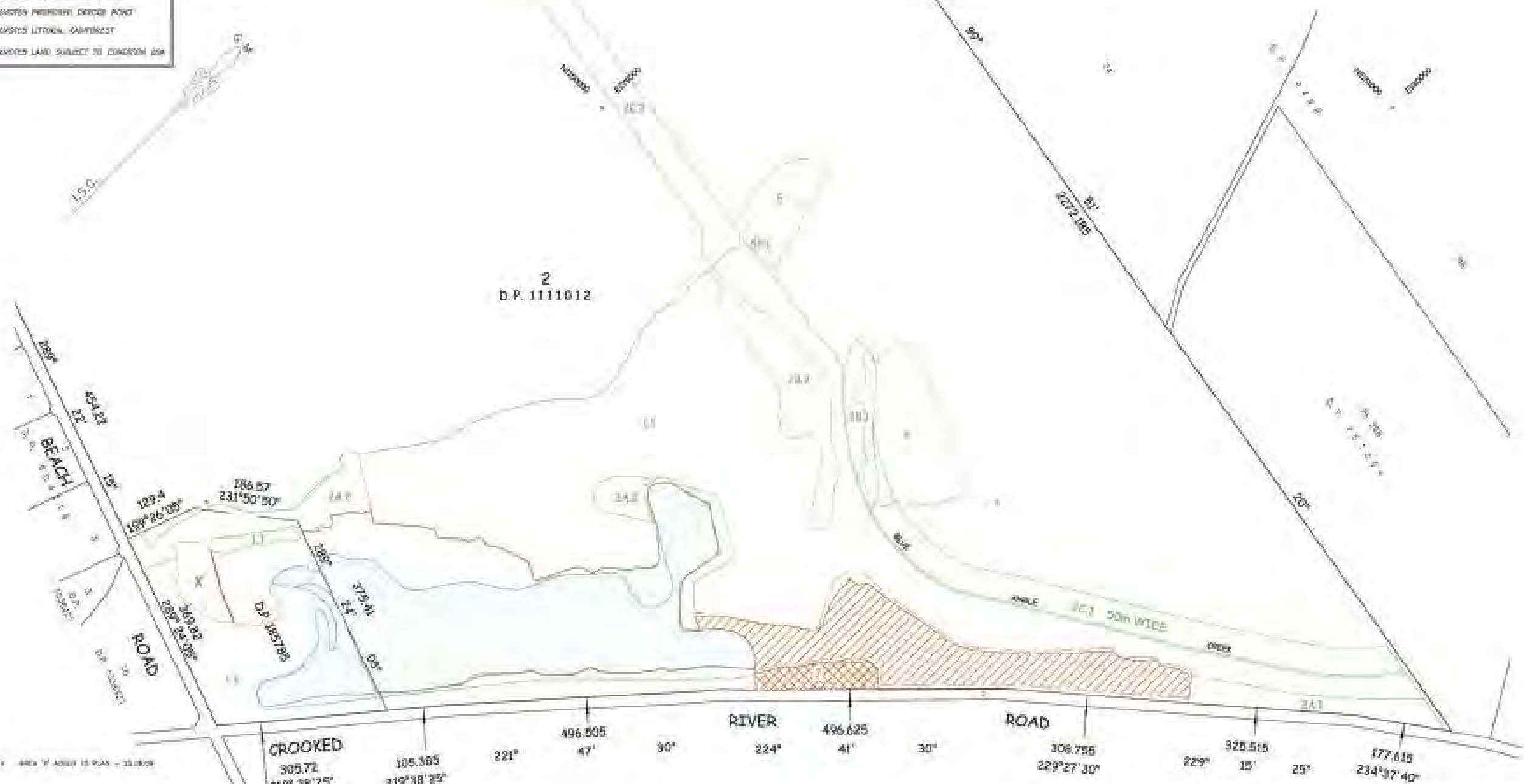


APPENDIX 1
VEGETATION MANAGEMENT AREAS AND SITE PLAN

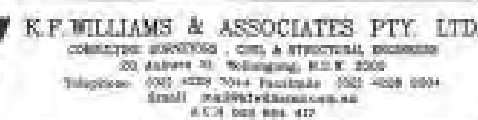


APPENDIX 1
VEGETATION MANAGEMENT AREAS AND SITE PLAN





No	Description	Rate
1	Assessment to state planning	27.50.00
2	Assessment to state planning areas 1 and 2	28.00.00
3	Assessment to southern area	30.00.00
4	Assessment to southern area	30.00.00
5	Assessment to southern area	30.00.00



VEGETATION MANAGEMENT AREAS
AND SITE PLAN
GERROA SAND MINE

200-90 KF106198 100-10 106198/308 100-10 106198/308	100-10 106198/308 100-10 106198/308
--	---

APPENDIX 2 STATEMENT OF COMMITMENTS

- 1) Undertake the extension of the Gerroa sand quarry in a manner consistent with the Environmental Assessment and Statement of Commitments;
- 2) Comply with obligations under any Act;
- 3) Update the Environmental Management Plan (EMP) for the site to include all relevant matters contained in the Environmental Assessment and any requirements emanating from the Land and Environment Court for the project;
- 4) Operate the sand quarry within the requirements of the EMP as updated in 3) above (Note: the existing EMP embraces the requirements of the existing development consent with regard to such matters as environmental management, monitoring, auditing, reporting and community consultation. These requirements will be retained except where superseded in the approval for the current application).
- 5) Survey and mark at regular intervals the approved boundary of the proposed extension and ensure that all activities associated with sand extraction other than rehabilitation or approved mitigation works remain within the marked area;
- 6) Maintain annual production within an upper limit of 80,000 tonnes per year;
- 7) Progressively rehabilitate all areas disturbed by the sand mining operations in accordance with the Environmental Assessment and the EMP;
- 8) Protect from disturbance and maintain existing native vegetation around the periphery of the sand quarry;
- 9) Undertake compensatory planting in the locations identified in the Environmental Assessment and nurture the vegetation and created habitat to maturity in accordance with the Landscape and Rehabilitation Management Plan, to be incorporated in the EMP;
- 10) Protect from disturbance Area A (shown on the figure in Appendix 6), of significance for potential Aboriginal relics;
- 11) Arrange for targeted salvage excavations for Aboriginal artefacts to take place as recommended by Navin Officer and to include the shell midden deposit situated at the South Western corner of the extraction area prior to mining occurring in the nominated locations (shown on the figure in Appendix 8);
- 12) Prior to extending workings into any part of the extension, ensure that a screen of vegetation, with or without bunding, effectively prevents viewing of the land to be disturbed from any publicly accessible locations;
- 13) Ensure that the requirements of the acid sulphate soils management plan are incorporated in the EMP and implemented where indicated to prevent degeneration of water quality in the dredge pond and in groundwater;
- 14) Include a section on fish management in the dredge pond in the revised EMP for the site;
- 15) Forward annual production data to the Department of Primary Industries;
- 16) Prior to finalising the revised EMP, forward a draft to DECC for comment;
- 17)
 - a. In surveying the boundary of the extraction area (see 5 above) include a minimum of 5 metres buffer to protect vegetation;
 - b. The external areas of the vegetation shall be fenced so as to exclude access by any farm animals to the satisfaction of the Director-General.
- 18) include a requirement to monitor compliance with the approved boundary in the revised EMP;
- 19) Revegetate and maintain the buffer area in conjunction with adjoining vegetation, except where the buffer is used for access;
- 20) Update the groundwater monitoring program in the revised EMP;
- 21) include a tree clearance protocol in the revised EMP incorporating pre-clearing inspection for koalas;
- 22) incorporate in the revised EMP a standard of revegetation to be achieved to the north and south of the extraction area before the existing east-west link can be severed. Do not completely remove the existing link until a qualified ecologist has confirmed that the required standard of revegetation has been achieved including the establishment of 60% of the plants species representative of the plant communities in the quarry area and in accordance with Appendix 8;
- 23) Include a revegetation monitoring program in the revised EMP to include all areas being revegetated as part of the project;
- 24) Define the compensatory vegetation land by survey and include an appropriate plan in the EMP;



- 25) include a detailed site rehabilitation program in the EMP addressing the matters listed in item 5a) of the submission from DECC dated 22 December 2008 (and shown in Appendix 8).
- 26) Maintain ongoing consultation with the Aboriginal community including notification of approvals and requirements that relate to Aboriginal heritage with an invitation to contribute to any heritage management activities.
- 27) Submit updated site information to DECC's AHIMS register when archaeological salvage is complete.
- 28) Include in the revised EMP, reference to protection of Aboriginal heritage items located in Area A as part of management of that land and consult the Aboriginal community in developing and implementing the management protocols.
- 29) Should any sand mining impacts occur within Area A, consult DECC and the Aboriginal community as soon as possible in developing an appropriate response.
- 30) Investigate and if practicable, install "clacker" reversing alarms on mobile plant within the sand quarry site.



APPENDIX 3
COMPENSATORY PLANTING



DO NOT SCALE



Image © 2008 DigitalGlobe
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REVISIONS	DESCRIPTION	DATE	BY	APP.
1	ISSUED FOR TENDERS	8-3-08	SA	
2	REVISED FOR TENDERS	10-3-08	SA	
3	REVISED FOR TENDERS	21-3-08	SA	
4	REVISED FOR TENDERS	22-3-08	SA	
5	REVISED FOR TENDERS	23-3-08	SA	

Rev F Amendments to zone numbering - 27.03.08
Rev G Amendments to zone numbering - 29.03.08
Rev H East-West Link zone added - 29.03.08
Rev I OUTCROP ADDED TO EAST-WEST LINK & NORTHERN CORRIDOR
OUTCROP, SOUTHERN AREA ADDED - 18.03.08
Rev J Southern AREA ADDED - 18.03.08
Rev C Southern AREA ADDED - 23.03.08
Rev E-1 Southern AREA ADDED - 23.03.08



K.F. WILLIAMS & ASSOCIATES PTY. LTD.
CONSULTING SURVEYORS, CIVIL & STRUCTURAL ENGINEERS & PLANNERS
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Telephone: (02) 42207044 - Facsimile: (02) 42207044
Email: info@kfwilliams.com.au - Web: www.kfwilliams.com.au
A.C.N. 605 854 417

DATE: 8-3-08
DESIGN: SA
CHECK: SA
APPROVED: SA
SCALE: 1:10000 POINT SCALE ONLY

**PLAN SHOWING MANAGEMENT ZONES
GERROA SAND MINE**

SHEET 1 OF 1

COMPENSATORY PLANTING

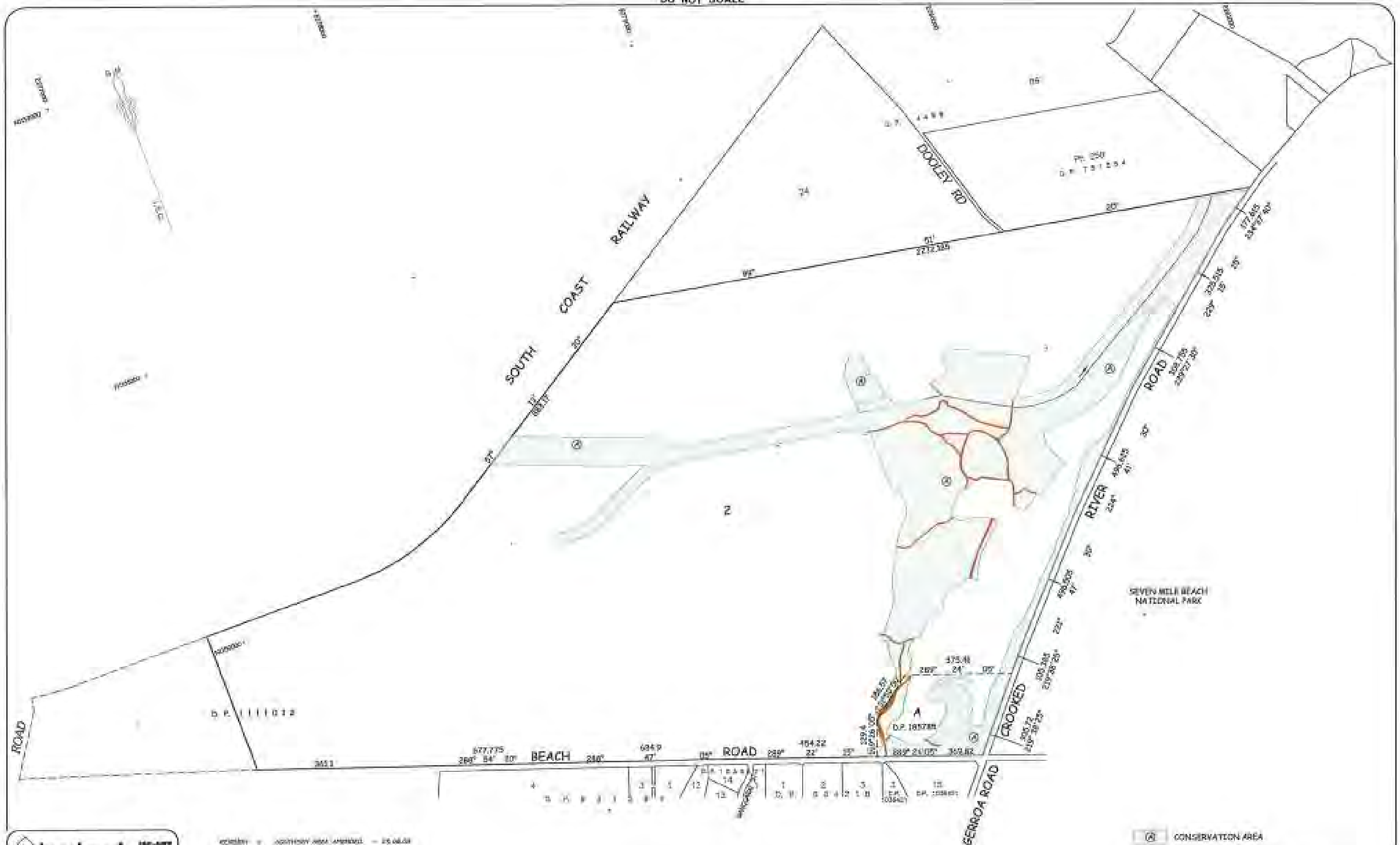
PROJECT NO:	KF108198
DRAWN BY:	6198/308
CHECKED BY:	
DATE:	

A3

APPENDIX 4
VEGETATION CONSERVATION AREA



DO NOT SCALE



CONSERVATION AREA APPROVED - 25 JUL 08

W44050

- ② CONSERVATION AREA
- DENOTES EXISTING ACCESS TRACES IN USE
- DENOTES 'BLUE ANGLE CREEK'

REVISIONS	DESCRIPTION	DATE	APP	BY
A	Issue 1/2008	01-01-08		
B	Outline	12-01-08		
C	Conservation Area	12-01-08		
D	Conservation Area	12-01-08		
E	Final 1/2008	12-01-08		

REVISIONS	DESCRIPTION	DATE	APP	BY
F	Final 1/2008	12-01-08		
G	Conservation Area	12-01-08		
H	Conservation Area	12-01-08		
I	Final 1/2008	12-01-08		

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REVISIONS	DATE	APP	BY
A	12-01-08		
B	12-01-08		
C	12-01-08		
D	12-01-08		
E	12-01-08		

PLAN OF PROPOSED CONSERVATION AREA OVER LOT A DP 185785 & PT. LOT 2 DP 1111012 BERRY'S BEACH & CROOKED RIVER RDS GERROA	DATE: 12-01-08	APP: 12-01-08	BY: 12-01-08
VEGETATION CONSERVATION AREA	12-01-08	12-01-08	12-01-08
106198/507	106198/507	106198/507	106198/507
106198/507	106198/507	106198/507	106198/507

APPENDIX 5 REHABILITATION OBJECTIVES

The objectives of site rehabilitation are as follows:

- after the conclusion of sand mining, leave the site free from all sand mining artefacts including machinery, structures, buildings, signage, products and roads, except as required for rural purposes;
- create safe and stable landforms with a natural appearance designed for low maintenance;
- establish indigenous vegetation on all land areas disturbed by the sand quarry to create wildlife habitat including wetland habitat within and around the shoreline of the dredge pond;
- nurture to maturity vegetation screens and compensatory planting established during the sand mining operation;
- control weed growth within the rehabilitation areas and compensatory planting areas;
- retain a minimum of access tracks for maintenance or as required for ongoing rural use of the property;
- progressively rehabilitate sections of the site when they are no longer required for operations to minimise the extent of work remaining when extraction ceases; and
- continue rehabilitation beyond closure of the sand mine until these objectives have been achieved.



**APPENDIX 6
SPECIES LIST**



APPENDIX 6

PLANT LIST FOR LITTORAL RAINFOREST VEGETATION TO BE REMOVED

Tall Canopy Trees

Banksia integrifolia C
Eucalyptus botryoides C
Eucalyptus pilularis C

"Rainforest Species" (11 species)

Middle Canopy Trees (individual counts)

Clerodendrum tomentosum (3 plants)
Endiandra sieberi (1 plant)
Glochidion ferdinandi (110 plants)

Understorey

Acronychia oblongifolia R
Breynia oblongifolia U
Cayratia clematidea U
Clerodendrum tomentosum R
Eustrephus latifolius R
Ficus obliqua R
Marsdenia rostrata R
Pittosporum revolutum U
Pyrosia rupestris R

Other species (14 native species)

Acacia maidenii VC
Billardiera scandens R
Commelina cyanea C
Desmodium varians R
Dichondra repens U
Hibbertia scandens R
Imperata cylindrica U
Lomandra longifolia VC
Oplismenus imbecillis VC
Pteridium esculentum U
Rubus parvifolius R
Stephania japonica R
Themeda australis U
Viola hederacea U
**Lantana camara* VC

Subjective assessment of abundance: VC – very common, C – common, U – uncommon, R – rare

NATIVE PLANT LIST FOR AREA OF BANGALAY SAND FOREST TO BE REMOVED

Acacia binervata
Acacia longifolia
Acacia maidenii
Angophora floribunda
Banksia integrifolia
Breynia oblongifolia
Carex longibrachiata
Cayratia clematidea
Clerodendrum tomentosum
Commelina cyanea
Cynodon dactylon
Desmodium varians
Dianella caerulea
Dichelachne crinita
Dichondra repens
Echinopogon caespitosus
Eragrostis leptostachya
Eucalyptus botryoides
Eucalyptus pilularis
Geranium solanderi
Glochidion ferdinandi
Glycine sp.
Hibbertia scandens
Imperata cylindrica
Isolepis nodosa
Kennedia rubicunda
Lomandra longifolia
Microlaena stipoides
Monotoca elliptica
Opfismenus aemulus
Opfismenus imbecillis
Oxalis exilis
Pteridium esculentum
Rubus parvifolius
Stephania japonica
Themeda australis



**APPENDIX 7
DECC LETTER**



In addition, we would also appreciate being provided a copy of the draft Director General's Environmental Assessment report and associated conditions for perusal to ensure the above matters have been addressed. This is because we consider them essential for the development as well as ensuring DEC's effective ongoing regulation of the premises should Approval be granted.

The site is currently licenced for Dredging Works under the Protection of the Environment Operations (POEO) Act 1997 (Environment Protection Licence (EPL) No 4145). This licence may require amendments if development approval is granted. Should the Minister of DoP decide to grant approval the proponent may need to make a separate application to DEC to vary the EPL under the POEO Act 1997 for the proposed extension prior to any construction or operational works commencing on site.

There are also some conditions on the existing EPL which will also relate to the proposed development. These conditions will not be subject to variation, however to ensure that any approval is consistent with the existing licence, DoP should consider these conditions when drafting any approval conditions.

If necessary we would be able to meet at a suitably convenient time with DoP and the proponent to clarify any of the comments provided above and outlined in our attachment.

If you have any questions, or wish to discuss this matter further please contact Paul Weame on 4224 4100.

Yours sincerely



PETER BLOEM
A/Manager Iliwera
Environment Protection and Regulation

22/12/06

Att:

(N:\Part 3A\Draft\Proposed Cleary Bros Sand Quarry (Banco.dwg)



ATTACHMENT 1

The Department of Environment and Conservation (DEC) considers that the draft Statement of Commitments (SOC) detailed in the Environmental Assessment (EA) should be adopted in the development of any proposed approval conditions. In addition, we have also provided the following additional comments and SOC to address issues that have arisen during DEC's assessment of the development.

For the purpose of these comments the following terms have been adopted:

- **Conservation area** This is defined in the EA and refers to the area to the east of the site consisting of *Littoral Rainforest* and significant Aboriginal cultural heritage values including Area A.
- **Compensatory package** This refers to the overall conservation measures for the site including areas of remnant *Endangered Ecological Community (EEC)* such as *Swamp Sclerophyll Forest*, *Bangalay Sand Forest*, *Littoral Rainforest* and *Swamp Oak Floodplain Forest*. It also includes the conservation area and areas of rehabilitation and replanting at the site (the exact area of this package is yet to be defined).

BIODIVERSITY CONSERVATION

1. Boundary of Extension Area

The footprint of the proposed extension area borders the conservation area and a remnant of *Swamp Sclerophyll Forest* which is an EEC. To avoid any potential adverse impacts to these areas we recommend that an adequate separation distance is maintained from the dredging activities/mine operations. DEC considers it crucial that the edge around these sensitive areas is managed to avoid such impacts. To address this issue we recommend the following additional SOCs:

- a) *The boundary of the extension area must be clearly defined in consultation with a fully qualified ecologist prior to the commencement of any construction works to ensure that an adequate buffer distance is maintained from the dredging activities/ mine operations to the conservation area and Swamp Sclerophyll Forest.*

All dredging activities and associated mine operations must remain within the defined boundary.

A monitoring program must be developed and documented in the QEMP to demonstrate that the defined boundary of the extension area is maintained and not compromised during operations.

- b) *The buffer area should be revegetated with appropriate native species and should be subject to a vegetation management plan for inclusion in the QEMP for its long term restoration and management.*

2. Hydrology

DEC considers the remnant of *Swamp Sclerophyll Forest* adjoining the proposed extension area is regionally important. *Swamp Sclerophyll Forest* is reliant upon a particular hydrology as defined in the Scientific Determination to exist. Information provided to DEC by the proponent and their ecological consultants during the exhibition process state that current sand mining process have had no significant effect on the ground water quality or level. In addition the current mine has had no significant impact on the adjoining vegetation health and its composition. On the basis of this information, the proposal is unlikely to have a significant impact on this EEC. However to properly validate these conclusions we recommend the development and implementation of a groundwater monitoring program linked to an ecological assessment of the adjoining *Swamp Sclerophyll Forest*.





We recommend the following additional SOC:

- a) *The proponent must develop and implement a groundwater monitoring program as part of the QEMP to demonstrate that dredging activities and associated mine operations will not result in any actual or potential impacts to ground waters and the Swamp Sclerophyll Forest. DEC must be consulted in the development of the plan.*

3. **Fauna habitat and movement, the East-West link**

The proposed sand quarry will sever an east-west link between Seven Mile Beach National Park and a remnant of Swamp Sclerophyll Forest which is situated on Cleary Bros land. This link is likely to be used by fauna as habitat and to move between the two areas. The importance of this linkage has also been highlighted by the recent (unconfirmed) sighting of a Koala in the local area.

The proponent has proposed to compensate for the severing of the east west link with revegetation of a link to the north and south of the proposed footprint which would enable fauna to move between the National Park and the remnant.

In relation to the koala, information provided in the EA indicates that there are some feed trees to the west and east of the site. While information held by DEC revealed that there has been no recorded sightings of koalas in the adjoining Seven Mile Beach National Park, nor has DEC undertaken any survey work for this species, DEC considers that the re-establishment of linkages to the north and south of the site important elements for the project in regards to fauna movement and to act as compensatory habitat. In relation to the southern area this would involve continuation of current rehabilitation activities.

The above measures, however, are dependant on the success of planting a highly modified and cleared area in the north of the site and the period of time it would take for this area to become established. In response to this issue, DEC requested the company provide information on an existing rehabilitated area planted in approximately 1993 located in the northern section of the current east west link in order to evaluate its success. A review of this information which included vegetation survey and site inspection revealed that the site was successfully regenerating.

The company has indicated that this should also be the case to the north of the site and that a replanted area should be able to act as a fauna habitat, and thus a suitable compensatory fauna corridor. In this regard we recommend that the complete removal of the east west link should not occur until the northern and southern vegetated areas have been successfully established.

The submitted information also indicated that the existing-link consisted mainly of Blackbutt trees containing very few hollows, however the site does contain a number of large Bangalay trees. Bangalay trees are known to contain large hollows and a higher concentration of hollows which provide potential for fauna habitat. The proposal includes removal of some Bangalay trees. To minimise impact to fauna during the removal of any potential habitat trees we recommend the development of a *Tree Clearance Protocol* as part of the QEMP. The aim of this measure is to reduce the direct impacts to any tree dwelling fauna species during the construction phase.

To address the above issues we recommend the following SOCs:

- a) *A Tree Clearance Protocol must be developed by a suitably qualified person as part of the QEMP to reduce any direct impacts to any tree dwelling Threatened Species or arboreal mammals during the construction phase. The DEC must be consulted in the preparation of this protocol.*



- b) *The northern and southern rehabilitation areas must be established for fauna movement to the satisfaction of DEC before the East West link is severed.*
- c) *The northern and southern revegetation areas must be monitored for regeneration success as per the QEMP. The DEC must be consulted in the preparation of this monitoring program.*

4. **Compensatory package**

The original proposed compensatory package in the EA did not fully satisfy DEC guidelines. Recent discussions between DEC, Cleary Bros and their ecological consultants have revealed that the Swamp Sclerophyll Forest remnant will now be included as part of the compensatory package. The DEC considers this remnant as regionally significant and as such an appropriate offset for inclusion in the compensatory package. A subsequent report received from Perram and Partners on 13 December 2000 confirms the remnant is to be included in the compensatory package. However the long term security of this remnant and other areas covered by the compensatory package is a major issue and is yet to be resolved. In this regard we recommend the following SOCs:

- a) *Documentation must be developed defining both the area to be included in the compensatory package and associated management strategies for their protection.*
- b) *The areas covered by the compensatory package must be secured for long term conservation prior to operations commencing through a means agreed to by the DoP Cleary Bros and DEC.*
- c) *Any future development of the land must not compromise the compensatory package for this proposal.*

5. **Site Rehabilitation and End of Mine uses**

DEC understands that Cleary Bros have numerous options for end of mine uses including a proposed golf course and tourist development. There is the potential that these proposals together with the proposed sand quarry could have cumulative impacts on the environment. For this reason any end of mine uses must ensure any areas included in the compensatory package are protected.

While end of mine uses is an important consideration, DEC appreciates that a final land use may not yet be determined. Inexpensive DEC considers that rehabilitation should be staged to manage not only exposed areas of the site which contribute to wind blown dust emissions and polluted stormwater runoff, but also to contribute towards progressive revegetation over the life of the quarry. We also consider that opportunities exist as part of staged rehabilitation to implement programs to increase biodiversity values of the land such as the construction of shallow areas within and surrounding the edge of the pond to promote habitat for fauna such as wading birds. While a SOC has been recommended for progressive rehabilitation in accordance with the QEMP we recommend the following additional SOC to assist in guiding the development of this plan.

- a) *A site rehabilitation program must be developed by a suitably qualified person and documented as part of the QEMP. The DEC must be consulted in the preparation of this program. The plan must:*
 - (i) *incorporate staged rehabilitation of the extraction area based on best practice and appropriate guiding principles at the time of rehabilitation;*
 - (ii) *be consistent with the Department of Primary Industries - Mineral Resources Rehabilitation and Mine Closure Environmental Policy Implementation Principles*
 - (iii) *detail practices that protect surface and groundwater from pollution*



- (iv) detail practices that maintain or improves biodiversity so there is no net impact on threatened species or native vegetation
- (v) detail practices that protect places, objects and features of significance to Aboriginal people
- (vi) outline performance criteria/points/principles for staged rehabilitation during the life of the quarry and post mining.

ABORIGINAL CULTURAL HERITAGE

6. Review of Aboriginal Cultural Heritage Assessment

The site has important and significant aboriginal cultural heritage values. The proposal involves the mining of the dune crest which contains aboriginal cultural heritage items comprised mainly of shell (pipi) midden and stone artefacts.

DEC has engaged in discussions with DoP, Cleary Bros and heritage consultants on numerous occasions in regards to the aboriginal cultural heritage values of the site. DEC also visited the site on 8 December 2006 with Cleary Bros and Navin Officer Heritage Consultants to assess and discuss the Aboriginal cultural heritage values. The EA states that the Jerrinja Local Aboriginal Land Council and Jerrinja Consultants have been consulted in regards to the development. Local Aboriginal representatives were also on site during the archaeological subsurface testing program.

Previous reports have identified Area A and Area B as areas of archaeological significance (Paton 1992), as shown in Figure 5.4 of the EA. These areas have been reassessed as part of this current proposal. In the original report by Paton the locations of Area A and Area B were sketched, however, precise grid references were not given. Cleary Bros had surveyors plot their locations based on Paton's descriptions (Navin Officer para. comm.) and as such their locations may not be exact. Reassessment of these areas (Navin Officer 2006) have concluded that there was no material of archaeological significance in Area B, and as such it is likely that mining the proposed area of Area B will have minimal impact on Aboriginal cultural heritage values. Cleary Bros proposed to remove the conservation status for Area B to allow mining to occur in that area. They also propose that Area A be extended to include more of the dune crest and that this area be conserved through a long term agreement.

The proposed sand mining will destroy the pipi midden and any other objects of Aboriginal cultural heritage significance present on the dune, further reducing their occurrence within the Seven Mile Beach area. DEC considers these Aboriginal cultural heritage items significant both locally and regionally. In this regard we recommend that a suitable compensation strategy is developed to mitigate against the loss of Aboriginal cultural heritage in addition to the proposed archaeological salvage and conservation of Area A. This compensation strategy should be prepared in consultation with DEC, the DoP, the local Aboriginal community and Cleary Bros. In this regard we recommend that the following additional SOG be added:

- a) The compensation strategy for the mining of areas containing Aboriginal cultural heritage objects must be negotiated prior to operations commencing to the satisfaction of DEC, the DoP, the local aboriginal community and Cleary Bros.
- b) The recommendations provided in the report by Navin Officer Heritage Consultants in Appendix L of the Environmental Assessment must be followed.
- c) The compensatory package must include the area labelled 'Area A' in figure 5.4 of the EA and must be secured for long term conservation prior to operations commencing through a means agreed on by DEC, the DoP and Cleary Bros.
- d) DEC be consulted regarding the research design for the archaeological salvage work that is to be undertaken prior to further sand mining.

- e) *Consultation with the Aboriginal community should be ongoing. The Aboriginal community must be provided with notification of development approvals and requirements as they relate to Aboriginal heritage and be invited to contribute to any further heritage management activities including the archaeological salvage and management of Area A.*
- f) *Once the archaeological salvage is complete, DEC's AHIMS register must be provided with updated site information.*
- g) *As per the Navin Officer report, the protocol for Human Skeletal Remains must be followed.*

The section identified as 'Area A' in Figure 5.4 of the EA has been identified to conserve some of the cultural heritage and threatened species values on site. It is understood that weed eradication and other rehabilitation works will occur in this area. Due to the aboriginal cultural heritage values of Area A the DEC consider it important that any disruption to the area is minimised. In this regard we recommend the following additional SOCs be added:

- h) *The Environmental Management Plan that is to be developed for conservation Area A must include consideration for the protection of Aboriginal heritage items within that area. The management plan should be developed in consultation with the Aboriginal community (Jerrinja LALC and Jerrinja Consultants) and a suitably qualified archaeologist.*
- i) *Any vegetation clearing or other maintenance works within Area A must be undertaken in consultation with the local Aboriginal community.*
- j) *Should any impacts occur within Area A as a result of sand mining related activities (such as erosion impacts) DEC and the Aboriginal community must be advised immediately so as to develop an appropriate strategy to minimise impacts.*



**APPENDIX 8
ARCHAEOLOGICAL AREAS**





Figure 5.4 Archaeological Areas

APPENDIX 9
INDEPENDENT DISPUTE RESOLUTION PROCESS



APPENDIX B
INDEPENDENT DISPUTE RESOLUTION PROCESS

**Independent Dispute Resolution Process
(Indicative only)**

Matter referred to Independent Dispute Facilitator appointed
by the Department in consultation with Council

Independent Dispute Facilitator meets with parties
discuss dispute

Dispute resolved

Dispute not resolved

Facilitator consults relevant
independent experts for
advice on technical issues

Facilitator meets with relevant
parties and experts

Dispute resolved

Dispute not resolved

Facilitator consults the
Department and
final decision made

Agreed Outcome



Appendix B

ENVIRONMENTAL PROTECTION LICENCE 4146

Environment Protection Licence

Licence - 4146



Licence Details	
Number:	4146
Anniversary Date:	01-February

Licensee	
CLEARY BROS (BOMBO) PTY LTD	
PO BOX 210	
PORT KEMBLA NSW 2505	

Premises	
SOUTHERN EXTRACTION AREA	
BERRY BEACH ROAD	
GERROA NSW 2534	

Scheduled Activity	
Extractive Activities	

Fee Based Activity	Scale
Water-based extractive activity	> 50000-100000 m3 extracted

Region	
Metropolitan - Illawarra	
Level 3, NSW Govt Offices, 84 Crown Street	
WOLLONGONG NSW 2500	
Phone: (02) 4224 4100	
Fax: (02) 4224 4110	
PO Box 513 WOLLONGONG EAST	
NSW 2520	

Environment Protection Licence

Licence - 4146



INFORMATION ABOUT THIS LICENCE	3
Dictionary	3
Responsibilities of licensee	3
Duration of licence	3
Licence review	3
Fees and annual return to be sent to the EPA	3
Transfer of licence	4
Public register and access to monitoring data	4
1 ADMINISTRATIVE CONDITIONS	5
A1 What the licence authorises and regulates	5
A2 Premises or plant to which this licence applies	5
A3 Information supplied to the EPA	5
2 DISCHARGES TO AIR AND WATER AND APPLICATIONS TO LAND	5
P1 Location of monitoring/discharge points and areas	5
3 LIMIT CONDITIONS	6
L1 Pollution of waters	6
4 OPERATING CONDITIONS	6
O1 Activities must be carried out in a competent manner	6
O2 Maintenance of plant and equipment	6
5 MONITORING AND RECORDING CONDITIONS	6
M1 Monitoring records	6
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M3 Telephone complaints line	7
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G1 Copy of licence kept at the premises or plant	9
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General Dictionary	11

Environment Protection Licence

Licence - 4146



Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act); and
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

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The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

CLEARY BROS (BOMBO) PTY LTD
PO BOX 210
PORT KEMBLA NSW 2505

subject to the conditions which follow.

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1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Extractive Activities	Water-based extractive activity	> 50000 - 100000 m3 extracted

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
SOUTHERN EXTRACTION AREA
BERRY BEACH ROAD
GERROA
NSW 2534
THE AREA BORDERED IN BROWN ON THE MAP TITLED "GERROA SAND RESOURCE" DATED 7/12/11 AND HELD ON EPA FILE 281283A8.

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:

- a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
- b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

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- P1.1 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.
- P1.2 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1		Discharge to waters	The end of the "Overflow Pipe" from the dredge pond as labelled on the map titled "Gerroa Sand Resource" dated 7/12/11 and held on EPA file 281283A8.

3 Limit Conditions

L1 Pollution of waters

- L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

- O1.1 Licensed activities must be carried out in a competent manner.
This includes:
- a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
 - b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

- O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
- a) must be maintained in a proper and efficient condition; and
 - b) must be operated in a proper and efficient manner.

5 Monitoring and Recording Conditions

M1 Monitoring records

- M1.1 The results of any monitoring required to be conducted by this licence or a load calculation

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protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:

- a) in a legible form, or in a form that can readily be reduced to a legible form;
- b) kept for at least 4 years after the monitoring or event to which they relate took place; and
- c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:

- a) the date(s) on which the sample was taken;
- b) the time(s) at which the sample was collected;
- c) the point at which the sample was taken; and
- d) the name of the person who collected the sample.

M2 Recording of pollution complaints

M2.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M2.2 The record must include details of the following:

- a) the date and time of the complaint;
- b) the method by which the complaint was made;
- c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
- d) the nature of the complaint;
- e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
- f) if no action was taken by the licensee, the reasons why no action was taken.

M2.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M2.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M3 Telephone complaints line

M3.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M3.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M3.3 The preceding two conditions do not apply until 3 months after:

- a) the date of the issue of this licence or
- b) if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

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6 Reporting Conditions

R1 Annual return documents

- R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
- a) a Statement of Compliance; and
 - b) a Monitoring and Complaints Summary.
- At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.
- R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.
- R1.3 Where this licence is transferred from the licensee to a new licensee:
- a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
 - b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.
- R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
- a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
 - b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.
- R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').
- R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.
- R1.7 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
- a) the licence holder; or
 - b) by a person approved in writing by the EPA to sign on behalf of the licence holder.
- R1.8 A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

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R2 Notification of environmental harm

- R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.
- R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

- R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
- a) where this licence applies to premises, an event has occurred at the premises; or
 - b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
- and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.
- R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.
- R3.3 The request may require a report which includes any or all of the following information:
- a) the cause, time and duration of the event;
 - b) the type, volume and concentration of every pollutant discharged as a result of the event;
 - c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
 - d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
 - e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
 - f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
 - g) any other relevant matters.
- R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

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- G1.1 A copy of this licence must be kept at the premises to which the licence applies.
- G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.
- G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

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Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .

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TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non - putrescible), special waste or hazardous waste

Ms Nadia Kanhoush

Environment Protection Authority

(By Delegation)

Date of this edition: 22-August-2000

End Notes	
1	Licence varied by notice 1019326, issued on 25-Jul-2002, which came into effect on 19-Aug-2002.
2	Licence varied by change to DEC Region allocation, issued on 17-Mar-2006, which came into effect on 17-Mar-2006.
3	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>
4	Licence varied by legislative change to Sched. Act. name, issued on 28-Apr-2008, which came into effect on 28-Apr-2008.
5	Licence varied by notice 1502807 issued on 09-Dec-2011

Appendix C

EROSION AND SEDIMENT CONTROL PLAN

EROSION AND SEDIMENT CONTROL PLAN

1. Introduction

At the commencement of operations in the quarry extension area, all of the disturbed land within the boundary of the sand quarry drains towards the dredge pond. The dredge pond receives any rainfall runoff from disturbed areas and acts as a large settling basin.

Land currently disturbed by sand extraction is bordered on its eastern side by higher ground and on its western side by a flood bund, constructed to a height of 3.2 metres AHD to keep external flood water out. The flood bund has the secondary effect of retaining any runoff from disturbed areas within the sand quarry.

As sand mining progresses into the extension area, it will pass through an elevated forested dune area and then enter an area of lower altitude, partly cleared with scattered trees. A new section of flood bund will be required on the western side of this lower area where levels drop below 3.2 metres AHD. Further north from this section the site is grassland with a western boundary above the 3.2 m AHD level. To the west of the extraction area the land slopes away to the property's main drainage channel, which leads to Blue Angle Creek.

Having regard to the unique circumstances of the sand quarry, the potential risk of erosion and sedimentation that is addressed in this plan is as follows:

- ❑ erosion during mining operations caused by wind, vehicle movement, rainfall or wave action;
- ❑ sediment movement from unmined dunes during initial disturbance for clearing and topsoil stripping;
- ❑ sediment movement from the western side of the extension area downslope towards the main channel; and
- ❑ erosion of final batters both within the foreshore zone and in the dry zone above.

The above risks are addressed in the following sections

2. Erosion Control during Sand Mining

While the site is functioning as a sand quarry, procedures to be observed to control erosion include:

- ❑ internal roadways and the loading area are to be kept moist when in use to minimise erosion initiated by vehicles;
- ❑ activities involving disturbance to dry sand will cease during periods of high wind when there is visible evidence of material escaping to the wind as a result of mobilisation by machinery;

- ❑ topsoil stockpiles will be stabilised (seeded or mulched) unless the topsoil is to be used for rehabilitation within two weeks of stockpiling;
- ❑ prior to sand removal, clean water cutoff drains shall be installed above any cut batter location where there is potential for external rainfall runoff to flow down the batter towards the dredge pond. The purpose of the drain is to protect the cut batter from rilling and slumping which might reduce the width of buffer to the adjoining vegetation.
- ❑ the rate of sand mining will be controlled to match product dispatch to avoid accumulating excessive stockpiles;
- ❑ each section of the dredge pond foreshore will be backfilled to a stable landform as soon as possible after sand has been extracted from that section;
- ❑ finished surfaces will be stabilised as soon as possible following shaping to minimise exposure to erosion;
- ❑ completed sections of the dredge pond foreshore and batters are to be inspected at least quarterly and any erosion damage repaired; and
- ❑ cut off drains are to be inspected and maintained at least quarterly.

3. Sediment Control during Sand Mining

3.1 Clearing and Topsoil Stripping

Prior to any disturbance for clearing or topsoil stripping, silt stop fencing will be installed across any aspect of the worksite where there is a slope away from the dredge pond. The fencing is to be installed as shown in Figure 1.

If it is likely the fencing will remain in place for the duration of sand mining, it should be installed on the boundary fence where it will not be in the way of operations. Fencing is not needed on any slope leading into the working area of the dredge pond as any sediment movement in that direction will be collected by the dredge.

3.2 Boundary Protection

Parts of the western side of the extension area slope downwards through Swamp Sclerophyll Forest to the main drainage channel. To ensure that there is no sediment movement off the western side of the site, silt stop fencing will be installed along the boundary wherever disturbed land adjoins a slope leading away from the dredge pond. Such a slope may occur on the western side of the access track or flood bund.

3.3 Maintenance

Silt stop fencing is to be inspected at least monthly and after any significant rainfall event. Any necessary maintenance is to be effected whenever the need is apparent. Sediment shall not be allowed to build up in front of silt stop fencing.

4. Protection of Final Landform

Finished surfaces will have a 6H:1V slope within the normal operating water level of the dredge pond and 3H:1V slope in dryland areas above. Stabilisation works are to commence on these surfaces as soon as profiling is complete. Habitat creation and vegetation planting shall be in accordance with the Landscape and Rehabilitation Management Plan. If necessary the finished dry batter is to be stabilised with mulch and/or jute webbing to assist in holding the surface while vegetation matures.

Sand dune batters and the dredge pond foreshore are to be regularly inspected in the post mining period and maintenance undertaken until such time as stability is confirmed. Should it be found that wave action continually erodes a section of foreshore, expert advice is to be obtained as to measures to permanently stabilise the location.

Silt stop fencing will be removed upon completion of sand mining and rehabilitation, or sooner if the likelihood of sediment transfer has been eliminated.

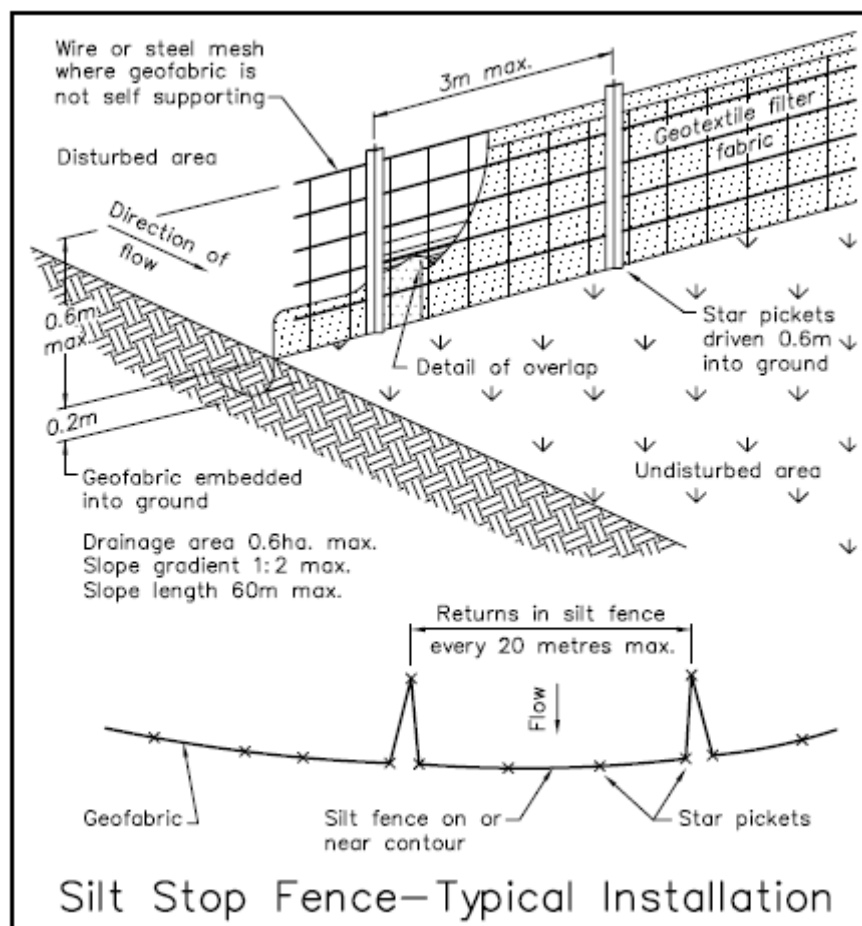
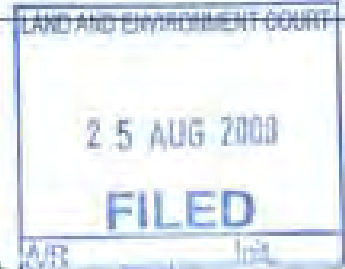


Figure 1

Appendix D

LANDSCAPE AND REHABILITATION MANAGEMENT PLAN

**LANDSCAPE AND REHABILITATION MANAGEMENT PLAN
EXTENSION AND CONTINUATION OF GERROA SAND QUARRY
MUNICIPALITY OF KIAMA
CITY OF SHOALHAVEN**



a report prepared by
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20 August 2008

07/44

Kevin Mills & Associates Pty Limited ACN 003 441 610
as trustee for Kevin Mills & Associates Trust



*Plan accepted by the Court as appropriate
Dreston 2-9-08*

Cover photograph:

Initial tree plantings in the north-eastern corner of the conservation area (Area 2A.1); further random plantings of various plants will follow to increase the density of plants to more closely resemble a natural forest, along with the introduction of habitat features such as timber debris. The trees at left are part of a remnant of forest along Blue Angle Creek.

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1 Introduction



1.1 Background

This Landscape and Rehabilitation Management Plan has been prepared in response to the project approval issued by the NSW Minister for Planning to Cleary Bros (Bombo) Pty Limited ('the company'), application number 05-0099. The plan addresses those matters set out in the modified conditions of consent, that relate to landscape management.

This document is a plan of management for the land described in the project approval, with the primary aim of setting out the management requirements for rehabilitating disturbed land after quarrying, protecting and enhancing conservation values of existing vegetation and habitats on the land, and extending the vegetated area and habitats as required in the project approval.

Particular attention is given to managing endangered ecological communities existing on the site. The plan sets out a proposal for a major replanting and habitat creation scheme to reafforest certain areas with local communities, thus increasing their area and also providing habitat links (connections) between existing stands of forest.

The area covered by this management plan is shown on **Figure 1**, and is referred to here as the "management area". The proposal can be divided into two main parts; i.e. (i) managing the existing forests, and (ii) developing forest habitat on existing cleared land.

This plan will be viewed as a dynamic document, in that although quite extensive in its role of guiding the management of biodiversity in the area, new issues will arise that will require additions and modifications to the Plan; this is expected and the assumption under the 'adaptive management' philosophy (see Section 8.5). A review of the Plan is envisaged after a five (5) year period.

Various other documents are available that provide useful information on managing native forest and revegetation of natural bushland; reference will be made to these documents where relevant. For example, *Recovering Bushland on the Cumberland Plain* (DEC 2005), while not directly relevant to the coastal zone, does provide useful information on revegetation methods.

1.2 Requirements of the Landscape and Rehabilitation Plan

The matters to be covered by this plan or are relevant to the preparation of this plan are set out in the conditions of consent. The plan has been considerably expanded following extensive discussions during the Land and Environment Court hearing and in deference to the latest conditions of consent. The plan incorporates all relevant best practice guidelines for vegetation clearing, revegetation, recipient site preparation, topsoil translocation and soil management, soil hygiene, seed collection, weed control and management, feral animal control, sediment and erosion control, habitat creation, adaptive management and monitoring relevant to the project.

The intended outcome of the compensatory plantings is the re-creation in accordance with this plan of the complex eco-systems that will be removed or affected by the project.

1.3 The Challenge Ahead

This is a most ambitious proposal, probably the largest ever revegetation project undertaken in the Illawarra region. To ensure its success it will require considerable resources and commitment from the Company and its staff. The project will also require a high level of understanding of the ecological requirements for the success of the enhancement and revegetation proposals. Close liaison between the on-ground staff and a qualified ecologist is therefore essential throughout the project. Regular monitoring is also critical, as is immediate action to address any identified problem with the revegetation works or management. There

should be no expectation that forest cover will occur quickly; trees take a long time to reach maturity. However, experience shows that a good cover of trees several metres in height can be achieved in a few years with appropriate management, along with a reasonably dense understorey. A high diversity of species will take some time to achieve, but will increase as time goes by; this will occur through natural colonisation by native species and be accelerated through appropriate plantings.

1.4 Ecologist

The qualified ecologist, bush regeneration or providence nursery group, as required, will be fully involved in the project on a regular basis. This will involve site induction activities for new staff, providing advice on issues such as weed management and habitat development, as well as regular monitoring of the project.



2 The Vegetation Management Area

2.1 Character of the Area

The extent of the Vegetation Management Area is shown in **Figure 1**. The area has been divided into various management zones and sub-zones, depending upon the location, purpose and/or character of the individual area. These zones are described individually in detail in Sections 4 and 7 of this plan.

2.2 Plant Species Present

A native plant list was prepared for the whole of the company's property by Kevin Mills & Associates (2005). This plant list is provided in **Appendix 1**, where the name of the species, both the botanical and common name, and the family to which each belongs, is stated. The list contains the names of 139 native species. Most of these species can be found in and around the forest on or adjacent to the quarry. This list is used later to identify native species suitable for use in the proposed planting programs.

2.3 Existing Vegetation Communities

The forest covering most of the management area is described and mapped in the 2005 report by Kevin Mills & Associates and the key vegetation types are elucidated below. The following vegetation types have been identified in the area (Kevin Mills & Associates 2005, 2006). It is important to appreciate these communities and their characteristics to successfully revegetate similar communities. The extent of the existing vegetation communities identified within the general area on the company property is shown on **Figure 2**.

Littoral Rainforest

Key Species: *Glochidion ferdinandi*, *Guiba semiglauca*, *Eucalyptus botryoides*

Description: This is a simple rainforest community, being dominated by only a handful of species. The dominant tree is Cheese Tree *Glochidion ferdinandi*, with occasional *Guiba semiglauca*. A few shrub specimens of Hairy Clerodendrum *Clerodendrum tomentosum*, Native Olive *Notelaea longifolia* and Breynia *Breynia oblongifolia* occur. There is an overstorey of Bangalay *Eucalyptus botryoides* and Blackbutt *Eucalyptus pilularis* above the dense canopy of Cheese Trees. The ground cover is mainly composed of "non-rainforest" species, such as Spiny-headed Mat-rush *Lomandra longifolia*, Wandering Sailor *Commelina cyanea* and Flax-lily *Dianella caerulea*. Creepers are relatively common, with 10 species being recorded. These include Snake Vine *Stephania japonica*, Slender Grape *Cayratia dematidea* and Wombat Berry *Eustrephus latifolius*.

Blackbutt - Banksia Forest

Key Species: *Eucalyptus pilularis*, *Banksia integrifolia*, *Eucalyptus botryoides*

Description: This tall forest is dominated by Blackbutt *Eucalyptus pilularis*. The associated trees are Rough-barked Apple *Angophora floribunda* and Bangalay *Eucalyptus botryoides*, although these species are uncommon in the forest in the investigation area. The understorey is composed of small trees and shrubs, including Coast Banksia *Banksia integrifolia*, Cheese Tree *Glochidion ferdinandi*, Tree Broom-heath *Monotoca elliptica* and Maiden's Wattle *Acacia maidenii*. The common smaller shrubs and other plants in the forest include Spiny-headed Mat-rush *Lomandra longifolia*, Bracken *Pteridium esculentum*, Blady Grass *Imperata cylindrica* and Kangaroo Grass *Themeda australis*. Creepers such as Climbing Guinea Flower *Hibbertia scandens* and Native Raspberry *Rubus parvifolius*. Dense stands of the introduced rambling shrub *Lantana camara* occur in many places.

Bangalay - Banksia Forest (Bangalay Sand Forest)

Key Species: *Eucalyptus botryoides*, *Banksia integrifolia*, *Angophora floribunda*, *Acacia maidenii*

Description: The trees present in this forest are mainly Bangalay *Eucalyptus botryoides* and Rough-barked Apple *Angophora floribunda*, with occasional Maiden's Wattle *Acacia maidenii*. The open understorey is a grassland of native and some introduced species, mainly the result of grazing and "underscrubbing". The common native species include Kangaroo Grass *Themeda australis*, Common Bracken *Pteridium esculentum*, Spiny-headed Mat-rush *Lomandra longifolia*, Couch Grass *Cynodon dactylon*, Small-leaved Bramble *Rubus parvifolius* and Blady Grass *Imperata cylindrica*. Scattered shrubs include Breytia *Breytia oblongifolia* and Corkwood *Duboisia myoporioides*.

Swamp Sclerophyll Forest

Key Species: *Eucalyptus robusta*, *Melaleuca linariifolia*, *Livistona australis*, *Casuarina glauca*, *Eucalyptus botryoides*

Description: This forest contains the wetland trees Swamp Mahogany *Eucalyptus robusta*, Swamp Oak *Casuarina glauca* and Narrow-leaved Paperbark *Melaleuca linariifolia*. Other characteristic species, most associated with wet sites, include Cabbage Palm *Livistona australis*, Harsh Ground Fern *Hypolepis muelleri*, Tall Sedge *Carex appressa*, Tall Saw-sedge *Gahnia clarkii*, Common Reed *Phragmites australis* and, climbing the trees, Monkey-rope Vine *Parsonsia straminea*. On drier sites, Bangalay *Eucalyptus botryoides* is common and the following species are prominent, Coast Banksia *Banksia integrifolia*, Golden Wattle *Acacia longifolia* and Corkwood *Duboisia myoporioides*.

Swamp Oak Forest

Key Species: *Casuarina glauca*

Description: This community is completely dominated by the tree Swamp Oak *Casuarina glauca*, has largely been cleared from the area of Foy's Swamp, there are only a few stands remaining here and there. Various other wetland species occur in the community; these are mainly freshwater species in this location. On clayey soils on the southern margin of the area Forest Red Gum *Eucalyptus tereticornis* occurs with Swamp Oak.

Fresh Wetlands

Key Species: *Phragmites australis*, *Typha orientalis*, *Eleocharis sphacelata*

Description: This community covers small areas within the Swamp Sclerophyll Forest and along drainage channels and parts of the dredge ponds. The main species are Common Reed *Phragmites australis*, Cumbungi *Typha orientalis*, Tall Spike-rush *Eleocharis sphacelata*, River Club-rush *Schoenoplectus validus* and some aquatic species such as alter Ribbon *Triglochin procerum*, that generally grows quite densely. It is a part of the identified endangered ecological community, known as Swamp Sclerophyll Forest or Freshwater Wetlands on Coastal Floodplains.

Significant Vegetation Communities

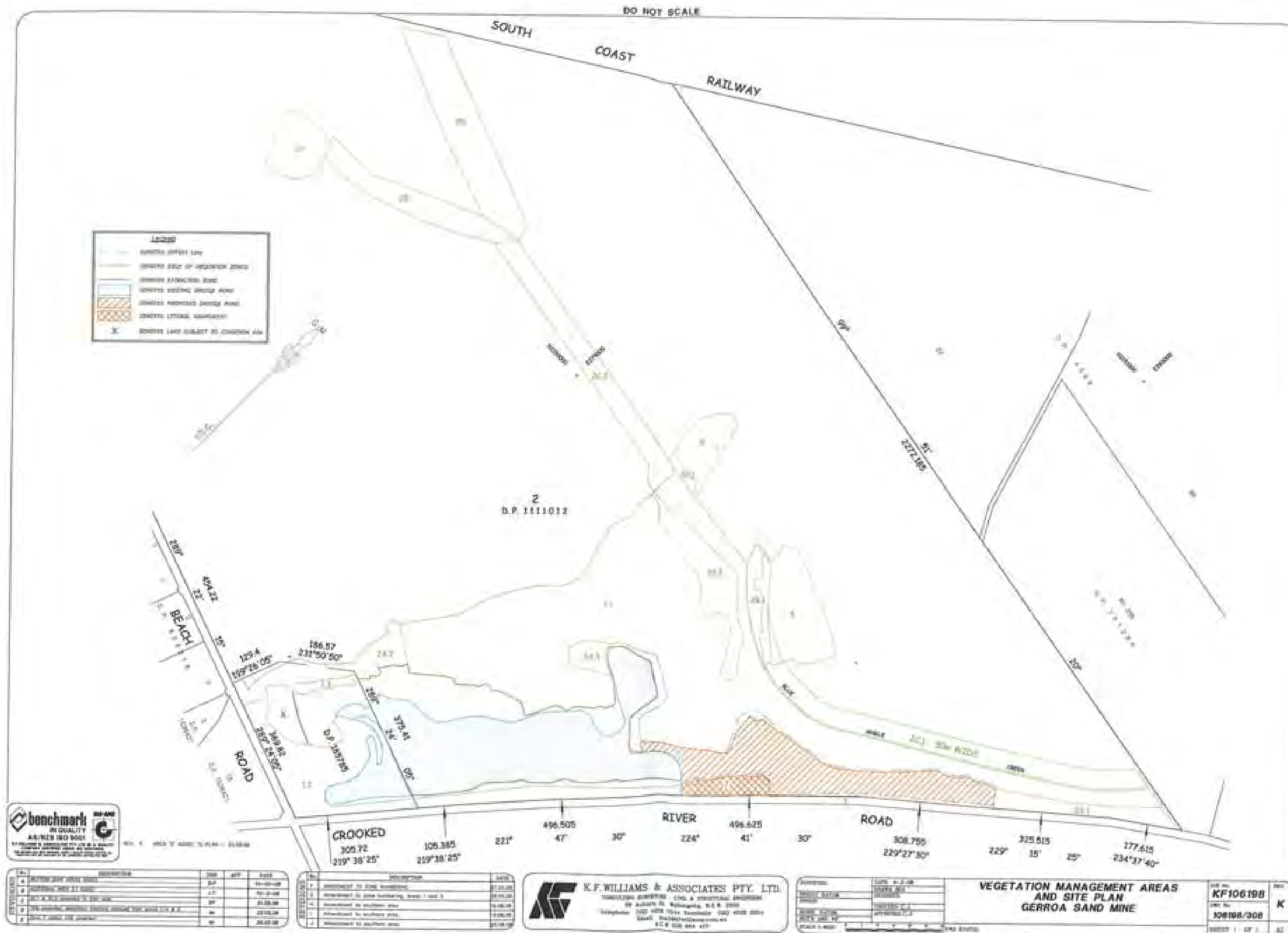
Five endangered ecological communities occur in the general area; these are Littoral Rainforest, Bangalay Sand Forest, Swamp Sclerophyll Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains and Swamp Oak Forest. The distribution of



these communities in the area is shown on the maps in the reports by Kevin Mills & Associates (2005, 2006). One aim of the management program is to replicate these communities, along with the Blackbutt - Banksia Forest, through an extensive revegetation scheme. Each community grows in a particular environment so that species selection to match site conditions is an important part of the replanting program.

Figure 1. Vegetation Management Areas and Site Plan
(Appendix 1 of Second Respondent's Draft Conditions of Approval)





Year	Production (kg)	Yield (kg/ha)	Cost (€)
2000	1000	10.0	1000
2001	1200	12.0	1200
2002	1500	15.0	1500
2003	1800	18.0	1800
2004	2000	20.0	2000
2005	2200	22.0	2200
2006	2500	25.0	2500
2007	2800	28.0	2800
2008	3000	30.0	3000
2009	3200	32.0	3200
2010	3500	35.0	3500
2011	3800	38.0	3800
2012	4000	40.0	4000
2013	4200	42.0	4200
2014	4500	45.0	4500
2015	4800	48.0	4800
2016	5000	50.0	5000
2017	5200	52.0	5200
2018	5500	55.0	5500
2019	5800	58.0	5800
2020	6000	60.0	6000

No.	Description	Value
1	Advertisement in local newspaper	\$7,250.00
2	Advertisement in local business journal	\$5,000.00
3	Advertisement in local business journal	\$5,000.00
4	Advertisement in local business journal	\$5,000.00
5	Advertisement in local business journal	\$5,000.00
6	Advertisement in local business journal	\$5,000.00
7	Advertisement in local business journal	\$5,000.00
8	Advertisement in local business journal	\$5,000.00
9	Advertisement in local business journal	\$5,000.00
10	Advertisement in local business journal	\$5,000.00



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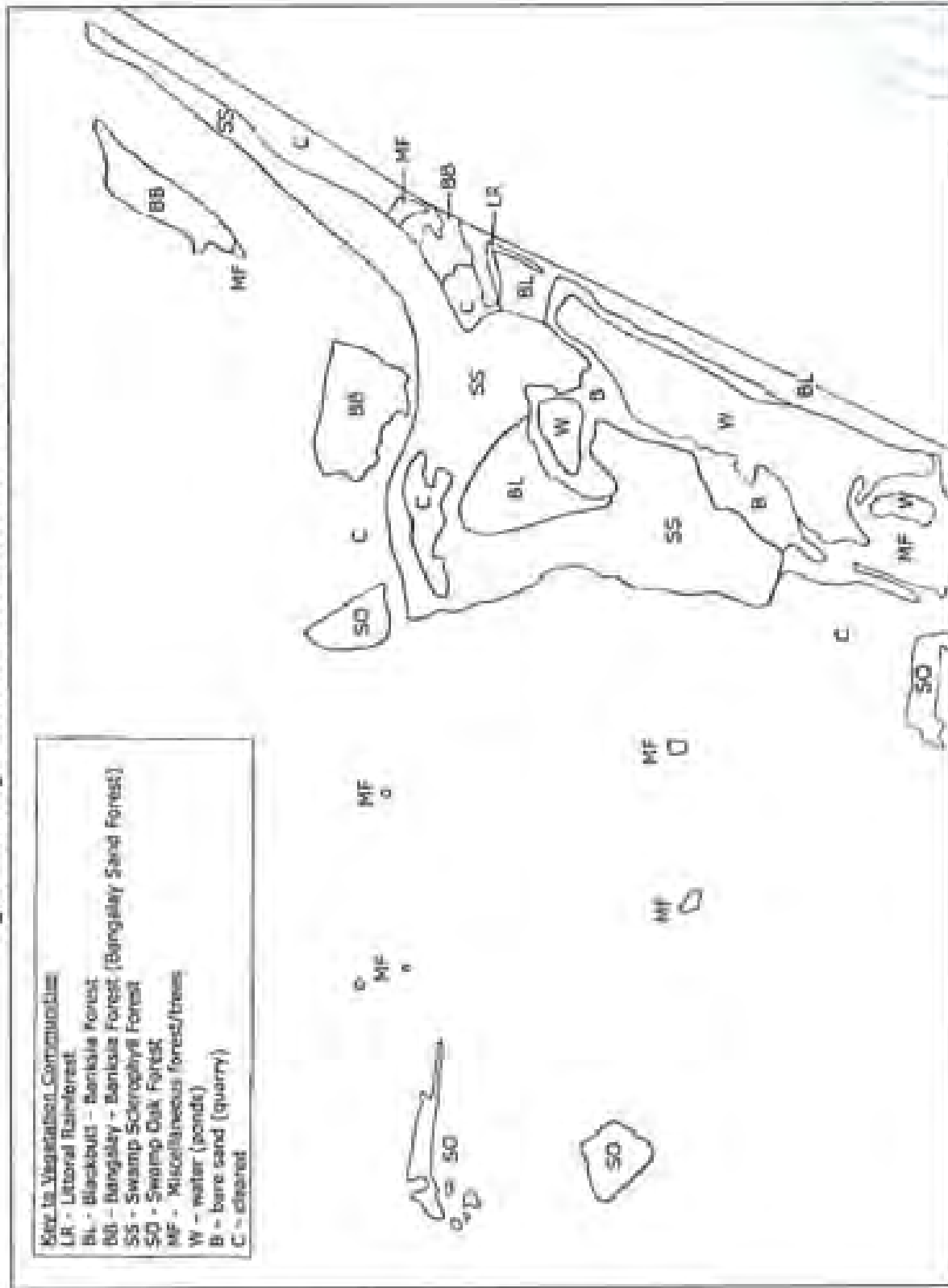
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VEGETATION MANAGEMENT AREAS
AND SITE PLAN
GERROA SAND MINE

2000 年	KF106198
2001 年	106198/308

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Figure 2. Vegetation Communities in the Area



3 Management Objectives

The following over-arching management objectives have been identified; objectives for each of the management zones are set out in the following section of the report, while each zone and sub-zone is described in detail in Section 7.

- i) To identify, develop and secure offset revegetation/habitat zones in compensation for the removal of about 3.3 hectares of modified forest.
- ii) To develop a revegetation program for the management zones that includes replanting the natural communities of the locality, particularly those removed by the proposal.
- iii) To develop through targeted actions suitable habitat the northern and southern management zones, particularly Sub-zones 2A.1 and 2A.2 respectively, as habitat corridors for those species recorded in the forest to be removed.
- iv) To develop a maintenance program that ensures the success of the revegetation program, and enhances the quality of the existing forest areas.
- v) To describe techniques for managing the perimeter of the quarry working area to preserve and enhance the adjacent retained forest.
- vi) To rehabilitate areas disturbed by sand quarrying, including the batter slopes around the dredge pond.
- vii) To ensure best practice guidelines are used in all management activities.
- viii) To develop a monitoring and reporting regime that ensures a successful outcome for the above management objectives, particularly the success of the above northern and southern habitat corridors.
- (ix) To ensure all site staff including the Site Manager receives appropriate training from the consultant ecologist or bush regenerator, as required.





4 Management Zones

Several distinct management zones have been identified within the conservation area, based primarily on the management input required, e.g. areas requiring extensive planting onto cleared land are differentiated from forest where relatively minor enhancement is required. The zones are described below and their extent is shown on **Figure 1**. More detailed descriptions of the zones and sub-zones are described in Section 7.

Zone 1: Forest Enhancement Zone

(being Zones 1.1, 1.2, 1.3 and 1.4 shown on Figure 1)

Enhancement areas are those sites within the existing forest areas where management input would improve the quality of the forest. The level of management input is generally low; the main action required is the removal of troublesome weeds to promote the natural regeneration of indigenous plants. The area of forest, most of which is Blackbutt Forest and Swamp Sclerophyll Forest, is 46.25 hectares.

The objectives for the Forest Enhancement Zone are:

- to promote the regeneration of the forest through the management of threats;
- to fence the zone where required to exclude grazing stock
- to control weeds in recognition of the significant negative impact they have on natural vegetation and habitats;
- to regularly monitor the health of the forest and undertake remedial management actions as required;
- to strengthen the tree cover to the south of the existing dredge pond to enhance the east-west forest link between the preserved forest and Seven Mile Beach National Park;
- to ensure that groundwater flow towards the Swamp Sclerophyll Forest is not significantly altered from the existing hydrological regime; and
- to ensure that best practice guidelines are always followed in managing these areas.

Zone 2: Broad Scale Planting Zone

The following approximate extent of the replanting zones for local forest communities have been calculated based on the management zones shown on **Figure 1**. Slight differences will occur in the final areas following site inspections to determine the makeup of some areas where the vegetation planted will depend upon the ground level in relation to watertable height.

Bangalay Sand Forest/Littoral Rainforest	8.8 hectares	Areas 2A.1, 2A.2, 2C.1
Blackbutt - Banksia Forest	0.65 hectares	Area 2A.3
Swamp Sclerophyll Forest/Swamp Oak Forest	5.3 hectares	Areas 2B.2, 2C.2
Swamp Sclerophyll Forest/Bangalay Sand Forest	1.3 hectares	Area 2B.1
<u>Swamp Oak Forest</u>	<u>7.94 hectares</u>	<u>Areas 2D, 2E</u>
Total Replanted Forest	23.99 hectares	
Remnant Forest	Bangalay Sand Forest	3.65 hectares Area 4
(enhancement)	Swamp Oak Forest	1.6 hectares Area 5

The objectives for the Broad Scale Planting Zone are:

- to develop habitat for a broad range of fauna species, thus maximising the diversity of fauna catered for in the planting areas;
- to re-establish appropriate forest communities through a planting program;
- to facilitate the establishment of stronger habitat corridors to the north and south of the existing forest;
- to maximise the success of the planting program through appropriate planting methods and maintenance regime;
- to monitor the plantings and take action where necessary to ensure successful forest regeneration and fauna usage of the created habitats;

- to strengthen east-west forest links across the property between the preserved forest and Seven Mile Beach National Park;
- to ensure that best practice guidelines are always followed in managing these areas.

The broad scale planting zone is divided into several sub-zones, based on the proposed staging plan; these are labelled from Zones 2A to 2E, and Zones 4 and 5 on **Figure 1**, 2A zones being the first to be planted. Zone 6, the dredge pond foreshore, will be stabilised and developed as habitat as the dredge pond progresses northwards.

Zone 3: Screen Planting Zone

The site to be screen planted is about three kilometres to the southwest of Gerroa, in the Municipality of Kiama, about 500 metres to the north of the existing sand quarry. The site is on the western side of Seven Mile Beach Road, and wholly on Cleary Bros' land. **Figure 1** shows the location of the site.

The subject land was cleared many years ago and has since been used for the grazing of cattle. It is now covered by exotic grassland and is slashed regularly.

The objectives for the Screen Planting Zone are:

- to establish a substantial screen of native vegetation along the eastern edge of the quarry extension site, to screen it from view;
- to ensure the screen will be well advanced by the time it is required to screen the quarry operations within the extension area; and
- to establish the screen totally on land owned by Cleary (Bros) Pty Limited;
- maintain existing trees along the south-eastern boundary, remove Lantana and replace with native plantings.

Zone 4: Bangalay Sand Forest

Zone 4 contains a stand of modified Bangalay Sand Forest, isolated in grazing land, but not far from the Blue Angle Creek corridor. Although grazed by stock, the stand generally retains a good tree cover and the ground cover has some native species.

The objectives for this remnant forest are:

- to promote the regeneration of the forest through the management of threats, primarily fencing to exclude stock grazing;
- to establish a forested link to the nearby larger area of forest through plantings;
- to regularly monitor the health of the forest and undertake remedial management actions as required (e.g. weed control).

Zone 5: Swamp Oak Forest

Zone 5 is a stand of Swamp Oak trees, isolated in a paddock to the north of Blue Angle Creek. These trees have apparently been planted many years ago.

The objectives for this remnant forest are:

- to promote the regeneration of the Swamp Oaks through the management of threats, primarily fencing to exclude stock grazing;
- to establish a forested link (i.e. Zone 5C.1) to the nearby larger area of forest through plantings;
- to regularly monitor the health of the forest and undertake remedial management actions as required (e.g. weed control).

Zone 6: Dredge Pond Foreshore

The foreshore of the dredge pond will be stabilised and revegetated with suitable local plant species. The zone includes the minimum five metre set back plus the batter slopes to the pond (reinstated following quarrying). The zone includes the existing dredge pond and the edges of the new pond to be created to the north and west.

The objectives for the dredge pond foreshore zone are:

- to stabilise the batter on the edges of the dredge pond;



- to revegetate the slope as soon as practical after dredging is completed in the area;
- to progressively revegetate the foreshore zone as quarrying progresses northwards;
- to undertake plantings ahead of the quarrying operation within the five metre set back area along the edge with the retained littoral rainforest;
- to continue the rehabilitation work on the existing dredge pond;
- create foreshore habitat;
- to maintain groundwater flow to the Swamp Sclerophyll Forest.

Groundwater monitoring has been conducted on the project site for many years and will be continued to be monitored during the course of the excavation of the pond and the subsequent rehabilitation. Regular assessment will be made of the data obtained to ensure fluctuation in groundwater levels in the Swamp Sclerophyll Forest do not deviate by more than two standard deviations of the mean groundwater level for more than six months at a time and do not follow a trend that can be attributed to climatic effects.

High conductivity material is to be placed at intervals along the length of the pond extension. This material is to be of a hydraulic conductivity, and placed at such intervals and in such places, that will maintain comparable typical groundwater flow through to the SSF as existed prior to the proposed excavation. The existing and comparable typical groundwater flow is to be determined in accordance with the calculation based on the existing typical hydraulic gradient and the hydraulic conductivity of the *in situ* strata provided for in Condition 14(c) of the Conditions of Consent.

If the review of the hydrogeologist considers that remedial action is necessary to maintain the pre-existing ground water regime in the vicinity of the SSF he/she shall be requested to recommend an appropriate remedial action plan. This plan may include adjustment to the placement strategy for panels of high hydraulic conductivity material required by Condition 11(d).

Establishment of the upper foreshore zone (i.e. the set-back area) can mostly be planted well ahead of the excavation, in most cases several years in advance. The majority of the littoral rainforest edge can be planted some one to two years ahead of excavation, resulting in the establishment of dense shrub/small tree buffer vegetation between the excavation (top of the batter) and the rainforest. Within a short time after excavation, the batter will be established and further plantings can be undertaken to increase the total width of the buffer area.

Zone 7: Littoral Rainforest

The littoral rainforest zone is immediately to the east of the new dredge pond; it is primarily a littoral rainforest growing below an open eucalypt canopy. This is part of the retained forest, but is identified separately to Zone 1 because of its special management requirements. The zone is one hectare in extent. The main actions required are protection during quarrying operations and the removal of troublesome weeds to promote the natural regeneration of the rainforest plants.

The objectives for the Littoral Rainforest Zone are:

- to promote the regeneration of the rainforest through the management of threats;
- to control weeds, particularly Lantana, in the forest;
- to regularly monitor the health of the forest and undertake remedial management actions as required;
- to protect the western edges of the site from inadvertent impacts from quarrying;
- to remove weeds and plant the buffer area well ahead of the quarrying operations;
- to ensure that the felling of trees does not impact on the retained rainforest vegetation;
- to ensure that best practice guidelines are always followed in managing the area.



5 Management issues – Retained Forest

5.1 Key Objectives for Forest Areas

The following key objectives have been identified for the areas of retained forest:

- to promote the regeneration of the forest through the management of threats;
- to control weeds in recognition of the significant negative impact they have on natural vegetation and habitats;
- to regularly monitor the health of the forest and undertake remedial management actions as required;
- to strengthen the tree cover to the south and north to enhance the forest habitat linkages between the retained forests and Seven Mile Beach National Park; and
- to ensure that groundwater flow towards the Swamp Sclerophyll Forest is not significantly altered from the existing hydrological regime.

5.2 Key Management Goals for Forest Areas

The aims for each of the management zones covering the retained forest, primarily Zone 1, are set out in the descriptions of each zone in Sections 4 and 7 of this plan. An important goal is the improvement of the existing forest in terms of reduced weed invasion and increased native plant species abundance and diversity. Habitat corridors to the north and south of the retained forest have been described and their importance emphasised elsewhere in this plan.

5.3 Littoral Rainforest

The retained littoral rainforest to the east of the new dredge pond requires special attention to ensure its survival and enhancement. The following issues have been identified as matters to be addressed in managing this area.

- maintaining the set back distance with the dredge pond;
- careful felling of the trees within the vicinity of the littoral rainforest to ensure that they do not fall towards and impact upon the rainforest;
- individual tree assessment to determine the best way of removal so as to avoid impact on the rainforest (e.g. some stumps may be left in the ground);
- removal of Lantana in a controlled manner so as not to encourage other weeds to invade the area;
- exclusion of cattle
- planting of the set back areas ahead of the dredging;
- appropriate selection of plant species for use in and near the rainforest;
- planting of the batters nearby as soon as the dredging is completed and batters are stable.

Short term, medium and long term specific measures for management of this area will be in accordance with the time line found on page 41 for Zone 7.

5.4 Swamp Sclerophyll Forest

The relevant issues in regard to the protection of the Swamp Sclerophyll Forest, contained within Zone 1, are as follows:

- ensuring that the dredge pond does not intrude upon the identified area of the forest or the set back area;
- maintaining the existing level of groundwater flow to the area;
- controlling weed species; this is generally a minor problem in the swamp.



5.5 Bangalay Sand Forest

The area of Bangalay Sand Forest north of Blue Angle Creek (Zone 4) already has a good tree cover and some native understorey species. This area only requires fencing and future monitoring to determine if plantings are required, should natural regeneration not be adequate, and to identify any weed problems.

6. Management Issues – Planting Areas

6.1 Key Objectives for Planting Areas

The following key objectives have been identified for the revegetation of the area and should be implemented in accordance with this plan:

- to establish natural forest communities in the area
- to re-establish the forest links to the surrounding forest, including that within Seven Mile Beach National Park to the east and south
- only locally occurring indigenous plants will be used on this project;
- to obtain all plants from a local source, derived from plant material obtained on the property or nearby;
- to ensure a range of indigenous plant species (ground covers, shrubs and trees) are used, so that the result is a multi-layered forest with a natural character and high habitat value;
- to maintain the vegetation on the site for the life of the adjoining quarry i.e. a period of 15 years;
- for the consultant ecologist and, if required, a bush regeneration expert, to carry out an annual inspection and submit an annual report to the Director General on the progress and condition of the vegetation as part of the AEMR and provide a copy of the AEMR to the Community Consultative Committee in accordance with Schedule 5 Condition 4 of the Conditions of Consent;
- create foreshore habitat; and
- to create habitat for native ground and arboreal fauna through the use of logs and other debris, as well as tree hollows, salvaged from the site
- to strategically place nest boxes in the area for arboreal mammal and bird use
- ensure use of best practice in all management actions.

6.2 Identifying Key Management Goals for Planting Areas

The aims for each management zone are set out in the descriptions of each zone in Section 7 of this plan. An important goal is the creation of habitat corridors to the north and south of the existing forest, to improve connectivity with the nearby forest areas (e.g. within the national park). These areas are most important for fauna although plants also require connectivity. The development of these corridors will be aimed at providing habitat attributes that maximise the value of the habitat for the fauna species known and expected to occur in the existing "east-west link" (i.e. the forest to be cleared). The targeted fauna groups and the related important attributes for each group, along with the standard that should be met and the approximate time scale to achieve that habitat attribute are set out in **Table 1, Appendix 2** of this plan details the important habitat attributes for each species recorded in the locality, and identifies those species recorded in the habitat to be removed.



Table 1

Identification of Attributes, Standards and Time Scales for Creating Vertebrate Fauna Habitat

Fauna Group	Species Example	Important Habitat Attributes	Standard to Meet	Time Scale
Large birds	Laughing Kookaburra Pied Currawong	Trees Foraging areas	Trees growing healthily Present now.	10+ years Immediate
Medium-sized birds	Crimson Rosella Satin Bowerbird	Foraging areas (ground and trees)	Trees growing healthily Ground foraging present now.	10+ years. Immediate
Small birds	Brown Thornbill Superb fairy-wren	Shrub layer Ground cover Logs/branches/litter debris	Moderately dense shrub layer Healthy ground cover Good cover of logs/debris	3 to 4 years 3 to 4 years Immediate
Arboreal mammals	Common Ringtail Possum Sugar Glider	Trees Tree hollows	Trees growing healthily Translocation of tree hollows	10+ years Immediate
Hollow users	Eastern Rosella Striated pardalote	Tree hollows	Installation of artificial hollows	Immediate, although natural hollows take decades
Large ground mammals	Swamp Wallaby	Shrub/small tree cover Foraging areas	Dense areas of shrubs Present in surrounding area	3 to 4 years Immediate
Medium ground mammals	Long-nosed Bandicoot Short-beaked Echidna	Ground cover Logs/branches/litter debris	Healthy ground cover Good cover of debris	3 to 4 years Immediate
Small mammals	Bush Rat Brown Antechinus	Ground cover Logs/branches/litter debris	Healthy ground cover Good cover of logs/debris	3 to 4 years Immediate
Reptiles	Green Skink Red-bellied Black Snake	Ground cover Logs/branches/litter debris	Healthy ground cover Good cover of logs/debris	3 to 4 years Immediate
Micro-bats	Chocolate Wattled Bat Large Bentwing-bat	Foraging areas (open areas near trees) Hollows (some species)	Present now Installation of artificial hollows	Immediate Immediate, although natural hollows take decades
Flying-foxes	Grey-headed Flying-fox	Trees (blossom, fruit) Foraging areas	Trees growing healthily Present in surrounding area	10+ years, Immediate



6.3 Best Practice Guidelines

'Best practice' guidelines have been developed over many years for activities related to various aspects of landscape management and the rehabilitation of native vegetation and habitat. Best practice procedures for clearing, soil handling, earthworks, revegetation, plant propagation, among other matters, are covered in the following documents and have been adopted so far as they are relevant on the Gerroa site:

- *Bush Regeneration. Recovering Australian Landscapes*, by R. Buchanan, TAFE NSW, 1989.
- *Best Practice Environmental Management in Mining, Rehabilitation and Revegetation*, by the Environment Protection Agency, 1995.
- *Recovering Bushland on the Cumberland Plain: Best Practice Guidelines for the Management and Restoration of Bushland*. Dept. Environment and Conservation, 2005.

Other references referred to in Section 10 'References'

Native revegetation is an active area of study and new information may over time determine that changes be made to best practice in some areas. The managers of this site will be made aware of this and respond as required to new procedures. This matter will be discussed in the annual reports by the consultant ecologist.

6.4 Initial Site Treatment

The area to be screen planted will where necessary be slashed and fenced before any work is undertaken; it is presently dominated by introduced grasses and other herbaceous plants. Planting would take place as soon as practicable. The area will be divided into several sections, or planting sites. Each section will be closely mown before planting, followed by "spot spraying" with herbicide around each plant location for a radius of 0.5 metres. The plant will be planted in the centre of the sprayed area when the grass has browned off. Alternatively, the whole section may be sprayed and, following planting, heavily mulched.

Initial site treatment for foreshore rehabilitation will include creation of irregular shorelines and the placement of logs, etc. to produce better habitat for native fauna.

6.5 Species Selection

Appendix 1 contains a native plant species list for the Cleary Bros property (Kevin Mills & Associates 2005). The list provides the name of each plant species (botanical and common names) and states the family to which each species belongs. The list contains the names of 135 native plant species occurring on the property. Most of the species occur in the forest on or near the proposed quarry extension site. The list has been used as a basis for species selection for this project.

To establish a cover of trees and shrubs as quickly as possible, plantings of fast growing species will be interplanted with more permanent trees. The fast growing species will include Coast Banksia *Banksia integrifolia*, Golden Wattle *Acacia longifolia*, Maiden's Wattle *Acacia maidenii*, Two-veined Hickory *Acacia binervata* and Hickory Wattle *Acacia implexa*. These species will be planted with the knowledge that the wattles may not live much more than 20-30 years, by which time the permanent trees would be quite large. The more permanent species will include Blackbutt *Eucalyptus pilularis*, Bangalay *Eucalyptus botryoides*, Rough-barked Apple *Angophora floribunda* and Cheesetree *Glochidion ferdinandi*. Ground cover species can provide a dense cover to about one metre in height, and are useful for weed control purposes. Such species include Climbing Guinea Flower *Hibbertia scandens*, Spiny-headed Mat-rush *Lomandra longifolia* and Kangaroo Grass *Themeda australis*.

Species selected for the initial plantings for the screen plantings are listed in **Table 2**. Depending on the availability of propagation material at the time, other species in **Appendix 1** may also be selected.



Species suitable for planting on the dredge pond foreshore are listed in **Table 3**. The species selected are low-growing plants, as taller plants will generally be unsuitable as they may not be stable when fully grown; the exception is *Casuarina glauca*. A general list of species suitable for planting in the various habitats in the conservation area are listed in **Table 4**; from this table, a group of species can be identified for each vegetation community.

Table 2: Species Suitable for the Proposed Screen Planting

Main Trees	<i>Angophora floribunda</i> <i>Banksia integrifolia</i> <i>Eucalyptus botryoides</i> <i>Eucalyptus pilularis</i> <i>Glochidion ferdinandi</i>	Rough-barked Apple Coast Banksia Bangalay Blackbutt Cheesetree
Other Trees	<i>Acacia binervata</i> <i>Acacia implexa</i> <i>Acacia maidenii</i> <i>Guioa semiglauc</i> <i>Myrsine hawittiana</i> <i>Pittosporum undulatum</i> <i>Synoum glandulosum</i>	Two-veined Hickory Hickory Wattle Maiden's Wattle Guioa Muttonwood Sweet Pittosporum Rosewood
Shrubs	<i>Acacia longifolia</i> <i>Duboisia myoporeoides</i> <i>Pittosporum revolutum</i> <i>Zieria smithii</i>	Golden Wattle Corkwood Yellow Pittosporum Sandfly Zieria
Ground Covers	<i>Hibbertia scandens</i> <i>Kennedia rubicunda</i> <i>Lomandra longifolia</i> <i>Themeda australis</i>	Climbing Guinea Flower Dusky Coral-pea Spiny-headed Mat-rush Kangaroo Grass

Table 3: Species Suitable for the Dredge Pond Foreshore

Batters	
<i>Acacia longifolia</i>	Golden Wattle
<i>Carex appressa</i>	Tall Sedge
<i>Casuarina glauca</i>	Swamp Oak
<i>Hibbertia scandens</i>	Climbing Guinea Flower
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Mealeuca ericifolia</i>	Swamp Paperbark
<i>Phragmites australis</i>	Common Reed
<i>Themeda australis</i>	Kangaroo Grass
Gentler topography	
<i>Acacia binervata</i>	Two-veined Hickory
<i>Acacia implexa</i>	Hickory Wattle
<i>Acacia longifolia</i>	Golden Wattle
<i>Acacia maidenii</i>	Maiden's Wattle
<i>Angophora floribunda</i>	Rough-barked Apple
<i>Banksia integrifolia</i>	Coast Banksia
<i>Duboisia myoporeoides</i>	Corkwood
<i>Eucalyptus botryoides</i>	Bangalay
<i>Eucalyptus pilularis</i>	Blackbutt
<i>Glochidion ferdinandi</i>	Cheesetree
<i>Guioa semiglauc</i>	Guioa
<i>Hibbertia scandens</i>	Climbing Guinea Flower
<i>Kennedia rubicunda</i>	Dusky Coral-pea
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Myrsine hawittiana</i>	Muttonwood
<i>Pittosporum revolutum</i>	Yellow Pittosporum
<i>Pittosporum undulatum</i>	Sweet Pittosporum
<i>Synoum glandulosum</i>	Rosewood
<i>Themeda australis</i>	Kangaroo Grass
<i>Zieria smithii</i>	Sandfly Zieria



Table 4

Species Suitable for Planting in Key Environments in the Conservation Area

Vegetation Community	Littoral Rainforest	Blackbutt Banksia Forest	Bangalay Banksia Forest	Swamp Sclerophyll Forest	Swamp Oak Forest	Fresh Wetlands
<i>Acacia binervata</i>		B	G			
<i>Acacia implexa</i>	L	B	G			
<i>Acacia longifolia</i>		B	G			
<i>Acacia maidenii</i>		B	G			
<i>Acacia suaveolens</i>		B	G			
<i>Ailisma plantago-aquatica</i>						W
<i>Alphitonia excelsa</i>	L					
<i>Angophora floribunda</i>		B	G			
<i>Banksia integrifolia</i>		B	G			
<i>Baumea articulata</i>				S	O	W
<i>Breyeria oblongifolia</i>	L	B				
<i>Carex appressa</i>						W
<i>Casuarina glauca</i>				S	O	
<i>Centella asiatica</i>				S	O	W
<i>Cissus hydroplicauca</i>	L					
<i>Clematis pauciflorus</i>	L					
<i>Clematis aristata</i>	L	B				
<i>Clerodendrum tomentosum</i>	L	B				
<i>Commersonia fraseri</i>	L	B				
<i>Croton pedunculatum</i>				S	O	W
<i>Dianella caerulea</i>		B	G			
<i>Dodonaea triquetra</i>		B	G			
<i>Duboisia myoporumoides</i>	L	B	G			
<i>Eleocharis sphacelata</i>						W
<i>Endandra sieberi</i>	L					
<i>Eucalyptus botryoides</i>	L	B	G			
<i>Eucalyptus pilularis</i>		B				
<i>Eucalyptus robusta</i>				S	O (dry sites)	
<i>Eucalyptus torresianensis</i>						
<i>Eupomatia laurina</i>	L					
<i>Eustrephus latifolius</i>	L	B				
<i>Ficus coronata</i>	L			S		
<i>Ficus macrophylla</i>	L					
<i>Ficus obliqua</i>	L					
<i>Ficus superba</i>	L					
Vegetation	Littoral	Blackbutt	Bangalay	Swamp	Swamp	Fresh

Community	Rainforest	Banksia Forest	Banksia Forest	Sclerophyll Forest	Oak Forest	Wetlands
<i>Gahnia clarkii</i>				S		W
<i>Geitonopileum cymosum</i>	L	B				
<i>Glochidion ferdinandi</i>	L					
<i>Guioa semiglauc</i>	L					
<i>Hibbertia obtusifolia</i>		B	G			
<i>Hibbertia scandens</i>	L	B	G			
<i>Hypolepis muelleri</i>	L			S		W (edge)
<i>Isoplepis nodosa</i>				S	S	W (total)
<i>Juncus kraussii</i>						W
<i>Juncus ustulatus</i>						
<i>Kennedia rubicunda</i>		B	G			
<i>Leptospermum juniperinum</i>				S		W
<i>Levistonla australis</i>	L			S		
<i>Lomandra longifolia</i>	L	B	G			W (edge)
<i>Marsdenia rostrata</i>	L			S	O	W
<i>Melaleuca entofolia</i>				S	O	W
<i>Melaleuca linariifolia</i>				S	O (dry sites)	
<i>Melaleuca styphelioides</i>						
<i>Melicope micrococca</i>	L					
<i>Monotoca elliptica</i>		B	G			
<i>Monarda jasminoides</i>	L					
<i>Myrsine howittiana</i>	L					
<i>Notelaea longifolia</i>	L	B	G			
<i>Omelandanthus populifolius</i>	L			S (dry sites)		
<i>Orethamnus diosmifolius</i>		B	G			
<i>Pandorea pandorana</i>	L	B				
<i>Parrsonsia straminea</i>	L	B		S	O	
<i>Persicaria decipiens</i>						W
<i>Persicaria strigosa</i>						W
<i>Persoonia linearis</i>		B				
<i>Phragmites australis</i>				S	O	W
<i>Pitcairnia revolutum</i>	L	B				
<i>Pitcairnia undulatum</i>	L	B				
<i>Restio tetraphyllus</i>				S		W
<i>Schoenoplectus validus</i>				S		W
<i>Smilax glycyphylla</i>	L	B				
<i>Stephania japonica</i>	L	B	G			
<i>Syntherisma glandulosum</i>	L	B				
Vegetation	Littoral	Blackbelt	Bangalay	Swamp	Swamp	Fresh

Community	Rainforest	Banksia Forest	Banksia Forest	Sclerophyll Forest	Oak Forest	Wetlands
<i>Themeda australis</i>		B	G			W
<i>Triglochin procernum</i> s. lat.	L	B				W
<i>Tylophora barbata</i>						
<i>Typha orientalis</i>	L	B				
<i>Viola hederacea</i>		B				
<i>Zieria smithii</i>		B				



6.6 Obtaining Plant Stock

Plants of the selected species will be obtained from a nursery that has propagated them from plant material obtained in the local area or, alternatively, has propagated them from plant material obtained on site, under contract from the company. Depending on the weather conditions at the time, it may be possible to transplant some small plants and seedlings from the quarry extension site, which is to be cleared.

6.7 Weed Control

Weed control in the early stages of the project is crucial. For new plantings in previously grassed areas, the growth of plantings will be severely retarded if the dense sward of grass is not controlled. In later years, woody shrubs such as Bitou Bush and Lantana may become a problem.

Weed control will be achieved by a combination of several methods, depending upon the weeds present and their abundance. These methods will include mowing, removal by hand, the use of thick mulch and judicious spraying with a herbicide (herbicide use on the foreshore will be avoided). Weed control effort will focus on species that are adversely affecting the plantings and the forest, particularly weeds declared noxious under the *Noxious Weeds Act, 1993* (NSW).

The weeds of most concern in the area covered by this plan are listed in **Table 5**, where weeds are either noxious weeds (*sensu Noxious Weeds Act, 1993*) or are regarded as environmental weeds (i.e. have a negative impact on native plants or animals). A few other species are listed that are considered to be locally troublesome and should be removed (unless agreed to be retained by the consultant ecologist or bush regeneration expert); these are generally not as invasive as the other species, grow in discrete clumps and are readily controlled. Note that noxious weeds, plant species that place a legal responsibility on a land holder to control the species, are in bold in **Table 5**. The control categories of noxious weeds are set out in **Appendix 3**.

A map showing the distribution of the key weeds in the management area will be prepared at the beginning of the project.

Consideration will be given to the methods used to control weeds and any adverse impact that may occur. The control methods for individual species must be those approved by the Illawarra Noxious Weeds Authority. Generally, heavy machinery will not be used for weed control. The removal of lantana may need to be staged as it sometimes provides habitat in the absence of native shrubs. This matter will be dealt with on the weed map to be produced by the ecologist at the start of the project.

6.8 Watering

The need for watering will depend upon local rainfall and soil conditions. The initial plantings will be planted with water-holding crystals and, in sandy soils, mulch mixed with the soil, and watered once at the time of planting. Follow-up watering will occur at least once per week, depending on rainfall. Watering will cease or be curtailed when the plants are large enough to survive without additional moisture; this will encourage deeper root growth and better plant health.

6.9 Fertilising

The use of strong fertilisers is generally avoided in native planting projects. However, a couple of tablets of a slow-release fertiliser in the hole at the time of planting can be beneficial.

6.10 Protection from Grazing Animals

Grazing stock will be excluded from the planting zones by fencing. Grazing by rabbits and possibly Swamp Wallabies may need to be addressed; bagging individual plants should provide enough protection.

Table 5
List of Important Weed Species

Name(Common Name)	Habit	Category/Control Class ¹ (LGA)
<i>Acacia podalyrifolia</i> (Queensland Wattle)	Perennial Shrub	Local
<i>Andropogon virginicus</i> (Whiskey Grass)	Annual Grass	Environmental
<i>Arundo donax</i> (Giant Reed)	Tall Grass	Local
<i>Axonopus Fissifolius</i> (Carpet Grass)	Perennial Grass	Environmental
<i>Chloris gayana</i> (Rhodes Grass)	Perennial Grass	Environmental
<i>Chrysanthemoides monilifera</i> (Bitou Bush)	Perennial Shrub	Noxious/4 (S,K)
<i>Erythrina x sykesii</i> (Coral Tree)	Tree	Local
<i>Ipomoea purpurea</i> (Morning Glory)	Rampant climber	Environmental
<i>Lantana camara</i> (Lantana)	Perennial Shrub	Noxious/4 (S,K)
<i>Paspalum urvillei</i> (Vasey Grass)	Perennial Grass	Environmental
<i>Pennisetum clandestinum</i> (Kikuyu Grass)	Perennial Grass	Environmental
<i>Psoralea pinnata</i> (Butterfly Bush)	Perennial Shrub	Local
<i>Ricinus communis</i> (Caster Oil Plant)	Shrub	Local
<i>Rubus fruticosus</i> sp. aggr. (Blackberry)	Perennial Shrub	Noxious/4 (S,K)
<i>Senecio madagascariensis</i> (Fireweed)	Annual Herb	Noxious/4 (S)
<i>Xanthium occidentale</i> (Noogoora Burr)	Annual herb	Noxious/4 (S)

1. See Appendix 3 for control class; species declared in: S – Shoalhaven; K - Kiama

Bold entries are declared noxious weeds in one or both LGAs. Environmental weeds are invasive species regarded as a threat to natural ecosystems. Local weeds are those that are of minor importance on this site (mostly occurring in one or two locations) and can be readily removed and are unlikely to return after their removal.



6.11 Timber / Litter Debris

Tree trunks, logs, branches and litter cleared from the site can be used in the planting zones to create ground habitat and logs placed on the edges of the pond to provide habitat. Material from nearby can also be utilised; e.g. native tree prunings from the side of Gerroa Road.

All mulch used on site will be from native species, preferably obtained elsewhere on the property or at least nearby. The mulch must be free of weed propagules and the seed of non-local plant species.



6.12 Planting Methods

The following planting methods will be used.

Plant Spacing

Trees and shrubs will be planted at a spacing of no more than about two (2) metre centres on average, but these will be arranged randomly and not in straight lines. On the foreshore, smaller plants can be planted at about 0.5 metres centres. Native aquatic plants will readily colonise the edges of the pond, so these do not need to be planted.

Plant Protection

The staking of individual plants will be avoided, as it requires much effort and may be detrimental to the plant, which will be left to grow naturally. Placing plastic bags or 'Grow Tubes' around each plant can improve the success rate. These plant guards are used to protect the plant from grazing animals, reduce weed competition, reduce wind and frost effects, and lower evaporation rates around the plant. Treating individual plants can be high maintenance, but the results are usually worth the effort.

Plant Size

Tubestock or similar sized plants will be used for all plantings. Advanced plants are not usually successful in this type of project and will not be used unless otherwise recommended by the consultant ecologist or bush regeneration expert.

Planting Configuration

For aesthetic reasons, the plants will not be planted in rows, lines or grid patterns. The plantings will be random, with an average density as set out above.

Individual Planting Method

Each plant will be placed in a hole of suitable size. Two slow-release fertiliser tablets will be placed at the bottom of the hole, and a handful of water-holding crystals placed around the plant as the hole is filled in. A tree guard (e.g. plastic bag) will be placed around the planted trees and shrubs, although this may not be necessary for the ground cover plants. Each plant will be watered immediately after planting. The area around the plant will be mulched as soon as possible after planting.

6.13 Maintenance

The revegetation zones will require ongoing maintenance for the life of the quarry, i.e. 15 years. The maintenance requirements will decrease over time.

The following main maintenance activities will be undertaken on a daily by Cleary Bros (Bombo) on-site staff:

- check that the fencing is intact;
- carry out weed control;
- water plants as required;
- replace dead plants;
- remove rubbish (e.g. roadside litter);
- treat erosion should this occur; and

- address the impact of grazing animals, if required.

6.14 Vegetation Clearing Protocols

The following tree clearing protocols would be followed; these are summarised from the actions set out in Table 6.

Genetic testing of fauna populations

The conditions of consent contain the following matters regarding genetic testing.

Condition 25

Prior to the severance of the east-west link the Proponent shall:

- (c) *conduct genetic analysis for a number of key species for whom genetic markers have already been developed (e.g. Brown Antechinus, Bush Rat and at least two skink species) to establish that genetic relatedness exists between individuals within the two corridors, the Conservation Area and National Park.*

If no genetic relatedness exists between individuals in the Conservation Area, northern corridor, east-west link and the National Park, then this demonstrates that neither the east-west link nor the northern corridor is functional and therefore the east-west link can be severed without creating additional fragmentation to animal populations.

If genetic relatedness exists between individuals in the northern corridor, Conservation Area and the National Park, but not in the east-west link, then this demonstrates that the east-west link is not functional, but the northern corridor is and therefore, the east-west link can be severed without creating additional fragmentation to animal populations.

If genetic relatedness exists between individuals in the Conservation Area, the east-west link and the National Park, but not the northern corridor, then this demonstrates that the northern corridor is not functional and the east-west link cannot be served until there is compliance with condition 23 and 24.

Search for Koalas prior to tree clearing

The ecologist will inspect the trees to be removed on the day of the clearing to ensure that no animals are present. If animals are present, then clearing must be delayed until the animal has moved away under its own accord.

Clearing Existing Vegetation and Felling of trees

The understorey must be cleared the day prior to trees being felled, to allow fauna to move away if present. Tree with hollows, previously tagged by ecologist, will be shaken by machinery just prior to felling to give fauna within the hollows an opportunity to escape before tree is felled. Trees will not be felled into the forest areas to be retained. The site manager must make sure that tree felling is carried in an appropriate way to avoid harm to the adjoining forest, and in accordance with WorkCover safety guidelines.

Trees will not be felled into the forest areas to be retained; this must particularly be ensured along the edge of the littoral rainforest to be retained. All tree hollows are to be inspected after tree felling to determine if animals are still present. The site manager will locate the nearest vet or animal carer prior to clearing taking place. If animals are injured during clearing, then they can be taken directly to the vet/animal carer after their discovery. Clearing is best undertaken in autumn.

Tree hollow salvage

The Environmental Officer and the ecologist will identify and tag tree hollows that will be salvaged and identify and tag suitable host trees in the retained forest. Hollows over 15 cm will be salvaged whenever suitable condition for reuse. The site manager will subsequently organise the removal of the hollows prior to clearing and for the cut hollows to be strapped to the identified trees. The Environmental Officer or consultant ecologist is to inspect all hollow-

bearing trees immediately after they have been felled to look for animals within the hollows or nearby. Any injured animals found are to be taken to WIRES or a similar wildlife care organisation for treatment.

Use of organic debris

The site manager will ensure that any organic material (e.g. logs, tree trunks, mulch) useful in the revegetation program is appropriately stored and re-used to best advantage. The ecologist will advise on the best use of this material, e.g. using logs on edge of pond and in planting zones, use of mulch.

6.15 Sediment and Erosion Control

Prior to the commencement of any vegetation clearing, sediment and erosion controls will be implemented in accordance with best practice guidelines as set out in the document titled "Soil and Construction and Management Urban Stormwater", prepared by Landcom (2004).

6.16 Management of Feral Animals

Several species of feral animal occur on the property that have the potential to impact on forest and wetland conservation values. These animals will be controlled in accordance with legislative requirements or where needed to ensure the success of the project.

Rabbits and foxes will be controlled on an 'as needs' basis, as they are now on the Company's property as a part of normal farming activities.

The dredge pond will be monitored by an appropriate freshwater ecologist once per year for the presence of feral fish. Action as recommended by the ecologist will be taken if required.

Unusual feral animal problems such as European Bees and Deer will be identified and addressed as and when they become a problem.

Any recommendations from the ecologist regarding the control of feral animals will be taken as required.

6.17 Bushfire

Bushfire has not historically been a problem on the company's property; it has not had a fire for many decades. This is probably because of the extensive areas of cleared land surrounding the area. Seven Mile Beach National Park south of Beach Road is burnt in a widespread fire about once every ten years. The section of the park and the adjoining forest north of Beach Road picnic area has not burnt for a very long time and has developed an extensive rainforest understorey to the tall eucalypt forest.

No special provisions are required in regard to bushfire protection or hazard reduction. Where appropriate, the company will co-operate with the local bushfire brigade and the regional bushfire committee. Bushfire management on this site will be consistent with the Bushfire Plan for Seven Mile Beach National Park and the Regional Bushfire Plan.

6.18 Access

Access to the conservation area will be minimised and only for the purposes of management, monitoring and research. In particular, vehicles are completely excluded from all conservation areas except for their use for the above purposes and then, they will be restricted to the existing identified tracks as shown on Appendix 4 of the conditions of consent.



6.19 Soil Testing

There is little need for soil testing on the rehabilitation areas as these are all natural sand dune soils with no known areas of foreign soil. It is proposed to undertake one set of soil sampling and testing to confirm that there is no likelihood of detrimental impact on forest regeneration.

6.20 Reporting

Monitoring the success or otherwise is an important component of the management plan. Day to day monitoring of the project will be carried out by Cleary Bros on-site staff. The preparation of an annual monitoring report by an ecologist is required under this management plan. The strategies and actions set out in the accompanying table indicate the specific matters to be considered. The desired outcomes set out in column two in the accompanying table should be the basis of the annual reporting.

The following key matters must be discussed in these annual reports:

- general condition of the retained forest, with particular reference to the Swamp Sclerophyll Forest area;
- general condition of each planted area;
- results of inspections of the screen planting area and the edge of the dredge pond;
- matters relevant to the success of the project, particularly weed invasion. A map showing the distribution of the weeds listed in **Table 5** will be updated annually.
- relevant photographs to demonstrate points being made;
- the condition of the quarry/forest boundary and any remedial works required;
- production of an updated map that shows the zones planted and any other relevant information; and
- results of the monitoring outlined in Section 8.

6.21 Boundary Marking of Conservation Area

The Department of Environment and Conservation (in litt., 22 December 2006, **Attachment 1**) in supporting the compensation proposals of the project stated that:

"The boundary of the extension area must be clearly defined in consultation with a fully qualified ecologist prior to the commencement of any construction works to ensure that an adequate buffer distance is maintained from the dredging activities/mine operations to the conservation area and Swamp Sclerophyll Forest."

and

"A buffer area should be revegetated with appropriate native species and should be subject to a vegetation management plan for inclusion in the QEMP for its long term restoration and management."

These matters have been dealt with in this plan. All boundaries have been marked on a survey plan and will be determined on site by an ecologist prior to any fencing being undertaken. The buffer areas have also been identified and incorporated into the design and plans for the project.



7 Descriptions of the Zones

This section provides details of the individual zones to be planted, as delineated on **Figure 1**. This information provides the basis for revegetation and habitat creation within each zone; this information will be read in conjunction with the principles outlined in Section 6 and other information on management elsewhere in the report. Note that Zone 1 and 7 cover the existing forest, where the main management actions are removal of stock grazing and weed control; existing native regeneration is generally good and will be improved through these actions.

The timing of the various zones is set out in Section 9, although it will be appreciated that site circumstances may change and the availability of species or habitat attributes become available from time to time that will modify the timing of the development of the sites or the actions proposed on a site. As stated later in this report, this is a part of the adaptive management approach.

7.1 Zone 1

(being Zones 1.1, 1.2, 1.3 and 1.4 shown on Figure 1)

Location: Throughout the project area, primarily the large area of forest immediately to the west of the existing and proposed dredge pond.

Extent: 46.25 ha

Existing Vegetation: Indigenous forest; this is mainly Swamp Sclerophyll Forest, with Blackbutt Tall Forest near the Crooked River Road and, to the northwest of the dredge pond, a stand of Swamp Oak Forest in the west of the property.

Primarily Purpose(s): Protection and enhancement of existing forest, particularly endangered ecological communities

Key Actions: (i) fence where required to exclude grazing stock; and (ii) carry out weed control.

Planting schedule: Generally unnecessary; area is existing forest where fencing and weed control will encourage natural regeneration of indigenous species.

Habitat Attributes to be Installed: Salvaged tree hollows and nest boxes.

Special Notes: Key weed infestations to be shown on a map.

7.2 Zone 2A.1

Location: North of quarry extension.

Extent: 2.1 hectares

Existing Vegetation: A few trees in the north, and along eastern fence. Rows of recently planted local trees. Natural regeneration of native plants is occurring. The existing plantings in this zone will be checked to ensure that they are of the correct species; thinning may be required if any unsuitable species are found.

Primary Purpose(s): (i) Connectivity with existing forests to north, east (across Gerroa Road) and west; (ii) Revegetation with local Bangalay Sand Forest with Littoral Rainforest.

Key Actions: (i) Spread timber debris; (ii) Plant key species; (iii) Remove problem weeds; (iv) Initiate monitoring.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest communities. Note that in addition to planting, direct spreading of seeds collected locally across the site will be carried out as this seed becomes available nearby.

Upper Canopy: *Eucalyptus botryoides*, *Angophora floribunda*, *Banksia integrifolia*

Middle canopy: *Glochidion ferdinandi*, *Gulea semiglauc*, *Acacia implexa*, *Duboisia myoporoides*, *Endiandra sieberi*, *Syhaum glandulosum*

Shrub Layer: *Monotoca elliptica*, *Acacia longifolia*, *Pittosporum revolutum*

Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, *Themeda australis* (by seed)

Habitat Attributes to be Installed: Timber debris such as tree trunks, branches and litter obtained from local sources. Salvaged hollows installed in trees when available.

Weed Control: Remove Lantana from near western side near creek.

Special Notes: Permanent survey plots to be established immediately after first plantings. Initial monitoring surveys to be undertaken prior to any works being carried out.

7.3 Zone 2A.2

Location: Southwest of existing dredge pond.

Extent: 2.5 hectares

Existing Vegetation: Planted local trees on bund along eastern side; scattered trees in far south near Beach Road. Understorey mainly exotic.

Primary Purpose(s): (i) Connectivity with existing forests to north and south (across Beach Road); (ii) Revegetation with local forest communities, including Bangalay Sand Forest with Littoral Rainforest and Swamp Oak Forest, depending upon drainage.

Key Actions: (i) Spray Kikuyu Grass; (ii) Spread timber debris; (iii) Plant key species; (iv) Remove problem weeds; (iv) Initiate monitoring.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest communities. Note that in addition to planting, direct spreading of seeds collected locally across the site will be carried out as this seed becomes available nearby.

Upper Canopy: *Eucalyptus botryoides*, *Angophora floribunda*, *Banksia integrifolia*, *Casuarina glauca* (wet sites), *Eucalyptus robusta* (wet sites);

Middle canopy: *Glochidion ferdinandi*, *Guilga semiglauc*, *Acacia implexa*, *Duboisia myoporoides*, *Endiandra sieberi*, *Synoum glandulosum*, *Melaleuca linariifolia* (wet sites)

Shrub Layer: *Monotoca elliptica*, *Acacia longifolia*, *Pittosporum revolutum*, *Melaleuca ericifolia* (wet sites)

Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, *Themeda australis* (by seed)

Habitat Attributes to be Installed: Timber debris such as tree trunks, branches and litter obtained from local sources. Nest boxes installed in trees.

Weed Control: Remove Lantana and problem weeds from bund area, spray Kikuyu Grass in patches ready for planting (increase area as planting progresses).

Special Notes: Permanent survey plots to be established immediately after first plantings. Initial monitoring surveys to be undertaken prior to any works being carried out.

7.4 Zone 2A.3

Location: Clearing in forest, northwest of existing dredge pond.

Extent: 0.65 hectares

Existing Vegetation: Planted local trees; native colonisation good; some weeds need control. Surrounded by forest.

Primary Purpose(s): (i) Consolidation of surrounding forest.

Key Actions: (i) Spray Kikuyu Grass; (ii) Plant key species; (iii) Remove problem weeds.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community. Note that there is good native regeneration already so that the plantings required are minimal.

Upper Canopy: *Eucalyptus botryoides*, *Eucalyptus pilularis*, *Banksia integrifolia*, *Eucalyptus robusta* (wet sites)

Middle canopy: *Melaleuca linariifolia* (wet sites), *Acacia implexa*

Shrub Layer: *Acacia longifolia*

Ground Cover: *Lomandra longifolia* (by seed), *Themeda australis* (by seed)

Habitat Attributes to be Installed: None necessary. Salvaged tree hollows installed nearby when available.

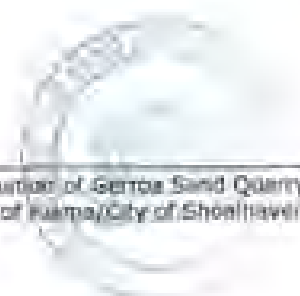
Weed Control: Remove Lantana and problem weeds from area, spray Kikuyu Grass if needed.

Special Notes: Management primarily aimed at enhancing the area with tree plantings and allowing the natural colonisation of natives to continue.

7.5 Zone 2B.1

Location: North of Blue Angle Creek, between zones 1 and 4.

Extent: 1.3 hectares



Existing Vegetation: Remnant trees, with mixed native and exotic ground cover, native regeneration good.

Primary Purpose(s): (i) Connectivity between remnant Bangalay Sand Forest in north and Swamp Sclerophyll Forest in south; (ii) buffer to edge of Blue Angle Creek.

Key Actions: (i) Plant key canopy species; (ii) Remove problem weeds.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community. Note that there is good native regeneration already so that the plantings required are minimal, the primary purpose is to gain a canopy so that native regeneration in the understorey is promoted. The edge of the creek requires swamp species, while the higher land needs Bangalay forest species.

Upper Canopy: *Eucalyptus botryoides*, *Banksia integrifolia*, *Eucalyptus robusta* (wet ground), *Casuarina glauca* (wet ground)

Middle canopy: *Melaleuca linarilfolia* (wet ground), *Acacia implexa*

Shrub Layer: *Melaleuca ericifolia* (near creek)

Ground Cover: Not needed.

Habitat Attributes to be Installed: None necessary.

Weed Control: Remove problem weeds from area, spray Kikuyu Grass around plantings if needed.

Special Notes: Management primarily aimed at excluding stock, creating a tree canopy and allowing the natural colonisation of natives to continue.

7.6 Zone 2B.2

Location: South of Blue Angle Creek, northwest of existing dredge pond.

Extent: 2.7 hectares

Existing Vegetation: Remnant trees around edge, with a mixed native and exotic ground cover.

Primary Purpose(s): (i) Consolidation of existing forest (Zone 1).

Key Actions: (i) Plant key species; (ii) Remove problem weeds.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community. The zone has been filled so may no longer support swamp forest; Blackbutt and Bangalay forest species can be planted in these higher areas.

Upper Canopy: Low areas: *Casuarina glauca*, *Eucalyptus robusta*, *Livistona australis*

High areas: *Eucalyptus botryoides*, *Eucalyptus pilularis*, *Banksia integrifolia*, *Banksia serrata*

Middle canopy: Low areas: *Melaleuca linarilfolia*,

High areas: *Acacia implexa*, *Duboisia myoporioides*, *Endiandra sieberi*, *Sydney glandulosum*,

Shrub Layer: Low areas: *Melaleuca ericifolia*, spread seed of *Gahnia clarkii*.

High areas: *Monotoca elliptica*, *Acacia longifolia*

Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, spread seed from nearby species when available.

Habitat Attributes to be Installed: Scatter logs and timber debris when available.

Weed Control: Remove/spray problem weeds from zone.

Special Notes: Management primarily aimed at excluding stock, creating a tree canopy and allowing the natural colonisation of natives to continue.

7.7 Zone 2C.1

Location: West of Blue Angle Creek.

Extent: 4.2 hectares

Existing Vegetation: Grassland or bare ground.

Primary Purpose(s): (i) Connectivity with existing forests to east and south; (ii) buffer to Blue Angle Creek; (iii) Revegetation with local Bangalay Sand Forest with Littoral Rainforest

Key Actions: (i) Plant key species; (ii) Spread timber debris; (iii) Spray problem weeds; (iv) spread "topsoil" from quarry area.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest communities. Note that in addition to planting, direct spreading of seeds collected locally across the site will be carried out as this seed becomes available nearby.



Upper Canopy: *Eucalyptus botryoides*, *Angophora floribunda*, *Banksia integrifolia*
Middle canopy: *Glochidion ferdinandi*, *Gulga semiglauca*, *Acacia implexa*, *Duboisia myoporoides*, *Endlandra sieberi*, *Synoum glandulosum*
Shrub Layer: *Monotoca elliptica*, *Acacia longifolia*, *Pittosporum revolutum*
Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, *Themeda australis* (by seed)
Habitat Attributes to be Installed: Timber debris such as tree trunks, branches and litter obtained from local sources. Salvaged hollows installed in trees when available.
Weed Control: Remove Lantana from near western side near creek.
Special Notes: Permanent survey plots to be established immediately after first plantings. "Topsoil" from quarry area to be spread when available; if necessary, part of zone to remain unplanted to receive soil. Exclude stock from area; this may require fencing.

7.8 Zone 2C.2

Location: South of channel, western part of conservation area.
Extent: 2.6 hectares
Existing Vegetation: Treeless, mostly an exotic ground cover, with wetland species near drain and scattered elsewhere.
Primary Purpose(s): (i) Develop long term connectivity to west.
Key Actions: (i) Plant key species; (ii) Remove problem weeds.
Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community.
Upper Canopy: *Casuarina glauca*, *Eucalyptus robusta*, *Livistona australis*
Middle canopy: *Melaleuca linariifolia*,
Shrub Layer: *Melaleuca ericifolia*, spread seed of *Gahnia clarkii* and other species in adjacent swamp forest when available.
Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, spread seed from nearby species when available.
Habitat Attributes to be Installed: Scatter logs and timber debris when available.
Weed Control: Remove/spray problem weeds from zone.
Special Notes: Management primarily aimed at excluding stock, creating a tree canopy and allowing the natural colonisation of natives to continue.

7.9 Zone 2D

Location: North arm, western part of conservation area.
Extent: 5.14 hectares
Existing Vegetation: Remnant trees towards western end of zone, mostly an exotic ground cover, with wetland species near drain and scattered elsewhere.
Primary Purpose(s): (i) Develop long term connectivity to west.
Key Actions: (i) Plant key species; (ii) Encourage existing trees to spread; (iii) Remove problem weeds.
Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community. The zone is wet and would primarily support Swamp Oak Forest.
Upper Canopy: *Casuarina glauca*, *Eucalyptus robusta*, *Eucalyptus tereticornis*
Middle canopy: *Melaleuca linariifolia*
Shrub Layer: *Melaleuca ericifolia*, spread seed of *Gahnia clarkii*
Ground Cover: *Lomandra longifolia*, spread seed of suitable wetland species when available.
Habitat Attributes to be Installed: Nil.
Weed Control: Remove/spray problem weeds from zone as required. May need to spray exotic grasses to establish trees.
Special Notes: Management primarily aimed at excluding stock, creating a tree canopy and allowing the natural colonisation of wetland natives.



7.10 Zone 2E

Location: South arm, western part of conservation area.

Extent: 2.8 hectares

Existing Vegetation: Treeless. Primarily exotic grassland with some wetland natives present.

Primary Purpose(s): (i) Develop long term connectivity to west; (ii) provide link to existing stand of forest.

Key Actions: (i) Plant key species; (ii) Remove problem weeds.

Planting Schedule: The following local native species are the key species to be planted; see lists at Table 4 in this report for further information on species from the relevant forest community. The zone is wet and would primarily support Swamp Oak Forest.

Upper Canopy: *Casuarina glauca*, *Eucalyptus robusta*, *Eucalyptus tereticornis*

Middle canopy: *Melaleuca linariifolia*

Shrub Layer: *Melaleuca ericifolia*, spread seed of *Gahnia clarkii*

Ground Cover: *Lomandra longifolia*, spread seed of suitable wetland species when available.

Habitat Attributes to be Installed: Nil.

Weed Control: Remove/spray problem weeds from zone as required. May need to spray exotic grasses to establish trees.

Special Notes: Management primarily aimed at excluding stock, creating a tree canopy and allowing the natural colonisation of wetland natives.

7.11 Zone 3

Location: Between northern part of quarry and eastern boundary of property

Extent: approximately 500 metre by 10 metres

Existing Vegetation: Some trees planted, further planting required.

Primary Purpose(s): (i) Screen between quarry and Gerroa Road; (ii) Provision of forest habitat.

Key Actions: (i) Plant screen species; (iii) Remove problem weeds.

Planting Schedule: The following local native species are the key species to be planted; see list at Table 2 in this report for further information on species to plant.

Upper Canopy: *Eucalyptus botryoides*, *Angophora floribunda*, *Banksia integrifolia*

Middle canopy: *Glochidion lerdinandi*, *Gulda semiglauc*, *Acacia implexa*, *Duboisia myoporioides*, *Pittosporum undulatum*

Shrub Layer: *Monotoca elliptica*, *Acacia longifolia* (to be used as protection of the rainforest), *Pittosporum revolutum*

Ground Cover: *Lomandra longifolia*, *Hibbertia scandens*, *Themeda australis* (by seed)

Habitat Attributes to be Installed: Nil.

Special Notes: Plantings to be undertaken to provide a dense vegetated screen; this involves planting a mixture of canopy to ground cover pats throughout length of the screen.

7.12 Zone 4

Location: North of Blue Angle Creek, north of Zone 2B.1.

Extent: 3.65 hectares

Existing Vegetation: Remnant forest, with mixed native and exotic ground cover, native regeneration good.

Primary Purpose(s): (i) maintenance and improvement of remnant Bangalay Sand Forest (endangered ecological community).

Key Actions: (i) Remove problem weeds.

Planting Schedule: The local native species for Bangalay Sand Forest at Table 4 in this report could be utilised, but fencing and weed control is all that is required to initiate improved natural regenerating. The trees below are the most appropriate.

Upper Canopy: *Eucalyptus botryoides*, *Angophora floribunda*, *Banksia integrifolia*

Middle canopy: *Acacia implexa*

Shrub Layer: Not needed.

Ground Cover: Not needed.

Habitat Attributes to be Installed: None necessary.

Weed Control: Remove/spray problem weeds in the area.



Special Notes: Management primarily aimed at excluding stock, enhancing the tree canopy and allowing the natural colonisation of natives to continue.

7.13 Zone 5 and 5C.1

Location: North of Blue Angle Creek, north of Zone 2C.2/Zone 1.

Extent: 1.6 hectares (existing forest); 0.25 hectares (planting areas)

Existing Vegetation: Remnant forest (apparently planted some years ago), with mainly an exotic ground cover.

Primary Purpose(s): (i) maintenance and improvement of remnant Swamp Oak Forest (endangered ecological community).

Key Actions: (i) Remove problem weeds.

Planting Schedule: The local native species for Swamp Oak Forest at Table 4 in this report could be utilised, but fencing and weed control is all that is required to initiate improved natural regenerating within the existing forest. Planting will occur within the adjoining small area Zone 5C.1; *Casuarina glauca* is the most appropriate tree.

Habitat Attributes to be Installed: None necessary.

Weed Control: Remove/spray problem weeds in the area.

Special Notes: Management primarily aimed at excluding stock, enhancing the tree canopy and allowing the natural colonisation of natives to continue.

7.14 Zone 6

Location and extent: Dredge pond foreshore, on batters above high water mark.

Existing Vegetation: Foreshores will be bare sand following completion of dredging and batter establishment.

Primary Purpose(s): (i) provision of a stable edge to the dredge pond; (ii) establishment of fringing wetland habitat.

Key Actions: (i) prepare final batter slope as soon as practicable after dredging is completed; (ii) spread timber debris across batter; (iii) plant batter with appropriate local species.

Planting Schedule: The appropriate species are set out in Tables 3 and 4, where suitable local wetland and foreshore species are identified.

Habitat Attributes to be Installed: Logs and timber debris, as available, to be scattered over batter. Local mulch to be used, if available. Some logs to be partly within the pond.

Weed Control: Undertaken as and when required. Hand removal of weeds only to be carried out.

Special Notes: If necessary, sections of permeable sand to be placed on batter to improve groundwater flow, as determined by the hydrogeologist. No chemicals (e.g. herbicides) are to be used on batters or in the pond.

7.15 Zone 7

Location: Retained littoral rainforest, east of dredge pond.

Extent: 1 hectare.

Existing Vegetation: Simple littoral rainforest below a higher canopy of eucalypts.

Primary Purpose(s): (i) retain and enhance the rainforest vegetation.

Key Actions: (i) plant buffer area ahead of nearby dredging; (ii) ensure tree felling does not impact upon retained forest; (iii) temporary fence buffer during quarrying nearby.

Planting Schedule: The appropriate rainforest species are set out in Table 4.

Habitat Attributes to be Installed: Not necessary as site is retained forest; some minor spreading of logs could be undertaken in buffer area.

Weed Control: Staged removal of Lantana and other weeds; work areas to be identified by ecologist.

Special Notes: No machinery to enter the area, all weed removal by hand and done progressively over at least six months. No chemicals (e.g. herbicides) are to be used.



8 Management Strategies and Actions

8.1 Key Threatening Processes

Key threatening processes are listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1994* (FM Act) and provide a ready list of the main threats to biodiversity in NSW. This management plan has been prepared in part of address the following key threatening processes, particularly where these threats impact on the endangered ecological communities present within the conservation area.

TSC Act

"Clearing of native vegetation"

The majority of the forest and wetland vegetation on the land (43.8 ha) will not be affected by the proposal; 3.3 ha would be removed. The proposal will in fact improve this forest through management actions, while about 19 ha will be revegetated and developed as habitat.

"Competition and grazing by feral European Rabbit"

Rabbits will be controlled on the land.

"Invasion and establishment of exotic vines and scramblers"

Weed vines and scramblers will be controlled as part of the overall weed management of the land.

"Invasion, establishment and spread of *Lantana camara*"

Lantana is one of the key weeds on the land and will be removed almost completely over time and control will be on-going.

"Invasion of native plant communities by *Chrysanthemoides monilifera*"

Bitou Bush occurs occasionally across the land; it will eventually be removed completely and control will be on-going.

"Invasion of native plant communities by exotic perennial grasses"

A few perennial grasses are problem weeds on the site and these will be controlled as required to ensure that they do not significantly impact upon the forest or the revegetation zones.

"Loss of hollow-bearing trees"

As some hollows will be removed, a program of salvage of hollows from trees cut down and their installation into trees to be retained in the forest will be undertaken, along with the installation of nest boxes.

"Predation by the European Red Fox"

Foxes will be controlled as required.

"Predation by the Feral Cat"

Feral Cats will be controlled as required.

"Removal of dead wood and dead trees"

A small amount of dead wood will be removed from the area to be cleared, this material will be spread across the revegetation zones where it will provide ground habitat for small fauna.

FM Act

"Introduction of fish to fresh waters"

Monitoring will be undertaken to determine if exotic fish have been introduced into the dredge pond. Advice from Department of Primary Industries will be taken should control measures be required.



"The degradation of native riparian vegetation"

The proposal does not impact on riparian vegetation as it has been designed to avoid removal or indirect impacts on this vegetation near Blue Angle Creek.

9.2 Addressing Key Management Issues

This section presents, in a tabular form, the management strategies and actions to achieve the objectives identified in the previous section of the Plan. The following tables describe the management issue and the desired management outcomes, followed by strategies and actions that have been identified to address each issue. This table will be read in conjunction with the other information provided in this plan.

The following matters have been identified as the key management issues to be addressed in this plan (refer to Table 6)

- i) identify the land zones to be replanted/enhanced;
- ii) define the forest communities/habitats to be re-created;
- iii) describe the techniques to be used in the planting program;
- iv) design revegetation and rehabilitation to provide habitat features for keystone species;
- v) identify and control important weeds;
- vi) installing habitat attributes including use of on-site organic materials;
- vii) salvage of tree hollows
- viii) search for Koalas prior to tree clearing;
- ix) genetic testing of fauna populations;
- x) identify plant species to be used in the planting program;
- xi) use on-site organic materials;
- xii) describe a maintenance regime;
- xiii) develop specific management actions for the quarry-forest boundary;
- xiv) develop a monitoring and reporting regime;
- xv) review the plan;

The successful completion of the actions set out in this plan is the responsibility of the Company's site manager. The Company has made a commitment to undertake and maintain this reforestation for the life of the sand mine. Additionally, regular monitoring by a qualified person and reporting to the consent authority will ensure the success of the project. All works would be guided by a qualified bush regenerator or similarly qualified person.

8.3 Performance Indicators

The success of the enhancement and revegetation programs will be measured using the following key criteria.

- invasive weeds are controlled and are not hindering the wellbeing of the forest or revegetated zones;
- all plantings are successfully growing and providing a high level of cover and are progressing towards the structure and diversity of a natural forest;
- retained forest and the revegetation zones support increasing populations of native fauna;
- fences or other barriers are maintained where necessary such that no vehicles or stock are impacting in a negative way on the retained forest or revegetation zones;
- all on-site staff have been inducted and are aware of the environmental management requirements of the site.

Monitoring of the edge zone of the quarry is an important part of the proposed monitoring; i.e. from quarry edge 20 metres into the forest.

The following performance indicators have been identified; these would be assessed as part of the annual reporting regime. Some of these indicators are obviously closely linked and overlapping. These indicators and their monitoring will be discussed with the DECC prior to their implementation.

Monitoring Area: Health of existing forest

Monitoring Regime:

1. Permanent plots and/or transects in retained forest; type and location to be discussed with DECC.
2. Weed surveys (see below).
3. General fauna observations.
4. General observations on the condition of the forest.

Performance indicated by:

1. No incursion of quarry activities.
2. No obvious negative impact on forest (e.g. die-back, weed invasion, major species change).
3. Weed growth is reduced over time and not negatively impacting upon the forest habitat.
4. Fauna use is not diminished and good populations being maintained.

Monitoring Area: Health of existing littoral rainforest

Monitoring Regime:

1. Permanent plots and/or transects in retained forest; type and location to be discussed with DECC.
2. Weed surveys (see below).
3. General fauna observations.
4. Photographic history of the rainforest edge over time is recorded.
5. General observations on the condition of the rainforest.

Performance indicated by:

1. No impact of quarry activities, particularly nearby clearing of trees.
2. No obvious negative impact on forest (e.g. die-back, weed invasion, major species change).
3. Weed growth is reduced over time and not negatively impacting upon the forest habitat.
4. Fauna use is not diminished and good populations are being maintained.

Monitoring Area: Health of revegetation zones

Criteria (from conditions of consent)

23. Successful establishment of the Northern Corridor shall be measured by the following criteria:
 - (a) presence of native flora species;
 - (b) a majority of the flora species recorded from the removed forest occur in the area; (e.g. 60% of flora species recorded in removed forest are present);
 - (c) species for all four layers have been planted and at least 50% of the projected cover has been achieved for each of the shrub and ground cover layers;
 - (d) self-sustaining native plant populations (e.g. regeneration of a second generation);
 - (e) no dominance by single flora species (e.g. Bracken);
 - (f) weeds are not significantly impacting on the native vegetation;
 - (g) weeds do not represent a majority of the flora species or a higher percentage cover than the native flora species; and
 - (h) impacts such as grazing are excluded from the area.

Monitoring Regime:

1. Permanent plots and/or transects in revegetation zones.
2. Weed surveys (see below).
3. General fauna observations.
4. General observations on the condition of the revegetation zones.

Performance indicated by:

1. The majority of plantings survive, including replacement plants.
2. Natural regeneration is occurring, including through spread seeds.
3. Plant diversity is increasing over time.
4. Use by native animals is increasing.
5. Successional establishment of second generation plants within the planting zone.

Monitoring Area: Health of fauna populations

Criteria (from conditions of consent)

24. Successful establishment of fauna habitat in the Northern Corridor would be measured by:

- (a) presence of species (e.g. healthy populations of species from all relevant animal groups are established);
- (b) a majority of the resident species recorded from the removed forest occur in the area;
- (c) fauna populations are resident in the area;
- (d) pest animals are controlled and not impacting upon the fauna or its habitat; and
- (e) impacts such as grazing are excluded from the area.

Monitoring Regime:

1. Permanent sample sites and/or timed transects in revegetation zones.
2. Feral animal surveys (see below).
3. General fauna observations.
4. General observations on the condition of the revegetation zones.

Performance indicated by:

1. Created habitat features are in place and being utilised by fauna.
2. Natural regeneration is occurring, increasing habitat complexity.
3. Fauna species diversity is increasing over time.
4. Use by native animals is increasing over time.

Monitoring Area: Weed growth

Monitoring Regime:

1. Recording the presence of weed growth on permanent plots or along transects.
2. Inspection of forest edges.
3. Regular surveys of areas where weed control has been undertaken.
4. General survey of known weed sites.

Performance indicated by:

1. Key weeds are reduced in their extent and abundance and eventually extirpated from the site.
2. Weeds are not significantly hindering natural regeneration.
3. All noxious weeds are adequately controlled on the land.

Monitoring Area: Presence of feral animals

Monitoring Regime:

1. Signs of feral animal presence surveyed for during regular inspections and continually by on-site staff.

Performance indicated by:

1. Feral animals are not having a significant detrimental impact upon the forest or revegetation zones.
2. Rabbits, Foxes and Feral Cats are controlled on the land.



8.4 Monitoring Habitat Corridors

In addition to the above monitoring, the northern and southern habitat corridors will be monitored as to their use by vertebrate fauna. The basis of this monitoring is set out in the conditions of consent.

The following Condition 25 from the conditions of consent is relevant here.

25. Prior to the severance of the east-west link the Proponent shall:
- (a) determine the presence in both the east-west link and northern corridor by conducting standard animal survey techniques at least twice in the first year (eg. Elliot trapping for small mammals, pitfall trapping for reptiles, observational surveys for frogs and birds, and spotlighting transects for arboreal animals);
 - (b) determine whether a majority of animal species (particularly those determined to be likely to be impacted by fragmentation) utilising the corridor in the east-west link are present in the conservation area and the northern corridor and the re-created link at the northern boundary;

8.5 Adaptive Management

In terms of native vegetation and other management issues, it is important to monitor and evaluate results on an on-going basis and to modify management actions in the light of these evaluations. This important concept, known as 'adaptive management', must be embraced in managing this project. Adaptive management can be defined as "a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs" (Lawrence, Bennett & Barchiesi 2008). In other words, a management plan should be flexible enough to deal with unforeseen issues that inevitably arise from time to time and also respond to new information that is learned from the project area or elsewhere that improve management outcomes.



Table 6: Management Actions

Management Issue	Desired Outcome	Strategy	Actions
1. Identify the land zones to be reclaimed/enhanced	The revegetation zones are delineated and fenced (where necessary) to prevent disturbance from stock) as soon as practicable following development approval	The zones to be planted are identified by survey, marked on a plan and the location of fencing determined on site; each to be endorsed by the consent authority.	1.1 Zones identified (Figure 1). 1.2 Zones to be surveyed and a survey plan prepared. 1.3 Finalise boundaries of zones before fencing, then fence where necessary.
2. Define the forest communities to be re-created	The distribution of the vegetation types to be re-created is delineated on the plan.	The distribution of the vegetation types is linearly shown on the plan and are to be endorsed by the consent authority.	2.1 Zones of each existing forest type are delineated on Figure 2. Planting zones identified on Figure 1 and described in this plan. 2.2 Proposal to be submitted to the Consent Authority for endorsement and modified, if required. 2.3 Finalise distribution of forest types before planting begins.
3. Describe the techniques to be used in the planting program	The methods to be used for revegetation are clearly described and ready for field use.	The methods are set out in the plan and are to be endorsed by the consent authority.	3.1 Planting techniques are described earlier in the report. 3.2 Proposals to be submitted to the Consent Authority for endorsement and modified, if required.
4. Identify plant species to be used in the planting program	Plantings are restricted to local native species, planted in their appropriate communities	Appropriate species are to be selected and planted in defined locations to re-create the following natural forest communities of the locality: <ul style="list-style-type: none"> - Littoral Rainforest; - Blackbutt - Banksia Forest; - Bungle - Banksia Forest; - Swamp Sclerophyll Forest; - Seeping Oak Forest. 	4.1 Lists of appropriate species are attached to this plan. 4.2 Proposed lists to be submitted to the Consent Authority for endorsement and modified, if required. 4.3 Finalise species lists for each community and associate plan.
5. Identify and control important weeds; i.e. those that threaten outcomes of the management plan.	Invasive and other important weeds are as far as practical eliminated from the management area.	Weed control is integrated into site management.	5.1 A list of the most important weeds is provided in this plan. 5.2 Map showing distribution of key weeds to be prepared in first stage of project.
6. Involving habitat attributes including use of on-site organic materials (other than plantings)	Appropriate use is made of cleared organic material from the development area or elsewhere on site.	The vegetation removed from the site will, where practical, be used to assist in the establishment of the planting zones. The top 30 cm of sandy soil (containing seeds and other propagation material), logs and timber debris are all useful in re-establishing forest habitat on the presently cleared land that is dominated by exotic plants.	6.1 Site manager will ensure that this material is appropriately used to best advantage; soil will not be stored in stockpiles for longer than seven days. Material must be stored for a minimal amount of time before use. 6.2 Ecologist to advise on best use of material, e.g. using logs on edge of pond and in revegetation zones.



7. Salvage of tree hollows.	Maximum number of tree hollows are salvaged and installed in nearby forest.	Tree hollows for salvage will be identified by an ecologist and removed prior to clearing of trees. Most trees to be identified by an ecologist and hollows installed as soon as possible. Trees to be located near to the subject site.	7.1 Site manager and ecologist to identify and tag tree hollows for salvage. 7.2 Site manager to organise removal of hollows prior to clearing. 7.3 Site manager and ecologist to identify and tag suitable host trees. 7.4 Site manager to organise for cut hollows to be strapped to identified trees. 8.1 Site manager to contact ecologist morning before clearing to arrange inspection of trees. 8.2 Ecologist to ensure no Koala present on site just prior to clearing commencing. 9.1 Company to engage specialists. 9.2 Ecologist to guide the specialists on the site. 9.3 Specialists to discuss findings with company and ecologist.
8. Search for Koalas prior to tree clearing.	No Koalas are present during clearing operations.	Carry out inspection of trees on the day of the clearing to ensure that no animals are present. If animals are present, then clearing is delayed until animal has moved away.	10.1 Slashing. Slashing or mowing of the exotic grassland in the planting zones may be required for some time. This will be carried out as required. 10.2 Watering. Watering of plantings will be required for some time after planting. Watering frequency must respond to local rainfall. 10.3 Weeds. Noxious weeds are to be controlled at all times. Other grasslike weeds may occur from time to time; it is the responsibility of the site manager to ensure infestations that threaten the revegetation are dealt with as soon as practicable. 10.4 Replacing dead plants. Dead plants are to be replaced with the same or other appropriate species as soon as practicable after plant death. 10.5 Feral animals. Rabbits and Foxes are to be controlled as required. Control methods must be in accordance with guidelines from the Rural Lands Protection Board.
9. Genetic testing of feral populations.	Information on the genetic makeup of local populations of selected species is obtained, allowing identification of 'genetic populations'.	Engage specialists to undertake the collection, sampling and analysis of target animals.	11.1 The limits of the approved quarry are to be highlighted on site during clearing works in each area; a temporary, coloured plastic fence would be appropriate. 11.2 The edge of the approved quarry shall
10. Describe a maintenance regime.	An appropriate maintenance program is incorporated into the plan and endorsed by the Consent Authority.	A maintenance program is to be developed that covers the following key matters:- - slashing/mowing; - watering; - weeds; - replacing dead trees; - feral animals	
11. Develop specific management actions for the quarry-forest boundary.	Procedures are in place to ensure that the forests immediately adjacent to the quarry are not adversely affected.	Appropriate measures are to be incorporated into the quarry management plan to protect adjoining areas of forest.	



			<p>be permanently pegged on site and no clearing or excavation is permitted beyond this point.</p> <p>11.3 The site manager is to include presentation on this plan as part of site inductions for on-site staff.</p> <p>12.1 The site manager is responsible for initiating the required reports.</p> <p>12.2 Reports to be submitted to the Consent Authority for their information and comment.</p> <p>12.3 Matters to be covered in the annual reports are set out in this plan.</p> <p>12.4 Recommendations contained in the reports are to be discussed with the site manager and implemented as appropriate.</p> <p>13.1 Ecologist to carry out Plan review in consultation with site manager after first five years.</p>
		<p>The revegetation zones are to be monitored for a period of five (5) years to ensure that these are progressing satisfactorily towards the planned forest communities. An annual report by a botanist is to be prepared after a site inspection in autumn each year.</p>	
	<p>A satisfactory monitoring and reporting regime is in place to ensure the success of the reforestation program and appropriate management of the quarry perimeter.</p>		
12. Develop a monitoring and reporting regime.			
13. Review of Plan:	<p>This plan is reviewed and updated as required after the first five years.</p>	<p>Plan to be reviewed to ensure current conditions and issues are adequately addressed.</p>	



9 Project Timing

The timing of the various components of the rehabilitation project based on the management zones described above are set out in the accompanying table, where the program for the first two five year time periods is described. This is a summary of and the information in Section 7 (outlining the management of each management zone) will be read in conjunction with this table.

It is envisaged that the majority of revegetation and enhancement activities will be completed by the end of year eight. The following seven year period would essentially be a maintenance period, concentrating on weed control and ensuring the upkeep of the fencing and other minor issues.



Table 7

Time Line: Years 1 to 5.

MANAGEMENT ZONE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Zone 1 Forest Enhancement	<ul style="list-style-type: none"> Identify areas requiring management input Construct fences Prepare weed map Remove identified weeds Identify planting areas and plant Install salvaged tree hollows 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control Plant into areas after preparation 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control Undertake Plan review (all zones), 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest control Undertake Plan review (all zones),
Zone 2 Broad Scale Planting	<ul style="list-style-type: none"> Plant out 2A zones Construct fence in Zones 2A, 2B and 2C Carrying out one off soil testing 	<ul style="list-style-type: none"> Plant out 2B zones Maintenance of completed zones as required 	<ul style="list-style-type: none"> Plant out 2C zones Maintenance of completed zones as required 	<ul style="list-style-type: none"> Plant out 2D zone Maintenance of completed zones as required Construct fence in Zones 2D and 2E 	<ul style="list-style-type: none"> Plant out 2E zone Maintenance of completed zones as required
Zone 3 Screen Planting	<ul style="list-style-type: none"> Construct boundary fence Complete planting Weed control as required Initial maintenance as required 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants
Zone 4 Remnant Forest	<ul style="list-style-type: none"> Install stock proof fence Plant canopy trees between zone and creek 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing

Zone 5: Remnant Forest (planted Swamp Oak)		<ul style="list-style-type: none"> • Install stock proof fence • Plant canopy trees between zone and creek 	<ul style="list-style-type: none"> • Maintenance <ul style="list-style-type: none"> - weed control - replace dead plants - check fencing • As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> • Maintenance <ul style="list-style-type: none"> - weed control - replace dead plants - check fencing • As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> • Maintenance <ul style="list-style-type: none"> - weed control - replace dead plants - check fencing • As for Year 1 as dredging progresses.
Zone 6: Dredge Pond Foreshore	<ul style="list-style-type: none"> • Stabilise foreshore: Place logs, etc. along foreshore • Undertake plantings • Determine need for additional permeable material on batters • Weed control as Required 	<ul style="list-style-type: none"> • As for Year 1 as dredging progresses. 			
Zone 7: Littoral Rainforest	<ul style="list-style-type: none"> • Identify trees to be felled ahead of quarrying (to avoid later impact on planting: from felling). • subject to Condition 20(b) and paragraph 7.15 of this plan, fell trees and plant ahead of quarrying. • Temporary fence buffer area. • Carry out weed removal by hand. 	<ul style="list-style-type: none"> • As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> • As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> • As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> • As for Year 1 as dredging progresses.

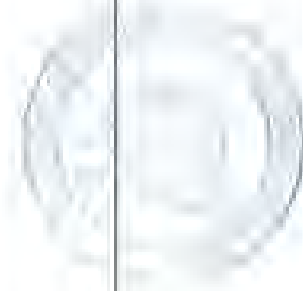


Table 7 cont...

Time Line: Years 6 to 10/11 to 15.

MANAGEMENT ZONE	YEAR 6 & 11	YEAR 7 & 12	YEAR 8 & 13	YEAR 9 & 14	YEAR 10 & 15
Zone 1 Forest Enhancement	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest animal control 	<ul style="list-style-type: none"> Maintenance as required <ul style="list-style-type: none"> weed control maintain fence pest control Undertake Plan review (all zones).
Zone 2 Broad Scale Planting	<ul style="list-style-type: none"> Maintenance of completed zones as required Monitoring 	<ul style="list-style-type: none"> Maintenance of completed zones as required Monitoring 	<ul style="list-style-type: none"> Maintenance of completed zones as required Monitoring 	<ul style="list-style-type: none"> Maintenance of completed zones as required Monitoring 	<ul style="list-style-type: none"> Maintenance of completed zones as required Monitoring
Zone 3 Screen Planting	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants
Zone 4 Remnant Forest	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing
Zone 5 Remnant Forest (planted Swamp Oak)	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing 	<ul style="list-style-type: none"> Maintenance <ul style="list-style-type: none"> weed control replace dead plants check fencing
Zone 6 Dredge Pond Foreshore	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. Weed control as required 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses.

Zone 7 Littoral Rainforest	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses. 	<ul style="list-style-type: none"> As for Year 1 as dredging progresses.
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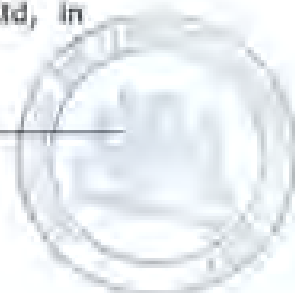
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Appendix 1 Indigenous Plant Species List for the Gerroa Property

PTERIDOPHYTA (Ferns)

DENNSTAEDTIACEAE

Hypolepis muelleri Wakef.
Pteridium esculentum (Forster f.) Cockayne

Marsh Ground Fern
Common Bracken

SINOPTERIDACEAE

Pellaea falcata (R. Br.) Fee

Sickle Fern

ANGIOSPERMAE (Flowering Plants)

ALISMATACEAE

Alisma plantago-aquatica L.

Water Plantain

AMARYLLIDACEAE

Crinum pedunculatum R. Br.

Swamp Lily

APIACEAE

Centella asiatica (L.) Urban
Hydrocotyle laxiflora DC.
Lilaeopsis polyantha (Gand.) H. Eichler

Indian Pennywort
Stinking Pennywort
Creeping Crantzia

APOCYNACEAE

Parsonsia straininea (R. Br.) F. Muell.

Monkey-rope Vine

ARECACEAE

Livistona australis (R. Br.) Mart.

Cabbage Palm

ASCLEPIADACEAE

Marsdenia rostrata R. Br.
Tylophora barbata R. Br.

Common Milk Vine
Bearded Tylophora

ASTERACEAE

Cassinia aculeata (Labill.) R. Br.
Cassinia quinquefaria R. Br.
Orethamnus diosmifolius (Vent.) DC.
Senecio bipinnatisectus Belcher
Senecio hispidulus A. Rich.
Sigesbeckia orientalis L.

Common Cassinia
Rosemary Cassinia
Everlasting
Groundsel
Rough Fireweed
Indian Weed

BIGNONIACEAE

Pandorea pandorana (Andrews) Steenis

Wonga Vine

CAMPANULACEAE

Wahlenbergia gracilis (Forster f.) A. DC.

Australian Bluebell

CASUARINACEAE

Casuarina glauca Sieber ex Sprengel

Swamp Oak

CLUSTIACEAE

Hypericum gramineum Forster f.

Small St John's Wort

COMMELINACEAE

Commelina cyanea R. Br.

Wandering Sailor



CONVOLVULACEAE*Dichondra repens* Forster & Forster f.

Kidney Weed

CYPERACEAE*Baumea articulata* (R. Br.) S. T. Blake*Carex appressa* R. Br.*Carex longibrachiolata* Boeck.*Eleocharis acuta* R. Br.*Eleocharis equisetina* C. Presl*Eleocharis sphacelata* R. Br.*Gahnia clarkii* Benth*Isolepis nodosa* (Rottb.) R. Br.*Schoenoplectus validus* (Vahl) A. & D. Love

Jointed Twig-rush

Tall Sedge

Bergalia Tussock

Common Spike-rush

Spike-rush

Tall Spike-rush

Tall saw-sedge

Knobby Club-rush

River Club-rush

DILLENIACEAE*Hibbertia obtusifolia* DC.

Grey Guinea Flower

EPACRIDACEAE*Monotoca elliptica* (Smith) R. Br.

Tree Broom-heath

EUPHORBIACEAE*Breynia oblongifolia* Muell. Arg.*Glochidion ferdinandi* (Muell. Arg.) Bailey*Glochidion ferdinandi* (Muell. Arg.) Bailey var. *pubens**Omalanthus populifolius* Graham

Breynia

Cheesetree

Hairy Cheesetree

Bleeding Heart

EUPOMATIACEAE*Eupomatia laurina* R. Br.

Bolwarra

FABACEAE**FABOIDEAE (subfamily)***Desmodium varians* (Labill.) G. Don.*Glycine clandestina* J.C. Wendl.*Kennedia rubicunda* (Schneev.) Vent.

Slender Tick-trefoil

Twining Glycine

Dusky Coral-pea

MIMOSOIDEAE (subfamily)*Acacia binervata* DC.*Acacia implexa* Benth.*Acacia longifolia* (Andrews) Willd.*Acacia maidenii* F. Muell.*Acacia mearnsii* De Wild.*Acacia suaveolens* (Smith) Willd.*Acacia ulidifolia* (Salisb.) Court

Two-veined Hickory

Hickory Wattle

Golden Wattle

Maiden's Wattle

Black Wattle

Sweet Wattle

Prickly Moses

GERANIACEAE*Geranium solanderi* Carolin

Native Geranium

GOODENIACEAE*Goodenia bellidifolia* Smith

Rocket Goodenia

HALORAGACEAE*Gonocarpus teucrioides* DC.

Raspwort

HYDROCHARITACEAE*Ottelia ovalifolia* (R. Br.) Rich.

Swamp Lily

JUNCACEAE*Juncus kraussii* Hochst.*Juncus planifolius* R. Br.*Juncus prismatocarpus* R. Br.

Sea Rush

Broad Rush

Branching Rush



Juncus usitatus L.A.S. Johnson

Common Rush

JUNCAGINACEAE

Triglochin procerum R. Br.

LAMIACEAE

Lycopus australis R. Br.

Australian Gypsywort

LAURACEAE

Cassytha pubescens R. Br.

Downy Dodder-laurel

Endiandra sieberi Nees

Hard Corkwood

LOBELIACEAE

Lobelia alata Labill.

Angled Lobelia

Pratia purpurascens (R. Br.) E. Wimmer

Lobelia Pratia

LOMANDRACEAE

Lomandra longifolia Labill.

Spiny-headed Mai-rush

LORANTHACEAE

Amyema pendulum (Sieber ex Sprengel) Tieghem

Drooping Mistletoe

LYTHRACEAE

Lythrum hyssopifolia L.

Hyssop Loosestrife

Lythrum salicaria L.

Purple Loosestrife

MELIACEAE

Synoum glandulosum (Smith) A. Juss.

Rosewood

MENISPERMACEAE

Stephania japonica (Thunb.) Miers

Snake Vine

MORACEAE

Ficus coronata Spn

Sandpaper Fig

Ficus macrophylla Desf. ex Pers.

Moreton bay Fig

Ficus obliqua Forster f.

Small-leaved Fig

Ficus superba Miq.

Deciduous Fig

MYRSINACEAE

Myrsine howittiana (F. Muell. Ex Mez) Jackes

Muttonwood

MYRTACEAE

Angophora floribunda (Smith) Sweet

Rough-barked Apple

Eucalyptus botryoides Smith

Bangalay

Eucalyptus pilularis Smith

Blackbutt

Eucalyptus robusta Smith

Swamp Mahogany

Eucalyptus tereticornis Smith

Forest Red Gum

Leptospermum juniperinum Smith

Prickly Teatree

Melaleuca ericifolia Smith

Swamp Paperbark

Melaleuca linariifolia Smith

Narrow-leaved Paperbark

Melaleuca styphelioides Smith

Prickly-leaved Paperbark

OLEACEAE

Notelaea longifolia Vent.

Native Olive

ORCHIDACEAE

Acianthus formicatus R. Br.

Pixie Caps

Dendrobium teretifolium R. Br.

Rat's-tail Orchid

PHILESIACEAE

Eustrephus latifolius R. Br.

Wombat Berry

<i>Geitonoplesium cymosum</i> (R. Br.) A. Cunn. ex Hook.	Scrambling Lily
PHORMIACEAE <i>Dianella caerulea</i> Sims	Flax-lily
PITTOSPORACEAE <i>Billardiera scandens</i> Smith <i>Citriobatus pauciflorus</i> Cunn. ex Ettingsh. <i>Pittosporum revolutum</i> Alton <i>Pittosporum undulatum</i> Vent.	Common Apple-berry Orange Thorn Yellow Pittosporum Sweet Pittosporum
POACEAE <i>Cymbopogon refractus</i> (R. Br.) A. Camus <i>Cynodon dactylon</i> (L.) Pers. <i>Dichelachne crinita</i> (L.) Hook. f. <i>Echinopogon caespitosus</i> C. E. Hubb. <i>Echinopogon ovatus</i> (G. Forst.) P. Beauv. <i>Entolasia stricta</i> (R. Br.) Hughes <i>Eragrostis ? brownii</i> (Kunth) Nees <i>Hemarthria uncinata</i> R. Br. <i>Imperata cylindrica</i> P. Beauv. <i>Microlaena stipoides</i> (Labill.) R. Br. <i>Opismenus aemulus</i> (R. Br.) Roem. & Schult. <i>Opismenus imbecillus</i> (R. Br.) Roem. & Schult. <i>Paspalum distichum</i> L. <i>Phragmites australis</i> (Cav.) Trin. ex Steud. <i>Themeda australis</i> (R. Br.) Stapf	Barbed Wire Grass Couch Grass Longhair Plumegrass Tufted Hedgehog-grass Forest Hedgehog-grass Wiry Panic Common Love-grass Mat Grass Blady Grass Weeping Grass Australian Basket-grass Pademelon Grass Water Couch Common Reed Kangaroo Grass
POLYGONACEAE <i>Persicaria decipiens</i> (R. Br.) K. L. Wilson <i>Persicaria strigosa</i> (R. Br.) Gross	Slender Knotweed Spotted Knotweed
POTAMOGETONACEAE <i>Potamogeton tricarlinatus</i> F. Muell & Benn. ex Benn.	Floating Pondweed
PROTEACEAE <i>Banksia integrifolia</i> L. f. <i>Persoonia linearis</i> Andrews	Coast Banksia Narrow-leaved Geebung
RANUNCULACEAE <i>Clematis aristata</i> R. Br. ex DC. <i>Ranunculus inundatus</i> R. Br. ex DC.	Australian Clematis River Buttercup
RESTIONACEAE <i>Restio tetraphyllus</i> Labill. subsp. <i>melostachyus</i> L. Johnson & O. D. Evans	Tassel Cord-rush
RHAMNACEAE <i>Alphitonia excelsa</i> (Fenzi) Reisseck ex Benth.	Red Ash
ROSACEAE <i>Rubus parvifolius</i> L.	Native Raspberry
RUBIACEAE <i>Morinda jasminoides</i> Cunn.	Morinda
RUTACEAE <i>Melicope micrococca</i> (F. Muell.) T. Hartley <i>Zieria smithii</i> Jackson	White Eyodia Sandfly Zieria



SAPINDACEAE

Dodonaea triquetra Wendl.
Guloa semiglauc (F. Muell.) Radlk.

Long-leaved Hop-bush
 Guloa

SCROPHULARIACEAE

Bacopa monniera (L.) Pennell

Bacopa

SMILACACEAE

Smilax glycyphylla Sm.

Thornless Sarsaparilla

SOLANACEAE

Duboisia myoporoides R. Br.

Corkwood

SPARGANIACEAE

Sparganium angustifolium Graciner

Floating Bur-reed

STACKHOUSIACEAE

Stackhousia viminalis Smith

Slender Stackhousia

STERCULIACEAE

Commersonia fraseri Gay

Bush Kurrajong

TYPHACEAE

Typha orientalis C. Presl

Broad-leaved Cumbungi

VERBENACEAE

Clerodendrum tomentosum R. Br.

Hairy Clerodendrum

VIOLACEAE

Viola hederacea Labill.

Native Violet

VISCACEAE

Notofixos subaureus Oliver

Golden Mistletoe

VITACEAE

Cayratia dematidea (F. Muell.) Domin
Cissus hypoglauca A. Gray

Slender Grape
 Water Vine



Appendix 2 Key Habitat Attributes for Animal Species Known or Expected in the Project Area and Nearby At Gerroa

Bold entries are animal species that have been recorded on the site to be cleared or immediately adjacent to it between 1988 and 2006. The other species have been recorded in the Seven Mile Beach locality.

Group Name	Common Name	Habitat Attribute		Shrubs	Ground Plants	Woody Debris	Open Areas	Wet Areas
		Trees	Tree Hollows					
Mammals								
Brown Antechinus	Antechinus stuarti	-	-	-	ground plants	woody debris	-	-
Bush Rat	Rattus fuscipes	-	-	-	ground plants	woody debris	-	-
Chocolate Wattled Bat	Chalinobatus morio	trees	tree hollows	-	-	-	open areas	-
Common Brushtail Possum	Trochurus vulpecula	trees	tree hollows	-	-	-	-	-
Common Ringtail Possum	Pseudocheirus peregrinus	trees	tree hollows	shrubs	-	-	-	-
Eastern Forest Bat	Vespadelus pumilus	trees	tree hollows	-	-	-	open areas	-
Eastern Freetail-bat	Mormopterus sp.	trees	tree hollows	-	-	-	open areas	-
East-coast Freetail-bat	Mormopterus novae-hollandiae	trees	tree hollows	-	-	-	open areas	-
Feathered Glider	Acrobates pygmaeus	trees	tree hollows	-	-	-	-	-
Goat's Wattled Bat	Chalinobatus gouldi	trees	tree hollows	-	-	-	open areas	-
Greater Glider	Petaurus volans	trees	tree hollows	-	-	-	-	-
Grey-headed Flying-fox	Pteropus poliocephalus	trees	-	-	-	-	-	-
Large Bentwing-bat	Miniopterus schreibersii	trees	-	-	-	-	open areas	-
Large Forest Bat	Vespadelus darlingtoni	trees	tree hollows	-	-	-	open areas	-
Little Forest Bat	Vespadelus vulturnus	trees	tree hollows	-	-	-	open areas	-
Long-nosed Bandicoot	Perameles nasuta	-	-	-	ground plants	woody debris	-	-
Short-beaked Echidna	Tachyglossus aculeatus	-	-	-	-	-	-	-
Southern Forest Bat	Vespadelus regulus	trees	-	-	-	-	open areas	-
Spotted-tailed Quoll	Dasyurus maculatus	trees	tree hollows	-	ground plants	woody debris	-	-
Sugar Glider	Petaurus breviceps	trees	tree hollows	shrubs	-	-	-	-
Swamp Wallaby	Wallabia bicolor	-	-	shrubs	ground plants	-	-	-
White-striped Freetail-bat	Nyctinomus australis	trees	-	-	-	-	open areas	-
Birds								
Australian Hobby	Falco longipennis	trees	-	-	-	-	-	-
Australian Magpie	Gymnorhina tibicen	trees	-	-	-	-	open areas	-
Australian Raven	Corvus corax	trees	-	-	-	-	-	-
Barn Owl	Tyto alba	trees	tree hollows	-	-	-	-	-
Bustard Thrush	Zosterornis lateralis	-	-	-	ground plants	woody debris	-	-
Black-faced Cuckoo-shrike	Coccyzus novae-hollandiae	trees	-	-	-	-	-	-
Black-faced Monarch	Monarcha melanoptera	trees	-	-	-	-	-	-
Black-shouldered Kite	Elaenia dohrnii	trees	-	-	-	-	open areas	-

Group Name	Common Name	Habitat Attribute					Woody Debris	Open Areas	Wet Areas
		Trees	Tree Hollows	Shrubs	Ground Plants				
Brown Falcon	Falco berigota	tree	-	-	-	-	-	open areas	-
Brown Gerygone	Gerygone olivacea	tree	-	shrubs	-	-	-	-	-
Brown Goshawk	Accipiter fasciatus	tree	-	-	-	-	-	-	-
Brown Thornbill	Acanthiza pusilla	tree	-	shrubs	-	-	-	-	-
Brown-headed Honeyeater	Malurus melanocephalus	tree	-	-	-	-	-	-	-
Brush Cuckoo	Cacomantis variolosus	tree	-	-	-	-	-	-	-
Charmy-bellied Cuckoo	Seythrops novaezealandiae	tree	-	-	-	-	-	-	-
Cuckoo	Concina tenuirostris	tree	-	-	-	-	-	-	-
Collared Sparrowhawk	Accipiter cirrocephalus	tree	-	-	-	-	-	-	-
Common Keel	Eudynamis scolopacea	tree	-	-	-	-	-	-	-
Crested Pigeon	Cycophaps uropygialis	tree	-	-	-	-	-	open areas	-
Crested Shrike-lark	Fulcrufus montanus	tree	-	-	-	-	-	-	-
Crimson Rosella	Platycercus elegans	tree	-	-	-	-	-	-	-
Dollarbird	Eurylaimus orientalis	tree	-	-	-	-	-	-	-
Double-banded Finch	Taeniopygia bichenovii	-	-	-	ground plants	-	woody debris	-	-
Dusky Woodswallow	Artamus cyanopterus	tree	-	-	-	-	-	open areas	-
Eastern Rosella	Platycercus elegans	tree	-	-	-	-	-	open areas	-
Eastern Spinebill	Acanthorhynchus tenuirostris	tree	-	shrubs	-	-	-	open areas	-
Eastern Whipbird	Pachyrodus olivaceus	-	-	shrubs	ground plants	-	-	-	-
Eastern Yellow Robin	Eopsaltria australis	tree	-	shrubs	ground plants	-	-	-	-
Emerald Dove	Chalcophaps indica	tree	-	shrubs	ground plants	-	-	-	-
Fairy Martin	Hirundo irrorata	-	-	-	-	-	-	open areas	-
Fawn-tailed Cuckoo	Cacomantis flabelliformis	tree	-	-	-	-	-	-	-
Frigatebird	Sphenocircus viridis	tree	-	-	-	-	-	-	-
Galah	Cacatua roseicapilla	tree	-	-	-	-	-	-	-
Gang-gang Cuckoo	Callipepla melanoleuca	tree	-	-	-	-	-	-	-
Golden Whistler	Pachycephala pectoralis	tree	-	-	-	-	-	-	-
Grey Butcherbird	Circus forficatus	tree	-	-	-	-	-	-	-
Grey Fantail	Rhipidura fuliginosa	tree	-	shrubs	-	-	-	-	-
Grey Goshawk	Accipiter novaehollandiae	tree	-	-	-	-	-	-	-
Grey Shrike-thrush	Culicivora hammondi	tree	-	shrubs	-	-	-	-	-
Hooded's Bronz-Cuckoo	Chrysococcyx basalis	tree	-	-	-	-	-	-	-
Laughing Kookaburra	Dacelo novaezealandiae	tree	-	-	-	-	-	-	-
Leaden Flycatcher	Myiagra rubecula	tree	-	-	-	-	-	-	-
Levin's Honeyeater	Meliphaga lewinii	tree	-	-	-	-	-	-	-
Little Eagle	Hieraaetus morphnoides	tree	-	-	-	-	-	-	-
Little Lorikeet	Glossopsitta pusilla	tree	-	-	-	-	-	-	-
Little Wattlebird	Anthracoceros chrysops	tree	-	-	-	-	-	-	-
Maggie-lark	Gallinula cyanoleuca	tree	-	-	-	-	-	open areas	-

Group Name	Common Name	Habitat Attributes					Open Areas	Wet Areas
		Trees	Tree Hollows	Shrubs	Ground Plants	Woody Debris		
Mistletoebird	<i>Dicaeum hirundinaceum</i>	trees	-	-	-	-	-	-
Musk Lorikeet	<i>Glossopsitta concinna</i>	trees	tree hollows	-	-	-	-	-
Nankai Kestrel	<i>Falco concinnoides</i>	trees	tree hollows	-	-	-	open areas	-
New Holland Honeyeater	<i>Phylidonyrs novaehollandiae</i>	trees	-	shrubs	-	-	-	-
Noddy Friarbird	<i>Phalanger corniculatus</i>	trunks	-	-	-	-	-	-
Noddy Miner	<i>Manorina melanoccephala</i>	trunks	-	-	-	-	-	-
Olive-backed Oriole	<i>Oriolus sagittatus</i>	trunks	-	-	-	-	open areas	-
Pallid Curlew	<i>Colinus pallidus</i>	trunks	-	-	-	-	-	-
Peregrine Falcon	<i>Falco peregrinus</i>	trunks	-	-	-	-	-	-
Pied Currawong	<i>Serpeta graculina</i>	trunks	-	-	-	-	-	-
Powerful Owl	<i>Ninox strenua</i>	trunks	tree hollows	-	-	-	-	-
Rainbow Lorikeet	<i>Tachypetecus haemastictus</i>	trunks	tree hollows	-	-	-	-	-
Red Wattlebird	<i>Anthochaera carunculata</i>	trunks	-	-	-	-	-	-
Red-browed Finch	<i>Neodroma temporalis</i>	trunks	-	shrubs	ground plants	-	open areas	-
Richard's Pipit	<i>Anthus novaeseelandiae</i>	-	-	-	ground plants	-	open areas	-
Rose Robin	<i>Petroica rosea</i>	trunks	-	-	ground plants	-	-	-
Rufous Fantail	<i>Rhipidura rufirostris</i>	trunks	-	shrubs	-	-	-	-
Rufous Whistler	<i>Pachycephala rufiventris</i>	trunks	-	shrubs	-	-	-	-
Sacred Kingfisher	<i>Todiramphus sanctus</i>	trunks	tree hollows	-	-	-	-	-
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	trunks	-	-	-	-	-	-
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>	trunks	-	-	-	-	-	-
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	trunks	-	shrubs	-	-	-	-
Silvereye	<i>Zosterops lateralis</i>	trunks	-	-	-	-	-	-
Southern Boobook	<i>Ninox novaeseelandiae</i>	trunks	tree hollows	-	-	-	-	-
Spangled Drongo	<i>Dicrurus bracteatus</i>	trunks	-	-	-	-	-	-
Spotted Pardalote	<i>Pardalotus punctatus</i>	trunks	-	-	-	-	-	-
Striped Pardalote	<i>Pardalotus striatus</i>	trunks	tree hollows	-	-	-	-	-
Striated Thornbill	<i>Acanthiza lineata</i>	trunks	-	shrubs	-	-	-	-
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	trunks	tree hollows	shrubs	ground plants	woody debris	-	-
Superb Fairy-wren	<i>Malurus cyaneus</i>	-	-	-	-	-	-	-
Tawny Frogmouth	<i>Rodericus nigropictus</i>	trunks	tree hollows	-	-	-	-	-
Topical Pigeon	<i>Lopholaimus antarcticus</i>	trunks	-	-	-	-	-	-
Tree Martin	<i>Hirundo nigricans</i>	trunks	tree hollows	-	-	-	open areas	-
Varied Sittella	<i>Daphoenositta chrysophaea</i>	trunks	-	-	-	-	-	-
Variegated Fairy-wren	<i>Malurus lamberti</i>	-	-	shrubs	ground plants	woody debris	-	-
Welcome Swallow	<i>Hirundo neoxena</i>	trunks	-	-	-	-	open areas	-
Whistling Kite	<i>Haliastur sphinxinus</i>	trunks	-	-	-	-	-	-
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	trunks	-	-	-	-	-	-
White-browed Swallow	<i>Sericornis frontalis</i>	-	-	shrubs	ground plants	woody debris	-	-



Group Name	Common Name	Habitat Attributes						
		Trees	Tree Hollows	Shrubs	Ground Plants	Woody Debris	Open Areas	Wet Areas
White-naped Honeyeater	Meliphaga lineata	traces	-	-	-	-	-	-
White-throated NewSheal	Mitrochalcus cauculatus	completely aerial	-	-	-	-	-	-
White-throated Nightjar	Eurostoedus mystacalis	traces	-	-	ground plants	-	-	-
White-throated Treecreeper	Corrobuthus leucophaea	traces	tree hollow	-	-	-	open areas	-
Willie Wagtail	Rhipidura leucophrys	-	-	-	ground plants	-	open areas	-
Yellow Thornbill	Acanthiza nana	traces	-	shrubs	-	-	-	-
Yellow-faced Honeyeater	Lichenostomus chrysops	traces	-	shrubs	-	-	-	-
Yellow-rumped Thornbill	Acanthiza chrysantroz	-	-	shrubs	ground plants	-	open areas	-
Yellow-tailed Black-Cockatoo	Calyptrornis lunatus	traces	-	-	-	-	-	-

Reptiles

Black-bellied Swamp Snake	Hemiaspis signata	-	-	-	ground plants	-	-	wet areas
Delicate Snake	Lampropholis delicata	-	-	-	ground plants	woody debris	-	-
Diamond Python	Morelia spilota	traces	tree hollow	-	-	-	-	-
Eastern Blue-tongued Lizard	Tiliqua scincoides	-	-	-	ground plants	woody debris	-	-
Eastern Tiger Snake	Notropis aculeatus	-	-	-	ground plants	woody debris	-	-
Eastern Water Dragon	Physignathus fasciatus	-	-	-	ground plants	woody debris	-	-
Eastern Water Snake	Eulamprus quoyi	-	-	-	ground plants	woody debris	-	-
Grass Skink	Lampropholis guichenoti	-	-	-	ground plants	woody debris	-	-
Jacky Lizard	Amphibolurus muricatus	-	-	-	ground plants	woody debris	-	-
Lara Monitor	Varanus varius	traces	tree hollow	-	ground plants	woody debris	-	-
Long-necked Tortoise	Chelonia longicollis	-	-	-	-	-	-	wet areas
Oak Snake	Cyclodomorphus canumaze	-	-	-	ground plants	woody debris	-	-
Red-bellied Black Snake	Pseudochis porphyreus	-	-	-	ground plants	woody debris	-	-
Southern Water Snake	Eulamprus heatwolei	-	-	-	ground plants	woody debris	-	-
Three-lined Snake	Salpinctes equalis	-	-	-	ground plants	woody debris	-	-

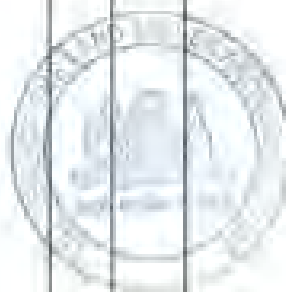
Frogs

Bleeding Tree Frog	Litoria dentata	-	-	-	ground plants	woody debris	-	-
Brown-striped Frog	Limnodynastes peronii	-	-	-	ground plants	woody debris	-	-
Common Eastern Froglet	Cryno signifera	-	-	-	ground plants	woody debris	-	-
Green and Golden Bell Frog	Litoria aurea	-	-	-	ground plants	woody debris	-	-
Green Tree Frog	Litoria caerulea	-	-	-	ground plants	woody debris	-	-
Jarvis Bay Tree Frog	Litoria jarvisensis	-	-	-	ground plants	woody debris	-	-
Peron's Tree Frog	Litoria peronii	-	-	-	ground plants	woody debris	-	-
Tyler's Tree Frog	Litoria tyleri	-	-	-	ground plants	woody debris	-	-
Vermilion's Tree Frog	Litoria verreauxi	-	-	-	ground plants	woody debris	-	-

All Species : 141 (100%)

Species on Site : 53 (100%)

Note: Some frogs utilize trees, tree hollows and shrubs



Appendix 3

Control Classes for Noxious Weed Species

Weed control classes

- (1) The following weed control classes may be applied to a plant by a weed control order:
 - (a) Class 1, State Prohibited Weeds,
 - (b) Class 2, Regionally Prohibited Weeds,
 - (c) Class 3, Regionally Controlled Weeds,
 - (d) Class 4, Locally Controlled Weeds,
 - (e) Class 5, Restricted Plants.
- (2) The characteristics of each class are as follows:
 - (a) Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
 - (b) Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
 - (c) Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
 - (d) Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
 - (e) Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.
- (3) A noxious weed that is classified as a Class 1, 2 or 5 noxious weed is referred to in this Act as a *notifiable weed*.
- (4) **Legal Requirements**
Class 1. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 2. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 3. The plant must be fully and continuously suppressed and destroyed.
Class 4. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Class 4*. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.
Class 5. The requirements in the *Noxious Weeds Act* for a notifiable weed must be complied with.



Appendix E

BASELINE WATER DATA

Groundwater - Pond Interactions

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Figures

Figure B-1: Monthly Rainfall 1993 - 2006

Figure B-2: Recorded Dredge Pond Levels

Figure B-3: Recorded Water Levels in Dredge Pond and Monitoring Bores

Figure B-4: Dredge Pond Water Levels Under the Influence of Rainfall and Evaporation Only

Tables

Table B-1: Average Monthly Rainfall, open Water Evaporation and Rainfall Excess

Table B-2 Monthly Rainfall 1993 – 2006

Table B-3 Correspondence Between Peak Pond Levels and Preceding Rainfall

Table B-4 Variation in Pond and Bore Water levels

B-1 Introduction

1. This report provides an analysis of the interaction between the existing and proposed dredge pond at the Gerroa Sand Mine and the groundwater in the immediate vicinity. The report also considers the effect of rainfall and evaporation on groundwater and pond levels.
2. As at December 2007, the existing dredge pond has a water surface area of about 15 ha.
3. The proposed extension to the dredge pond is located in a relatively narrow strip of land that runs in a north-easterly direction between Crooked River Road on the south-east and an excavated drain to the north-west. At completion, the dredge pond extension will measure approximately 900 m long by an average of 75 m wide and have a water surface area of 7 ha.

B-2 Data

4. In the course of preparing this report I have reviewed and taken account of the following data:
 - a) Dredge pond water level observations taken at an average of approximately 10 day intervals between 1993 and 2006 - data provided by Cleary Bros (Bombo);
 - b) Observations of water level in groundwater monitoring bores in the vicinity of the dredge pond taken at approximately monthly intervals between 1993 and 2006 - data provided by Cleary Bros (Bombo);
 - c) Records of the dredge pond water surface area at various dates - data provided by Cleary Bros (Bombo);
 - d) Daily rainfall records for Kiama (1897 – 2007) and Gerringong (Mayflower) (1895 – 2007) - provided by the Bureau of Meteorology;
 - e) Daily pan evaporation records for Nowra (1972 – 2006) - provided by the Bureau of Meteorology;
 - f) Mapping showing the variation of average annual and average monthly pan evaporation across Australia – provided by the Bureau of Meteorology.

B-3 Climatic Setting

5. Table 1 shows the estimated average monthly water balance for an open water body at Gerroa based on the long term daily rainfall records from Gerringong (1895 – 2006) and pan evaporation records from Nowra (1972 – 2006). For purposes of this analysis I have adopted the pan evaporation data from Nowra. I consider that this will lead to an over estimation of the actual evaporation loss from the dredge pond because the Nowra meteorological station (about 20 km inland) will tend to be hotter and less humid (and therefore subject to higher evaporation) than the dredge pond at Gerroa (about 1 km from the ocean).
6. The data in Table B-1 indicates that, on average there is likely to be an excess of rainfall over evaporation (positive values in the last column of Table B-1) for five months from March to July and an excess of evaporation (negative values in the last column of Table B-1) during the seven months from August to February. The estimated average annual

excess of evaporation over rainfall is 166 mm or 1.66 ML/ha. Obviously, the balance between rainfall and evaporation is highly dependant on the weather for the particular year. Analysis of the rainfall and evaporation data for the period 1972 (when evaporation records at Nowra began) and 2006 indicates that the annual water balance for an open water pond would have varied from a loss of 990 mm (1980) to a gain of 775 mm (1974).

Table B-1: Average Monthly Rainfall, Open Water Evaporation and Rainfall Excess

Month	Rainfall (mm)	Evaporation (mm)	Rainfall Excess ¹ (mm)
Jan	127	175	-48
Feb	132	143	-11
Mar	148	128	21
Apr	136	102	34
May	129	79	50
Jun	126	71	55
Jul	92	76	16
Aug	81	104	-23
Sep	73	126	-53
Oct	93	151	-58
Nov	95	157	-62
Dec	99	186	-87
Year	1,331	1,497	-166

Note 1: Rainfall that exceeds evaporation denoted by positive values.

- Table B-2 summarises the annual rainfall for the period 1993-2007 and the departure of the annual rainfall from the long term average. (Note that the average values quoted at the bottom of Table B-2 represent the long term average (1895 – 2006)). The last column of Table B-2 shows the departure from the long term average annual rainfall. The table shows that there has been significant variation from the long term average during the period 1993 to 2006 with 1993 being the driest (-490 mm) and 1999 being the wettest (+405 mm).

Table B-2: Monthly Rainfall 1993 - 2006

Year	J	F	M	A	M	J	J	A	S	O	N	D	Year	Departure
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1993	53	67	110	15	62	42	91	91	143	78	61	28	841	-490
1994	29	153	198	142	56	178	37	11	12	66	43	45	972	-359
1995	125	49	183	19	280	97	4	6	198	159	217	77	1,415	84
1996	155	75	61	105	63	101	70	83	104	40	127	33	1,018	-313
1997	226	142	129	8	151	143	108	13	168	52	39	43	1,221	-110
1998	94	39	60	190	202	139	93	619	44	21	129	69	1,699	368
1999	376	134	119	187	89	80	251	46	48	236	68	103	1,736	405
2000	76	22	145	76	61	78	50	31	48	52	230	77	946	-385
2001	101	285	111	69	104	56	200	96	33	60	125	31	1,270	-61
2002	243	396	135	110	82	74	13	16	25	27	27	92	1,241	-90
2003	68	96	110	202	539	72	66	63	18	79	207	54	1,574	243
2004	70	86	101	341	27	28	80	47	111	309	72	103	1,376	45
2005	175	107	128	35	138	65	158	5	101	106	173	45	1,236	-95
2006	125	66	52	24	124	228	184	90	91	16	70	90	1,161	-170
Ave	127	132	148	136	129	126	92	81	73	93	95	99	1,331	

8. Figure B-1 graphically shows the same monthly rainfall that is presented in Table B-1 and illustrates the significant variation in rainfall that has occurred over the period 1993 – 2006.

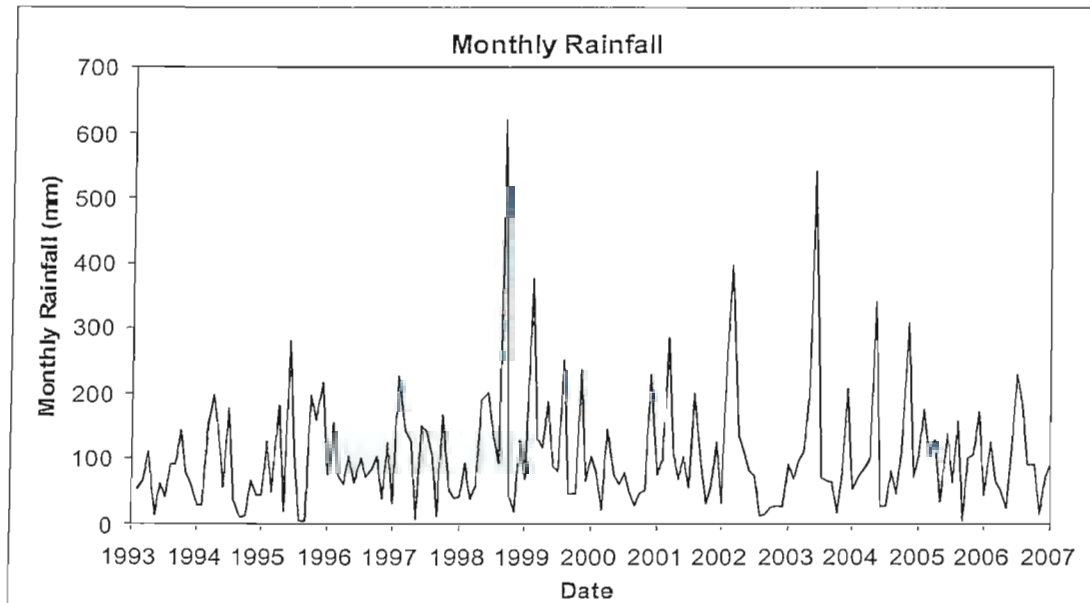


Figure B-1: Monthly Rainfall 1993 - 2006

B-4 Observed Pond and Groundwater Levels

9. Water levels in the dredge pond at Gerroa have been monitored at approximately 10 day intervals since 1993. Figure B-2 shows the variation of pond water level over this period.

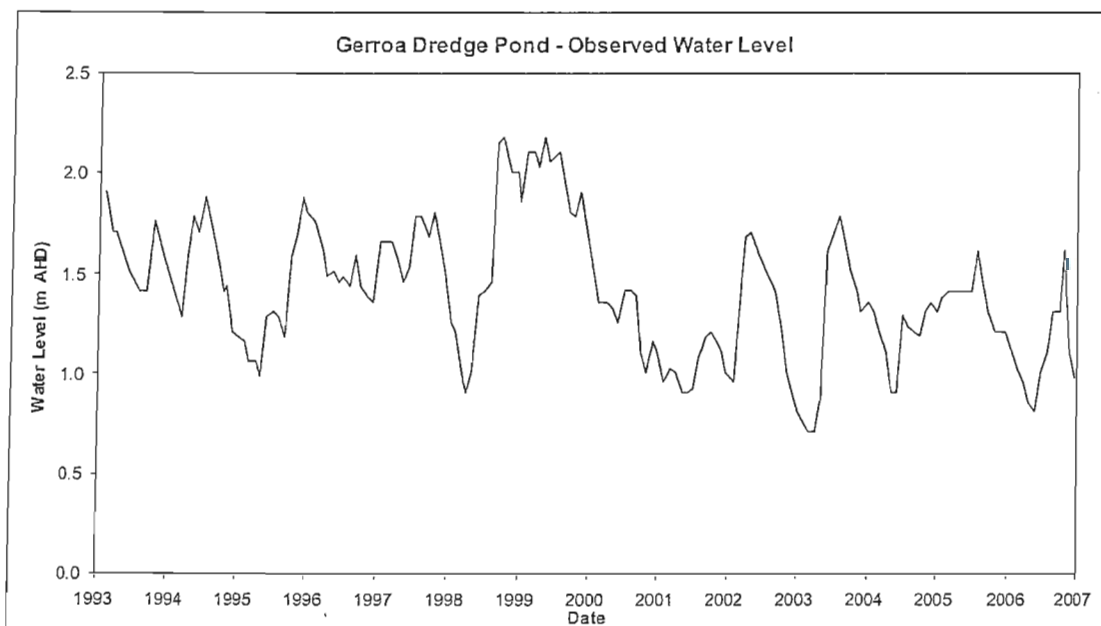


Figure B-2: Recorded Dredge Pond Levels

10. As would be expected, Figure B-2 shows a distinct correlation between pond water level and the preceding rainfall as set out in Table B-2 and Figure B-1. In particular the peaks in the pond water level are directly related to rainfall as shown in Table B-3.

Table B-3: Correspondence Between Peak Pond Levels and Preceding Rainfall

Pond		Rain	
Level (m AHD)	Month	Depth (mm)	Month
1.89	Jul-94	178	Jun-94
1.89	Nov-95	217	Nov-95
2.19	Nov-98	619	Aug-98
1.71	Apr-02	396	Feb-02
1.29	Jun-04	341	Apr-04
1.61	Jul-05	158	Jul-05
1.61	Nov-06	228	Jun-06

11. Figure B-3 shows the observed water levels in the dredge pond and in a number of monitoring bores located in close proximity to the existing dredge pond or the proposed extension:

- BH1 Located near the quarry entrance to the west of the southern end of the existing dredge pond;
- BH2 Located near the corner of Beach Road and Crooked River Road to the east of the southern end of the existing dredge pond;
- BH4 Located approximately 500 m north east of the existing dredge pond adjacent to Crooked River Road (near the centre of the proposed sand mine extension).

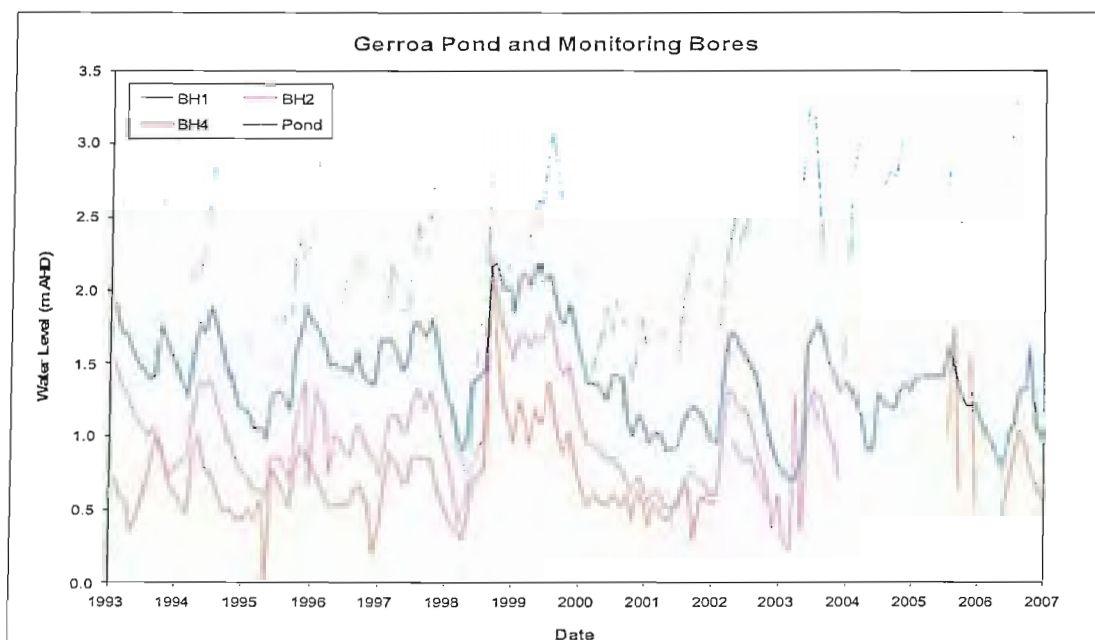


Figure B-3: Recorded Water Levels in Dredge Pond and Monitoring Bores

12. The water levels in Figure B-3 indicate the following characteristics:
- Groundwater levels respond to rainfall in a similar manner to the pond itself;
 - The relative levels in BH1, BH2 and the pond indicate that most of the time there is a hydraulic gradient that would cause flow from the vicinity of BH1 towards the pond, and from the pond towards BH2. The exceptions to this are:
 - the occasions when the level in BH1 drops below the level in the pond (eg towards the middle of 1998 and the middle of 2001) and flow would occur from the pond towards BH1;
 - the occasions when the level in BH2 rises above the level in the pond (eg towards the middle of 2003) and flow would occur towards the pond from the vicinity of BH2.
 - The fact that the pond level is above the level in BH2 for most of the time indicates that the pond is helping sustain the groundwater level in the vicinity of BH2;
 - The water levels in BH4 (which is located well away from any influence of the pond -about 500 m) are generally lower than the water level in the pond or BH1 and BH2. This indicates that there is a hydraulic gradient towards the north-east which would be fed by the pond.
 - The water levels in BH4 exhibit a similar response to rainfall as that exhibited by the other bores and the pond.
13. Table B-4 summarises the variation in observed water levels in the pond and the monitoring bores. The data in table B-4 shows that:
- Water levels in the pond vary over a smaller range than the groundwater. This infers that the pond has a moderating effect on the variation in groundwater levels in the vicinity of the pond;
 - The average groundwater level in BH4 is significantly lower than in the pond or BH1 and BH2.

Table B-4: Variation in Pond and Bore Water Levels

	BH1	BH2	BH4	Pond
Average Level (m AHD)	2.07	1.00	0.74	1.40
Maximum Level (m AHD)	3.32	2.21	2.23	2.19
Minimum Level (m AHD)	0.35	0.23	0.00	0.71
Range (m)	2.97	1.98	2.23	1.48

B-5 Water Losses from the Dredge Pond

14. The dredge pond forms a “window” onto the natural groundwater system.
15. The water level in the dredge pond is established by a combination of factors, principally:
- The hydraulic gradients that causes groundwater to flow into or out of the pond (see Paragraph 12 above);
 - The average water level in the drain upstream of the flap gates;
 - Evapotranspiration from vegetation that can access the groundwater; and
 - Water gains (rainfall) and losses (evaporation) from the surface of the dredge pond.

16. Based on the average climatic data set out in Table B-1, the loss of water from the surface of the existing dredge pond under average climatic conditions would have varied from about 16 ML/year in 1993 (10 ha area) to 24 ML/year in 2006. At the completion of sand extraction the average annual water loss is estimated to be 36 ML/year (22 ha water surface area).
17. Figure B-4 shows the results of an analysis of the expected water level in the pond under the influence of rainfall and evaporation only. This figure has been derived by subtracting the monthly evaporation from the monthly rainfall using the historic records for the period 1993 – 2006. To make the levels comparable with the levels shown in Figure B-1, the analysis shown in Figure B-4 starts and ends with the same water levels as observed in the pond.

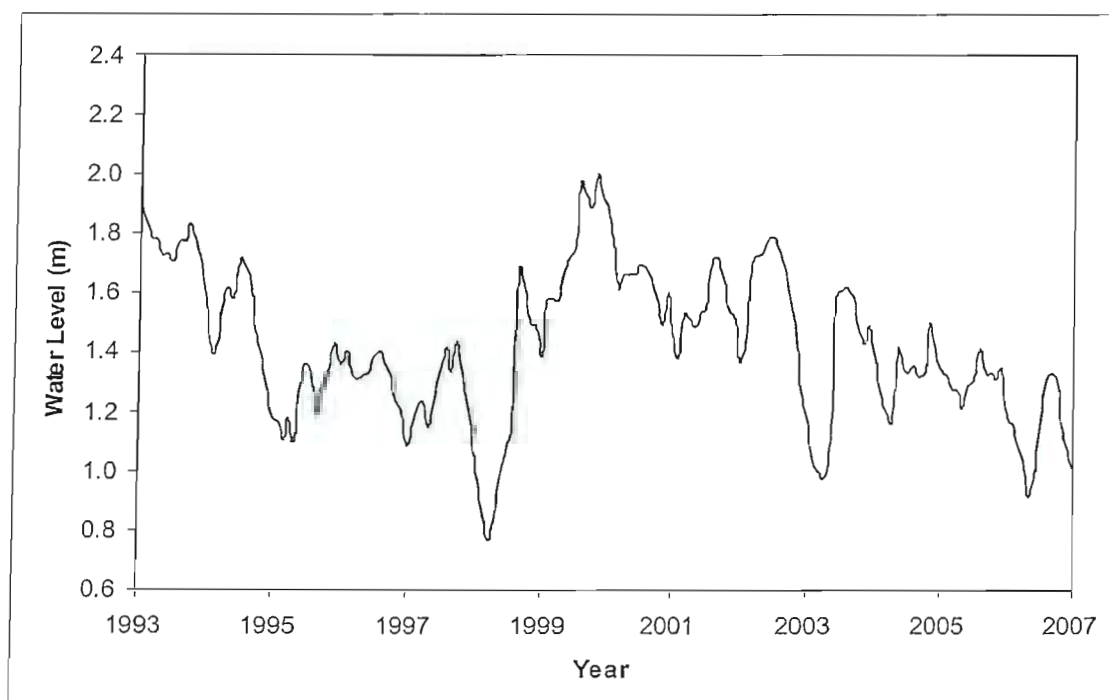


Figure B-4: Dredge Pond Water Levels under the Influence of Rainfall and Evaporation Only

18. Figure B-4 shows that that rainfall and evaporation on the surface of the pond are significant factors in determining the fluctuation of pond water level. However the figure also indicates that groundwater outflow and inflow are significant factors. This is illustrated by the levels observed in the pond as a result of two periods of heavy rainfall from mid 1998 to the end of 1999.
 - a) The effect of the first period of heavy rainfall in March to August 1998 was to raise the pond level by 1.28 m (see Figure B-1) but the rise attributable to direct rainfall and evaporation was only 0.91 m (see Figure B-3). This indicates that groundwater inflow contributed to the observed rise in the pond level.
 - b) A second period of heavy rainfall in the first six months of 1999 would have contributed 0.54 m to the water level as a result of direct rainfall and evaporation (see Figure B-4). However, as can be seen in Figure B-1, the pond water level only rose by 0.38 m. This indicates that during this period the pond was contributing water to the local groundwater system.

Appendix E – BASELINE WATER DATA - Part 2

This part contains two extracts from the Douglas Partners *Report on Geotechnical Assessment – Proposed Northern Extension of Gerroa Sand Quarry* (June 2006). This report was published in full in the environmental assessment for the quarry extension (Perram & Partners 2006).

Relevant extracts are:

- ❑ 6.3 – pH of Dredge Pond water and Groundwater;
- ❑ 6.4 – Groundwater Quality
- ❑ 2 (addendum) – Nutrient Levels

Tables of water quality monitoring results prior to 2006 upon which the attached extracts are based are included in the Douglas Partners report.

6.2 Rainfall and Evaporation from Dredge Pond

The assessed median rainfall for the Gerroa area is about 1165 mm (in comparison with 1047 mm for the period of recording at the Gerroa Sand Quarry). In comparison, available data for evaporation rates for a NSW south coast area recording station (Ulladulla) indicates that the average daily evaporation rate is of the order of 2.8 mm/day (1022 mm/year), less than either the assessed or measured rainfall data. It is however understood that readings at the Nowra monitoring station indicate average evaporation of the order of 4 mm/day (about 1460 mm/year). As such, there is an uncertainty with regard to the balance between rainfall and evaporation from the dredge pond at the site.

6.3 pH of Dredge Pond Water and Groundwater

Measurement of the pH of both the dredge pond water and groundwater in the Cleary Bros (Bombo) Pty Ltd monitoring bores has been carried out on a regular basis since 1993. The monitoring of the dredge pond and the monitoring bores WM 1 and WM 2 at the southern end of the Gerroa Sand Quarry, together with monitoring bores WM 3, WM 4, WM 5 and WM 6, the main drainage canal and Blue Angle Creek in or near the proposed Northern Extension Area indicated:

- the dredge pond pH has generally moved within the range 6.0 – 9.0 (moderately acidic to strongly alkaline) in comparison with a range of 5.4 – 8.5 (strongly acidic to strongly alkaline) for the monitoring bores.
- the lowest dredge pond pH values were measured in the period of heavy rainfall at the end of July 1998 and extreme rainfall in mid August 1998. This may reflect the flushing of organic acids or oxidised pyritic material from the sand aquifer.
- the minimum pH levels (pH 5.4 and 5.9, respectively) in the monitoring bores WM 2 and WM 3 may be an indicator of pyrite oxidation or the presence of organic acid complexes.
- the pH of Blue Angle Creek at the flood gates at the northern end of the CB property (i.e. north of the proposed quarry extension) generally ranged between 6.6 and 7.8, but with a lower pH reading of 4.8 being associated with transient stream flushing event during wet

weather. For comparison, pH readings as low as 3.2 have been recorded in the drains within Foy's Swamp, upstream (west) of the proposed quarry extension area.

The conditions represented by the pH values within the dredge pond or monitoring bores described above are not considered severe. The significantly lower pH values recorded in the Foy's Swamp drainage system and its discharge path (Blue Angle Creek) indicate periodic severe conditions probably related to flushing of acid formed by oxidation of acid sulphate soils.

6.4 Groundwater Quality

It is noted that the Berry Siltstone, which forms the bedrock to the immediate south of Berry Beach Road, frequently includes accessory pyrite mineralisation, but of a significantly different formation type and form than associated with acid sulphate soils. The soils developed on the Berry Siltstone are commonly acidic and surface runoff from these soils may influence the quality of the groundwater within the adjacent alluvial aquifer.

Measurement of the electrical conductivity (as an indicator of Total Dissolved Solids [TDS]) of groundwater in the dredge pond and the Cleary Bros (Bombo) Pty Ltd monitoring bores WM 1 - WM 6 has been carried out since 1993. Additional field measurement of TDS has also been undertaken by E2W and others in the dredge pond and at Blue Angle Creek. The results of the monitoring are summarised in Table 2 (see following page).

It is understood that the highest value at Blue Angle Creek was recorded at high tide and indicates substantial mixing with seawater.

Field measurements of Dissolved Oxygen (DO) have also been undertaken recently by E2W and others in the dredge pond, main canal and at Blue Angle Creek. The results indicate DO values in the ranges 65% - 100%, 24% - 100% and 26% - 92% in the dredge pond, main canal and Blue Angle Creek, respectively.

Table 2 – Summary of Electrical Conductivity ($\mu\text{S}/\text{cm}$) at Sampling Locations

Period	Electrical Conductivity ($\mu\text{S}/\text{cm}$) at sampling location							
	WM 1	WM 2	WM 3	WM 4	WM 5	WM 6	Dredge Pond	Blue Angle Creek
1993	636 - 5980	416 - 920	130 - 470	404 - 605	96 - 1140	91 - 225	400 - 626	NA
1994	390 - 2940	395 - 1162	132 - 1833	142 - 930	86 - 1140	495 - 966	NA	NA
1995	650 - 2440	322 - 1983	140 - 380	388 - 1620	96 - 490	76 - 209	NA	NA
1996	414 - 4620	321 - 1114	213 - 609	376 - 590	98 - 120	91 - 136	NA	NA
1997	2390 - 4980	335 - 501	214 - 537	351 - 677	109 - 180	73 - 120	NA	NA
1998	1220 - 6470	366 - 902	191 - 701	370 - 1052	54 - 171	93 - 236	NA	NA
1999	965 - 2900	455 - 879	161 - 314	264 - 1098	84 - 191	83 - 238	NA	NA
2000	739 - 3830	460 - 770	NA	604 - 1865	NA	113	NA	NA
September 2003-2004	278 - 1113	465 - 530	NA	NA	NA	NA	510 - 1339	750 - >20000
2005	290 - 1030	NA	NA	740 - 1110	100	NA	510 - 690	810 - >20000
Range over measurement period	278 - 6470	321 - 1983	130 - 1833	142 - 1865	54 - 1140	73 - 238	400 - 1339	750 - >20000

NA Not available

The results shown in Table 2 indicate that:

- monitoring bore WM 1, located up-gradient and closest to bedrock exposure, has the consistently highest yearly TDS values (where $\text{TDS} \approx 0.65 \times \mu\text{S}/\text{cm}$), consistent with flushing of salts from the bedrock.
- the highest minimum yearly TDS values in the monitoring bores were recorded in the up-gradient bores WM 1 and MW 2, consistent with flushing of salts from the bedrock.
- the increased minimum TDS values for the dredge pond in comparison with the surrounding groundwater mass are likely to relate to the disturbance caused by the dredging and processing procedures.
- all minimum conductivity values indicate fresh water conditions ($<1500 \mu\text{S}/\text{cm}$ of the Clean Waters Regulations).

- the maximum conductivity values for the dredge pond and monitoring bores WM 5 and WM 6 indicate fresh water conditions.
- monitoring bore MW 5 has the overall highest quality water, possibly related to mounding of infiltrated rainwater within the dune sand at that location.
- the surface water quality in Blue Angle Creek fluctuates with tide, being fresh at low tide and saline at high tide.

7. LABORATORY TESTING

7.1 Physical Testing

Selected samples from the current bores were tested in the laboratory for measurement of particle size distribution (grading), particle density, water absorption and organic impurities (other than sugar). The detailed results of the current testing are given in Appendix B and additional test results of particle size distribution, shell (carbonate) content and organic impurities from the previous investigations are given in Appendix C.

The results of all testing are summarised below.

7.1.1 Grading

A total of 29 particle size distributions were determined on samples from within or adjacent to the proposed extension area. The results are summarised in Table 1 (following page) with comparison with the grading requirements and limits of deviation for uncrushed fine aggregate for use in concrete (Australian Standard AS 2758.1 – 1998).

The results indicate that the very fine and fine grained sands of Unit 1 generally do not satisfy the requirements of AS 2758.1 – 1998, the samples generally exceeding the requirement for the passing 300 μm size range. The unprocessed, medium and coarse grained sands obtained from Unit 2 and Unit 5 generally satisfy the requirements with minor exception of small excesses in the coarser and 75 μm size ranges.

Where relevant, information included in the June 2006 DP report is reproduced in the following sections to provide background to the current comments.

2. NUTRIENT LEVELS

As part of the environmental management plan for the operating sand quarry, CB carries out a water monitoring program including sampling and analysis of water samples from the dredge pond on weekly, monthly, six monthly and yearly intervals. The six monthly samples for the dredge pond are tested for a limited number of nutrients; ammonia, nitrate and total phosphorus. During the period January to November 2005, monitoring of groundwater chemistry within the drainage system of Foy's Swamp and Blue Angle Creek also included assessment of nutrient levels.

A summary of the available test results for nutrients in the dredge pond during the period 2003 – 2006 is given in Table 1 which also includes ANZECC Guideline values for fresh water environments. The detailed results are included in Appendix A.

Table 1 – Summary of Nutrient Levels in Dredge Pond

Nutrient	Unit	ANZECC Guideline	Date										
			11/03	05/04	11/04	01/05	06/05	08/05	09/05	10/05	21/05	08/06	08/06
Ammonia as N	mg/L	0.9	<0.02	0.12	0.11	0.063	0.038	<0.01	0.20	0.03	0.19		
Nitrate as N	mg/L	0.7	0.02	<0.02	0.09	0.023	<0.01	0.025	<0.04	0.04	<0.04	0.04	0.04
Nitrite as N	mg/L					<0.01	<0.01	<0.01	0.034	0.022	0.027	0.06	0.05
Total Kjeldahl Nitrogen	mg/L					0.60	0.60	0.40	0.57	0.46	0.39	0.52	0.53
Total Phosphorus as P	mg/L	0.05	0.029	0.04	0.046	0.02	0.02	<0.01	0.014	0.026	<0.01	0.058	0.046
Reactive Phosphorus	mg/L						0.01	<0.01	<0.01	0.016	<0.01		

The testing results indicate that all samples included in Table 1 were within guideline values with the exception of one Total Phosphorus result from August 2006.

The testing of surface water from the Foy Swamp drainage system and its downstream continuation as Blue Angle Creek indicate that the nutrient levels have at various times exceeded the ANZECC Guideline values for Total Phosphorus. The test values for other nutrients were generally within guideline values.

The maximum values obtained from these sampling locations are compared in Table 2 with maximum values determined from dredge pond samples.

**Table 2 – Summary of Maximum Nutrient Levels
Dredge Pond, Drainage System and Blue Angle Creek**

Nutrient	Unit	ANZECC Guideline	Dredge Pond	Blue Angle Creek	Drainage System
Ammonia as N	mg/L	0.9	0.2	0.652	0.25
Nitrate as N	mg/L	0.7	0.09	0.231	0.09
Nitrite as N	mg/L		0.06	0.11	0.114
Total Kjeldahl Nitrogen	mg/L		0.6	2.3	2.4
Total Phosphorus as P	mg/L	0.05	0.058	0.28	1.02
Reactive Phosphorus	mg/L		0.016	0.912	<0.01

Review of the results in Table 1 indicates that water in the drainage system and Blue Angle Creek has generally higher concentrations of nutrients than the dredge pond.

3. HYDROGEOLOGY

3.1 Hydrogeological Setting

The Gerroa Sand Quarry and the proposed Northern Extension Area are located at the rear of the beach ridge system on low sand dune and sand sheet deposits.

During the DP 2004 investigation, groundwater was noted in the bores and inferred at hole collapse depths at CPT locations at RL 0.5 – 2.5 relative to Australian Height Datum (AHD). In comparison, maximum groundwater levels of approximately RL 0.9, RL 1.9 and RL 1.6 are

Appendix F

ACID SULPHATE SOILS MANAGEMENT PLAN



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**REPORT
ON
ACID SULPHATE SOIL MANAGEMENT PLAN**

**PROPOSED NORTHERN EXTENSION OF
GERROA SAND QUARRY
GERROA AND BEACH ROADS, GERROA**

***Prepared for
CLEARY BROS (BOMBO) PTY LTD***

***Project 37673B
June 2006***



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APPENDIX A: Notes Relating to this Report

Summary of Previous Screening and Laboratory ASS Tests
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APPENDIX B: ASSMP

DRAWINGS 1 - 4

GRW:pc
Project 37673B
23 June 2006

**REPORT ON ACID SULPHATE SOIL MANAGEMENT PLAN
PROPOSED NORTHERN EXTENSION OF GERROA SAND QUARRY
GERROA AND BEACH ROADS, GERROA**

1. INTRODUCTION

This report presents an Acid Sulphate Soil Management Plan (ASSMP) prepared for use in the pre-commencement, excavation and restoration phases of the proposed Northern Extension of the Gerroa Sand Quarry at Gerroa and Beach Roads, Gerroa. The ASSMP was requested by Cleary Bros (Bombo) Pty Ltd (CB), the operators of the quarry.

It is understood that CB is seeking approval from the Minister for Planning to extract sand from an area extending some 800 m to 900 m northeast of the existing dredge pond area, over a period of about 15 years.

The assessment comprised a review of published and unpublished data relevant to the existing quarry and surrounding areas, a visit by a senior geotechnical engineer, cone penetration testing and boring with sampling, followed by chemical and physical testing of selected samples. The details of the field work and subsequent analysis are given below and include reference, where appropriate, to the previous assessments and data.

The ASSMP was prepared to provide:

- pre-commencement monitoring methodology;
- an inspection protocol during excavation;
- methodology for on-site treatment and management of acid sulphate soils (ASS);
- water/leachate quality targets for the excavation, restoration and post-restoration periods.

As required by the Department of Environment and Conservation (NSW) in the Director General's Requirement, the ASSMP has been developed with reference to the guidelines presented by the NSW Acid Sulphate Soil Management Advisory Committee (ASSMAC) Acid Sulphate Soil Manual (1998), together with the Guidelines for Fresh and Marine Water Quality (ANZECC 2000) and where appropriate, the Queensland Acid Sulphate Soil Technical Manual (2002).

2. PREVIOUS INVESTIGATION

The preparation of the ASSMP follows recommendations made by Douglas Partners Pty Ltd (DP) in the *Report on Geotechnical Assessment, Proposed Northern Extension of Gerroa Sand Quarry, Gerroa and Beach Roads* (Project 37673, dated 22 March 2005). This report summarised investigations by both DP and others which identified ASS conditions within the existing quarry and the proposed quarry extension areas.

The relevant investigation by others comprised:

- periodic rainfall, dredge pond level and, groundwater monitoring bore data collected by CB;
- groundwater and surface water testing during 2005 and 2006 by Earth2Water Pty Ltd (E2W) and Enviromanagers Pty Ltd;
- materials testing carried out by Coffey Partners International Pty Ltd (Job No. SC568/1, July 1990);
- materials testing carried out by Network Geotechnics Pty Ltd (Job No. W2099/1, July 2000).

3. SITE DESCRIPTION

The site for assessment comprises an irregularly shaped area, generally ranging from 80 m to 160 m wide, extending some 800 m to 900 m in a north-eastern direction from the current northern extent of the operating dredge pond (Drawing 1). The site lies at the western side of Gerroa Road and is approximately 600 m from the current beachfront.

Natural surface levels relative to Australian Height Datum (AHD) range from RL 1, adjacent to a drainage canal (an extension of Blue Angle Creek) near the northern end of the proposed extraction area, to RL 5 – RL 7 (AHD) along the Gerroa Road frontage. Although the ground surface generally slopes to the west from the Gerroa Road frontage, there are no distinct water courses within the site area and the sand dune profile form a ready infiltration zone for rainfall.

Within the current dredge pond at the southern end of the proposed extraction area, sand extraction has been carried out to depths of up to about 4 m below dredge pond water level, corresponding to about 10 m below the level of Gerroa Road.

Limited clearing of vegetation has taken place progressively in front of the current extraction face beyond which the proposed extension area is densely tree covered for a length of about 200 m, thence partially tree covered or cleared over the remaining sections (Drawing 1).

4. GEOLOGICAL AND HYDROGEOLOGICAL SETTING

Reference to the Wollongong 1:250 000 Geological Series Sheet indicates that the existing Gerroa Sand Quarry and proposed Northern Extension lie within the drainage basin of Crooked River which discharges to the Shoalhaven Bight approximately 3.5 km to the northeast.

The basin is bounded to the north-west (at about the alignment of the South Coast Railway some 1.5 km to the northwest) by a topographic bedrock high of Berry Siltstone of Permian age. An east-trending spur of this bedrock high also extends to near the intersection of Gerroa and Beach Roads. The bedrock is overlain by sediments of Quaternary (Holocene) age, which may be separated into the following broad deposition modes in order of surface occurrence from the present day beach:

- beach ridges located between the current seafront and the eastern side of Gerroa Road comprising aeolian sand. The beach ridge system controls the local creek drainage which flows northeast before joining the Crooked River.
- low, aeolian sand dunes extending 100 m to 500 m from the beach ridges.

- aeolian sand sheets extending 100 m to in excess of 1 km inland from the low dunes.
- fluvial and back dune lagoonal sediments comprising inter-banded sands, clay and mud. These deposits within Foy's Swamp extend westerly from the edge of the sand sheet to the South Coast Railway.

The Gerroa Sand Quarry and the proposed Northern Extension Area are located at the rear of the beach ridge system on low sand dune and sand sheet deposits.

The CB monitoring bores in the Gerroa Sand Quarry and the area extending north-east to adjacent to the Crooked River indicate moderate variation in groundwater levels but a consistent, north-east trending flow gradient (about 0.3%) adjacent to the dredge pond, possibly reflecting the topographic bedrock high adjacent to southern side of Beach Road. Elsewhere, there is a generally easterly-trending flow gradient of about 0.1% - 0.2% towards the shore but with local apparent even flatter gradients and reversals of gradient, suggesting that groundwater mounding within the dunes sheds both eastward to the sea and westward to the main drainage canal which continues northward as Blue Angle Creek and thence Crooked River (both of which are tidal).

The CB measurements of the existing dredge pond level for the periods 1993 to 2000 and 2005 to 2006 indicated that:

- the yearly maximum dredge pond level in years of less than median rainfall moved within a limited range (about RL 1.7 – 1.9) with an average maximum of about RL 1.8.
- the increase in dredge pond level corresponded closely with the rainfall in excess of the median value.
- the yearly minimum dredge pond level moved within a limited range (about RL 0.95 – 1.4).
- the minimum dredge pond level (RL 0.95) was 0.45 m above mean sea level.
- the minimum dredge pond level is approximately that of the main canal adjacent to the closest approach of the proposed quarry extension.
- the maximum dredge pond level (about RL 2.2) occurred during the year of highest rainfall (1998) indicating the rapid effect of rainfall on the groundwater regime.
- for daily rainfall events generally in excess of 100 mm or close spaced rainfall events totalling about 100 mm there was a similar rise in the dredge pond level.

- high dredge pond levels declined rapidly towards the minimum (base) level between August 1999 (an above average rainfall period) and June 2000 (within a below average rainfall period).

Measurement of the pH of the dredge pond water, drainage canal water (at Blue Angle Creek) and groundwater in the CB monitoring bores has been carried out on a regular basis since 1993. The monitoring of the dredge pond, main canal and the monitoring bores WM 3 & 3A, WM 4, WM 5 and WM 6 in or near the proposed Northern Extension Area indicated:

- the dredge pond pH has generally moved with the range 6.0 – 9.0 (moderately acidic to strongly alkaline) in comparison with a range of 5.0 – 8.5 (very strongly acidic to strongly alkaline) for the monitoring bores.
- the lowest dredge pond pH values were measured in the period of heavy rainfall at the end of July 1998 and extreme rainfall in mid August 1998. This may reflect the flushing of organic acids or oxidised pyritic material from the sand aquifer.
- the minimum pH levels (pH = 5.9) in the monitoring bore WM 3 may be an indicator of pyrite oxidation or the presence of organic acid complexes.
- the pH of Blue Angle Creek at the flood gates at the northern end of the CB property (i.e. north of the proposed quarry extension) generally ranged between 6.6 and 7.8, but with a lower pH reading of 4.8 being associated with transient stream flushing event during wet weather. For comparison, pH readings as low as 3.2 have been recorded in drains within Foy's Swamp, upstream (west) of the proposed quarry extension area.

Field measurements of Total Dissolved Solids (TDS) and Dissolved Oxygen (DO) have also been undertaken by E2W and others in the dredge pond, main canal and at Blue Angle Creek. The results (see Appendix A) indicate:

- TDS values in the ranges 200 - 439 mg/L, 552 - 4574 mg/L and 263 – 14619 mg/L in the dredge pond, main canal and Blue Angle Creek respectively. The highest value at Blue Angle Creek was recorded at high tide and may indicate substantial mixing with seawater.
- DO values in the ranges 65% - 100%, 24% – 100% and 26% – 92% in the dredge pond, main canal and Blue Angle Creek, respectively.

5. BACKGROUND ACID SULPHATE SOIL INFORMATION

Coastal, low-lying alluvial soils, lying below about RL 12, may contain framboidal pyrite or other sulphides. These are rounded, microbially generated microscopic mineral grains, which are stable in soils below the water table, or in dense clay-rich soils that are periodically re-wetted. In such situations, where the sulphides are kept out of contact with air, they are relatively stable, and generally in "equilibrium" with the local environment. Soils, which have appreciable pyrite or other sulphides which have not yet reacted significantly with air, are referred to as Potential Acid Sulphate Soils, or PASS.

If sulphide-bearing or pyritic soils are disturbed by excavation, thereby allowing ready access of the sulphides to oxygen in the air, a spontaneous or irreversible natural oxidation reaction takes place. This results in the generation of sulphuric acid or acid sulphates. Pyritic soils, which have begun to generate acid, are referred to as Actual Acid Sulphate Soils (AASS). The acid is transported by water, and if allowed to build up in sufficient concentration, poses a direct environmental threat to organisms that come in contact with such waters.

Additionally, increasingly acidic waters can dissolve many metal ions which would otherwise remain insoluble and hence not available for uptake by organisms. These ions include aluminium and iron, plus a suite of heavy metals such as zinc, lead and cadmium, which at elevated levels can be toxic to plants, animals and humans.

The measure of acidity in waters is pH; pure neutral water has a pH of 7; pH values below 7 are acidic, pH values above 7 are basic or alkaline. The pH scale is logarithmic so a decrease of 1 pH unit represents a 10-fold increase in the concentration of hydrogen ions, which is the measure acidity. Further, the actual pH level is important because each metal has its own critical solubility, so a decrease in pH from 6 to 5 may be more undesirable than a pH decrease from 5 to 4 if, say, 5.5 is the critical pH for solubilisation.

Most organisms can cope with pH in the range 5.5 to 8.5 - pH values in natural waters below 5 are undesirable; below 4, they are generally unacceptable.

6. POTENTIAL FOR ACID SULPHATE SOILS

Details of the results of field screening and laboratory testing of the DP and previous investigations are given in Appendix A. The distribution of test locations and pyritic sulphur contents are additionally shown on Drawings 2, 3 and 4.

In general, positive field indicators for acid sulphate soils (after ASSMAC, 1998) are considered to be:

- a field pH (pH_F) of ≤ 4 for AASS.
- for PASS, in the peroxide test one or more of; a change in colour from grey to brown tones, effervescence, the release of sulphur smelling gases, the lowering of the pH by at least one unit and a final pH (pH_{FOX}) < 3.5 and preferably < 3 .

For a disturbance of greater than 1000 tonnes, an oxidisable sulphur content of 0.03% or equivalent total potential acidity (TPA) or total actual acidity (TAA) determined by laboratory testing is the threshold criteria for preparation of a detailed ASSMP.

The geological model for Northern Extension Area resource, as summarised in Drawings 3 and 4, comprises an upper, very fine to fine grained dune sand (Unit 1) underlain by generally medium to coarse grained sands of beach and tidal inlet deposits (Units 2 and 4). Clayey materials (Unit 3 and possibly the upper section of Unit 5) of lagoonal or back swamp depositional mode, which are likely to include sulphidic materials, form semi-continuous lenses to 3 m thick within the south-western section of the area, but are discontinuous and generally less than 1 m thick in the remaining sections.

The resource is partially affected by the presence of potential acid soils, mostly within the deeper sections of Unit 4 which may include pyritic materials eroded from the underlying Unit 5 during the marine transgression leading to the current sea level. The positive indicators PASS within Unit 1 are considered to be anomalous to the aeolian deposition mode and may result from clayey particles blown from the Foys Swamp area, which is recorded on acid sulphate risk maps as being of high probability of acid sulphate soil conditions.

Materials from Units 1, 2 and 4 form the recoverable resource. The processing of the very fine to fine grained sands of Unit 1 with the underlying Units 2 and 4 sands, which extend to depths of 17 m, is expected (on the basis of the satisfactory performance of the Gerroa Sand Quarry and testing) to produce fine concrete aggregate and reduce pyritic materials to acceptable levels. Testing of Total Oxidisable Sulphur (TOS) content of processed sand stockpiles during the period October 2003 and December 2004 indicated TOS values in the range 0.019% and 0.027%.

7. ACID SULPHATE SOIL RISK

As the previous sand extraction within Units 1 and 2 has been satisfactorily managed, the risk associated with the acid sulphate soils and continued extraction of these units should also be expected to result in a satisfactory outcome. However, as a consequence of the exceedance of the *Action Criteria* in some Unit 1 materials (although considered to be anomalous results) and in some Unit 2 and Unit 4 samples, together with the significant volume of the proposed excavation, a detailed Acid Sulphate Soil Management Plan (ASSMP) is required. Planning and management options should therefore assume that, unless otherwise indicated by site-specific testing before or during excavation, all materials of estuarine origin (Units 2, 3 and 4) and the site in general need to be tested and/or monitored. The excavated Unit 4 materials, which pose the greatest acid sulphate soil risk at this site, may require specific processing such as sluicing or hydrocycloning, the extent of which will need to be determined during the on-going extraction operation.

It is considered that an appropriate ASSMP should include:

- continuation of the current surface, groundwater and dredge pond water quality monitoring prior to, during and subsequent to the extraction process.
- additional testing of the acid sulphate soil potential to supplement the results of the investigations to date. This testing should be progressively carried out to permit selection of the final extraction areas and relevant treatment methods for the individual sections and/or units within the resource.

- on-going monitoring of the feed stock and finished product to confirm the effectiveness of the processing methodology in satisfying aggregate specification limits and licence requirements.
- monitoring of the pyritic content of the reject fine materials in order to provide assessment of concentration of oxidisable sulphur in the materials strategically buried below water. In the event of unexpected levels of acid generation, the sulphur content would be used to determine an initial neutralisation dosing rate.
- controlled placement of reject materials, including sulphidic fines and the oversize shell component from the processing (to assist in pH buffering) within the basal section of the dredge pond. The burial of these materials with non-sulphidic material may be appropriate.
- ensuring access to suitable quantities of buffering materials for addition to the dredge pond if modification of the pH is required on the basis of the on-going testing.

It is considered that the implementation the controls and procedures of the ASSMP will ensure that ASS related issues will be handled in an appropriate manner and in accordance with the relevant legislation.

8. RESPONSIBILITIES

The CB project manager (PM) is responsible for the correct implementation of the ASS protocols presented in the ASSMP. With respect to ASS management, the PM is responsible for on-site monitoring. To this end, an independent, suitably qualified consultant should inspect the site, on both regular and random basis, and carry out sampling and/or in-situ measurements as are necessary to check compliance with the ASSMP.

As a guide, the following inspection/monitoring regime is suggested:

Stockpiles of processed sand	Daily for pH of leachate (if any) from processed sand stockpile and weekly (or more frequently as necessary) for indication of sulphur content (trigger for additional testing for ASS management and requirements for fine concrete aggregate).
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Dredge pond water quality and level	Weekly and prior to any discharge.
Groundwater monitoring bores and streams	Monthly.

It is independent consultant's responsibility to inform the PM immediately on discovery of non-compliance or exceedence and to detail appropriate remedial measures. The requirements of ASS management are in addition to, but do not over-ride any standard procedure such as safety considerations. Where conflict results, or may result from, the implementation of the ASS management against other performance criteria including occupational health and safety, it is the contractor's responsibility to obtain directives from the PM. However, in all cases, legislative requirements must be paramount.

9. MANAGEMENT STRATEGY

The management strategy selected for the excavated or dredged sand (including PASS) is for the removal of pyritic fines and oversize materials (predominantly shells) by washing and potentially sluicing or cycloning, subject to the need to reduce pyritic content to levels suitable for use of the processed sand as fine concrete aggregate) with return of the reject material to the dredge pond for burial below the permanent groundwater table. This strategy continues the current methods of extraction and treatment practice that has successfully managed the acid sulphate risk during the quarrying of Units 1 and 2 to date.

Observation of the working method within the Gerroa Sand Quarry, which lies within an equivalent stratigraphic sequence, indicates that:

- water removed from the pond during dredging is returned almost directly to the pond via run-off from the discharge/processing area or via rapid infiltration of the sand profile about the working area.
- the working method does not lead to the extraction and disposal of the groundwater from the site. Rather, the pond water is recycled rapidly during the sand extraction process with possible minor additional evaporation. The records of the dredge pond pH indicates that if pyritic material is present within the sand resource, then the exposure time during extraction, processing and stockpiling, is insufficient to cause complete oxidation and increase in the

water acidity in comparison with the pH of the groundwater sampled from the nearby monitoring bores. Alternatively, as suggested by the current testing, relatively benign pH could signify generally low pyrite content and a buffering of the system by included shells.

It is anticipated that the stripped organics affected topsoil or silty sand will be reused in rehabilitation works and that reject (fines and larger shell fragments) materials will be placed into the completed dredged area. Consideration will need to be given to any requirement for capping of these materials to promote or maintain an anaerobic deposition environment.

An ASSMP template providing methodology for remediating or controlling the generation of acid, in those cases where excavation of (potential) acid sulphate soils is unavoidable, based on currently available data, is included in Appendix B. The following sections provide a background for recommendations and requirements included within the ASSMP.

9.1 Areas of Disturbance

It is expected that an excavation face ranging from 80 m to 160 m wide will be progressively moved northward from the current dredge pond over a period of some 15 years. Excavation depths of up to 17 m will potentially be developed to recover materials from Units 1, 2 and 4 within the area shown on Drawings 1 and 2. The closest approach of the extraction area to the main canal will be 40 m.

The proposed extraction of the sand resource will need to consider the long-term stability of the dredge pond, such that there is no migration of the batters of the completed pond outside of the nominated resource and to this end, it is suggested that an average excavation slope of not greater than 25° (about 2.1H:1V) below water level be employed during winning of product.

9.2 Neutralising Materials

The sand to be quarried from Units 1, 2 and 4 within the Northern Extension Area will contain significant proportions of shells which provide a natural buffering capacity to extraction and

replacement operations. Coffey Partners International Pty Ltd previously determined the shell content (see Table 1) of samples selected from Bores CB 201, CB 204 and CB 206 within or adjacent to the proposed extraction area.

Table 1 – Summary of Carbonate Content Testing

Location	Depth	Unit	Shell >1.18mm (%)	Shell <1.18mm (%)
CB201	3.0 – 5.0	2	-	8.2
	4.9 – 5.4	2	10.2	6.2
CB204	0 – 1.0	1 - 2	-	7.5
	2.0 – 5.0	2	1.0	2.6
CB206	6.0 – 8.0	2	34.9	20.3
	8.0 – 10.0	4	12.0	6.3
	10.0 -13.0	4	1.0	1.6

As a consequence of the natural carbonate content provided by the shells and the successful management of acid sulphate soil environmental risks to date, it is anticipated that there will be minimal or no requirement for addition of neutralising materials during the excavation, treatment and restoration phases of the quarry development. However, considering the precautionary principal, it is suggested that:

- for the case of unexpected acidic leaching from stockpiled dredged and/or processed product, the bases of processing and stockpile areas should be graded and/or bunded to ensure runoff returns to the dredge pond and should be prepared with a guard layer incorporating fine aglime.
- stores of aglime and quicklime should held on site for any cases where leachate needs 'finishing' before discharge to the dredge pond and/or unexpected flow to natural waterways (there is one over-flow drain near the south-western corner of the current dredge pond which has never been used and the current site is bunded to RL 3.2 to prevent flooding or runoff to surface water) or modification of the dredge pond water is required. Aglime is non-corrosive and requires no special handling techniques. Quicklime is dangerous to use, being very reactive and corrosive (caustic), and special handling and safety procedures are required. When mixed with water, the reaction generates substantial heat, so the lime should be slowly added to a large amount of water.
- shells recovered from the processing are returned with the fines and clay materials recovered from Unit 3 to the dredge pond. As a significantly greater buffering capacity is

obtained from fine shell particles, it is suggested that consideration be given to (where possible) the grinding of recovered shells to a particle size of less than 2 mm prior to return to the dredge pond.

9.3 Pre-Excavation Measures

Pre-excavation measures designed to reduce the risk of acid release to natural and forming part of the ASSMP for the site include:

- continuation of the surface water (main canal and Blue Angle Creek), groundwater and dredge pond water quality monitoring for subsequent comparison during the excavation, materials processing and restoration phases. The installation of additional groundwater monitoring bores between the proposed extraction area and the main canal and Gerroa Road is also appropriate.
- on-going testing of the acid sulphate soil potential within the proposed excavation depths to supplement the results of the previous investigations and to confirm the relevant processing methodology and buffering capacity of the individual sections and/or units within the quarry area as finally developed.
- initially, the preparation at least one, gently sloping, bunded and lined stockpile/processing area of sufficient size to accept the excavated or dredged products at the proposed production rate. The area should incorporating a limed guard layer, surface water diversions and should be either bunded off using non-ASS material, or a circumferential drain dug to collect and localise any leachate and direct it back to the dredge pond.

9.4 Excavation, Processing and Placement Procedures

The sand resource includes two distinct excavation environments; up to 4 m of very loose to very dense, very fine grained and fine grained sand and silty sand (Unit 1) lying above the water table and up to 13 m of fine grained sand (remainder of Unit 1) and medium dense to very dense, medium to coarse grained sand (Units 2 and 4).

The excavation of the profile above the water table should be stripped of topsoil and root affected sand (totalling an average of about 0.5 m in the current bores) by dozer operation, with the subsequent winning of materials either by an excavator loading into trucks or allowing the material to fall into the dredge pond as the underling materials are removed (i.e. the process currently in use within the Gerroa Sand Quarry).

The Queensland Acid Sulphate Soil Technical Manual – Soil Management Guidelines [2002] describes methods for enhancing the removal of sulphidic fines during dredging. Those appropriate or potentially appropriate to the Gerroa site include:

- the use of a 'cutter suction dredge', particularly for clayey bands;
- ensuring dredge material that contains significant amounts of sulphidic clay lenses or coffee rock layers also contains sufficient sand to ensure the break-up of clumps of clay and coffee rock;
- dredging continuous peat or clay horizons separately, and handle them independently at the discharge point by strategic reburial or neutralisation; when basement clays or continuous clay horizons are intersected, there is greater potential for the material to form clay balls;
- increasing the water-to-solids ratio if dredging materials high in sulphides or organic matter; pausing repeatedly, or pump slugs of water at each end of the dredge's cutting arc;
- the use of pumps and pumping arrays that produce high turbulence in the flow, as this will promote abrasion and liberation in the pipeline;
- ensuring a turbulent flow by incorporating tight bends or right angles in the pipe;
- increasing the residence time in the pipeline by increasing its length;
- keeping the discharge area relatively small and water in it turbulent to ensure that the fines remain in suspension and do not settle out and concentrate near the discharge point;
- having a swamp dozer or excavator available for shaping the discharge area, keeping the sulphidic fines overflow in one well-defined steep, fast flowing channel all the way to the point of discharge to the permanent sulphidic fines storage location;
- maintaining attention at the discharge point to prevent the build up of fines 'fans' that drain through previously washed sands, leaving the fines buried in the processed materials; and

- flushing the sluicing channel with excess water at shut down to help prevent the exposure of fines over nights and weekends, resulting in acidification.

Where it is economic to remove the clays of Unit 3 to provide access to the underlying sand (Unit 4), it is probable that the soft to stiff clay would require the use of a cutter-suction type dredge, possibly with the assistance of a long-reach excavator mounted on a barge or working from the head of the excavation. The excavated clays (expected to be PASS) will be placed below water level (which is not expected to vary from the previously monitored range in levels) within the worked-out section of the existing dredge pond together with the reject materials returned directly to the dredge pond from the sand processing (by washing, sluicing and/or hydrocycloning). The clay should preferably be placed directly in the final burial locations or otherwise placed within two days to prevent significant oxidation or if not, treated prior to disposal.

It is noted that a water column depth of 4 m above the buried materials is preferred on the basis of Queensland experience (*Queensland Acid Sulphate Soil Technical Manual – Soil Management Guidelines* [2002]) so as to minimise oxidation potential in the long-term. Subject to final assessment of the sulphidic fines won from processing and variations of oxygen concentrations with depth, consideration may need to be given to any requirement for capping of these materials to promote or maintain an anaerobic deposition environment.

It is anticipated that in the long-term, the completed dredge pond will be restored as a water body equivalent of a sheltered basin structure with:

- a 6H:1V batter for required beach zones in accordance with current approvals.
- a 2H:1V to 3H:1V maximum batter where re-vegetation and maintenance is required above the beach zone.
- an underwater maximum batter of 4H:1V (compared to a maximum of 2.1H:1V dredging slope) at depths greater than 1 m below extreme low water level.

The placement of materials as part of any restoration will need to be carried out so as not to disturb previously placed sulphidic materials and any capping materials.

The current Development Consent specifies that CB must undertake random sampling and analyses of the washed sand that is dredged and extracted, to determine the effectiveness of the removal of any acid sulphate material from the sand product (i.e. the Total Oxidisable Sulphur content should be less than 0.03%). This is equivalent to the performance criteria for the processed sand as proposed in the *Queensland Acid Sulphate Soil Technical Manual – Soil Management Guidelines* [2002]), where only residual levels of sulphides or pyrite are to remain, are (unless permitted by industry standards for concrete manufacture).

For statistical confidence, the Queensland guidelines indicate a testing regime with:

- a target of ≤ 18 moles H^+ /tonne (0.03%S);
- no sample shall exceed 25 moles H^+ /tonne (0.04%S);
- if any single sample exceeds 18 moles H^+ /tonne (0.03%S), then the average of any six consecutive samples (including the exceeding sample) shall have an average not exceeding 25 moles H^+ /tonne (0.03%S);
- if more than one sample in any six consecutive samples exceeds 25 moles H^+ /tonne (0.03%S), then the average of any six consecutive samples (including the exceeding samples) shall have an average content not exceeding 16 moles H^+ /tonne (0.03%S).

As the proposed extraction will extend deeper into the sedimentary sequence with ASS risk, it is suggested that samples of washed sand should be taken and laboratory analysed using the SPOCAS method at an initial testing frequency of one per 1000 m³ of processed sand to demonstrate compliance with the performance criteria for both ASS and concrete standards (i.e. verification testing). Note that the testing/reporting period is generally of the order of 10 days.

In those cases where the acceptable level of sulphides in the processed sands for an end use in concrete is higher than performance criteria/action levels, the sand must be appropriately contained (and leachate or runoff collected and managed) as with any other ASS.

9.5 Water and Leachate Monitoring, Treatment and Discharge

If left unmanaged, the acidity and heavy metals released by oxidation of ASS materials may be transported by water. Such water can contaminate both groundwater and surface water, eventually entering waterways and the ocean.

The aim of the ASSMP is to minimise the impact on the environment and to ensure that ASS leachate, which enter and mix with natural waters, meet acceptable guidelines. In addition, one of the measures of the performance of the management procedures lies in the water quality of leachate and surface runoff from processed sand stockpiles and the quality of local groundwater (including the dredge pondage) into which leachate has mixed. Continued monitoring of the water mass up-gradient and downstream of the dredge pond will be required to demonstrate that target criteria are met.

Flowing leachate from processed stockpiles should be monitored daily; if washing has been carried out correctly, spot neutralisation should not be required. Neutralisation should be carried out with a calcium hydroxide solution made from CaO or quicklime slurry; there is a natural limit to the pH in solution of around 12.2, and the neutralisation product is gypsum. The use of MgO is not recommended as the magnesium sulphate product is highly soluble, and can generate water with unacceptably high total dissolved solids (TDS).

The current EPA Licence and Development Consent require:

- a monitoring of discharged water at the overflow pipe from the dredge pond.
- monitoring of groundwater levels and water quality in the monitoring bores in and around the quarry and in the dredge pond, monthly and following any periods of extreme wet weather.
- water quality testing will include, as a minimum, conductivity (a measure of total dissolved solids) plus pH and in the event that acid sulphate material is detected the possible requirement for monitoring of additional water quality parameters.

Applicable target water criteria (after ANZECC 2000 or NSW Clean Waters Regulations 1972 where no ANZECC Guidelines are available) are for surface discharge (unlikely on the basis of the bunded nature of the site and no use of the discharge channel to date) or for potential subsurface migration of water from the existing or proposed dredge pond to the groundwater or

the “fresh” water canal system into either the existing overflow channel or the adjacent main canal.

- i) pH between 6.5 and 9.0
- ii) Dissolved oxygen (DO) > 6 mg/L (> 80 – 90% saturation)
- iii) Total dissolved solids (TDS) < 1500 mg/L
- iv) Total suspended solids (TSS) < 50 mg/L
- v) Fe (total) < 0.5 mg/L and Al (total) < 0.055 mg/L for pH > 6.5.

The available chemical testing (see Appendix A) indicates that the water within the current dredge pond meets all but the Fe (total) value (which is expected to be naturally elevated in the geological environment including acid sulphate materials and weathering of pyritic iron which forms an accessory mineral of the underlying bedrock of the Berry Formation) and is generally of higher quality than the groundwater and surface water in adjacent waterways that pass through the backdune AASS and PASS deposits of Foys Swamp.

At the flood gates to the north of the proposed extraction area, Blue Angle Creek is tidal and the main canal is subject to marine water mixing. Consequently, additional consideration needs to be given to the target water criteria for marine water:

- i) pH < 0.2 unit change;
- ii) Dissolved oxygen (DO) > 6 mg/L;
- iii) Total dissolved solids (TDS) > 1500 mg/L.

It is noted that the available chemical testing results of samples from Blue Angle Creek and the main canal vary widely in comparison to the criteria, inferred to be as a result of tidal mixing and rainfall.

Discharges (if required) should meet quality requirements, be controlled and preferably during substantial flows in the natural water systems. All water quality indicators should be checked before proposed discharge, to allow for any additional remediation if required to meet the criteria defined above. Just prior to discharge, pH and DO should also be checked.

10. CONTINGENCY PLANNING

The ASSMAC Guidelines (1998) indicate a range of contingency elements for inclusion in management plans. Field operation elements such as provision of immediate response to non-conformances, the holding of adequate materials on site and testing to confirm the adequacy of remedial measures, together with reporting requirements are include within the detailed ASSMP (Appendix B).

Contingency measures are included within the site excavation, monitoring, treatment and reporting protocols which are designed to provide an early detection of a non-conformance and a consequent corrective action. Any modification of the protocols required to meet unexpected conditions shall be agreed to by the PM. Monitoring shall be used to confirm the effectiveness of any changes.

The principal contingency during quarrying is by control of water/treated leachate within the dredge pond and any (unexpected) discharged from the site. The discharge of water/leachate will be halted where a non-conformance is identified, the source investigated and corrective actions implemented. Where remedial action fails or monitoring results indicate on-going failure of the management strategy to meet performance criteria, the excavation should cease during resolution of the required change in methodology.

11. LIMITATIONS

This report has been prepared for the exclusive use by CB for specific application to the proposed Northern Extension of the Gerroa Sand Quarry. This report's conclusions or recommendations do not apply if the nature, design or location of the facilities is changed. If changes are contemplated, DP must review them to assess their impact on this report's applicability.

DOUGLAS PARTNERS PTY LTD

Reviewed by

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APPENDIX A
Notes Relating to this Report
Summary of Previous Screening and ASS Laboratory Tests
Summary of Chemical Testing of Surface and Groundwater



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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25

Very dense greater than 50 greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

as 4, 6, 7
 N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain

samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6) N \text{ (blows per 300 mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

$$q_c = (12 \text{ to } 18) c_u$$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.

- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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Table A1 – Summary of Screening and Analytical Results (DP 2005 Testing Program)

Location	Depth (m)	Unit	Field Screening Tests				sPOCAS Test	
			Natural pH _F	Oxidised pH _{FOX}	pH _F - pH _{FOX}	Effervescence	S _{pos} %	S _{TPA} %
Bore 201	0.5	1	6.2	5.9	0.3	S		
	1.0	1	6.4	6.2	0.2	S		
	1.5	1	6.5	6.2	0.3	S		
	2.0	1	6.6	5.8	0.8	S		
	3.0	1	6.7	6.3	0.4	S		
	4.0	1	7.0	6.4	0.6	S		
	5.0	2	7.9	7.7	0.2	S	0.03	<0.01
	6.0	2	7.8	7.9	-0.1	S		
	7.0	2	7.9	8.2	-0.3	S		
	8.0	2	8.2	7.7	0.5	S		
	9.0	2	8.4	7.4	1.0	S		
	10.0	4	8.1	5.9	2.2	S		
	11.0	4	8.1	5.6	2.5	S		
	12.0	4	8.0	4.7	3.3	S		
	13.0	4	7.9	2.5	5.4	M	0.32	<0.01
Bore 202	0.5	1	8.3	4.8	3.5	S	0.08	<0.01
	1.0	1	8.3	5.8	2.5	S		
	1.0	1	7.9	5.6	2.3	S		
	1.5	1	8.0	5.8	2.2	S		
	2.0	1	6.8	7.0	-0.2	S		
	3.0	1	6.9	6.8	0.1	S		
	4.0	2	7.4	6.8	0.6	S		
	5.0	2	8.2	7.4	0.8	S		
	6.0	2	7.9	7.4	0.5	S		
	7.0	2	7.7	7.6	0.1	S		
	9.0	2	7.7	7.7	0.0	S		
	10.0	4	7.7	5.6	2.1	S		
	11.0	4	7.7	4.8	2.9	S - M		
	12.0	4	7.7	5.9	1.8	S		
	13.0	4	6.6	6.2	0.4	S		
	14.0	4	6.8	6.2	0.6	S		
	15.0	4	7.0	6.2	0.8	S		
Bore 203	0.5	1	7.5	6.0	0.5	S		
	1.0	1	7.2	6.1	1.1	S		
	1.5	1	7.3	6.0	1.3	S		
	2.0	1	7.3	6.4	0.9	S		
	3.0	1	7.7	6.5	1.2	S		
	4.0	1	7.4	6.5	0.9	S		
	5.0	1	7.4	6.5	0.9	S	0.09	<0.01
	6.0	1	7.4	6.8	0.6	S		
	7.0	1	7.9	7.4	0.5	S		
	8.0	2	7.7	7.5	0.2	S		
	9.0	2	7.5	6.8	0.7	S		
	10.0	2	7.4	7.1	0.3	S		
	11.0	2	7.6	7.5	0.1	S		
	12.0	4	7.9	7.2	0.7	S		
	13.0	4	7.9	7.2	0.7	S		
	14.0	4	7.9	7.0	0.9	S		
	15.0	4	7.9	6.9	1.0	S		

**Table A1 – Summary of Screening and Analytical Results (DP 2005 Testing Program)
(Continued)**

Location	Depth (m)	Unit	Field Screening Tests				sPOCAS Test	
			Natural pH _F	Oxidised pH _{FOX}	pH _F - pH _{FOX}	Effervescence	S _{pos} %	S _{TPA} %
Bore 204	1	0.5	7.3	6.2	1.1	S		
	1	1.0	7.4	6.2	1.2	S		
	1	1.5	7.4	6.5	0.9	S		
	1	2.0	7.4	6.2	1.2	S		
	1	2.5	7.4	6.1	1.3	S		
	1	3.0	7.3	6.1	1.2	S		
	1	4.0	7.2	6.1	1.1	S		
	1	5.0	7.9	7.9	0.0	S		
	2	6.0	7.9	7.1	0.8	S		
	2	7.0	8.2	7.3	0.9	S		
	2	8.0	8.2	7.7	0.5	S		
	2	10.0	6.3	6.4	-0.1	S		
	4	11.0	6.2	6.4	-0.2	S		
	4	12.0	6.5	6.4	0.1	S		
	4	13.0	6.6	6.5	0.1	S		
	4	14.0	7.7	6.5	1.2	M	0.89	0.47
	5	15.0	7.8	6.5	1.3	V		

Note: Bold indicates positive indicator S = Slight M = Moderate V = Vigorous

Table A2 (Continued) – Summary of Screening and Analytical Results (Previous Testing Programs)

Location	Material Type	Depth (m)	Field Screening Tests			Test Value	
			Natural pH _F	pH _{FOX}	pH _F minus pH _{FOX}	S _{pos} %	S _{cr} %
D8	SC	1.7 – 2.0	6.1	2.6	3.5		0.312
D9	SC	2.3 – 2.5	6.2	1.3	4.9		
D10	SC	1.9 – 2.4	5.8	0.9	4.9		0.709
D11	C	2.5 – 2.6	6.7	0.8	5.9		
D12	C	2.4 – 2.9	6.8	0.8	6.0		
D13	C/SC	1.4 – 1.8	6.1	1.7	4.4		0.595
D14	C	2.3 – 2.5	6.1	0.9	5.2		
D15	SC	2.2 – 2.5	6.6	2.0	4.6		
D16	C	3.8 – 4.1	6.4	0.7	5.7		1.98

Note: Bold indicates positive indicator S = sand/silty sand/sandy silt C = Clay/clayey silt SC = Clayey sand/sandy clay

Analytical Report - Enviro-Managers	
Client:	Cleary Bros (Bombo) Pty Ltd
	Springhill Rd
Contact Name:	Mr Ron Bryant
Client Reference:	Gerroa Bores

NR = No Result - Dry

Notes	Report Number:	W05/0186	W05/0186	W05/0186	W05/0186	W05/0186	W05/0186	W05/0186	W05/0186	W05/0671	W05/0671	W05/0671	W05/0671	W05/0671	W05/0671	W05/0671	W05/0671	W05/0671
Results:	Sample Received:	20/01/05	20/01/05	20/01/05	20/01/05	20/01/05	20/01/05	20/01/05	20/01/05	24/02/05	24/02/05	24/02/05	24/02/05	24/02/05	24/02/05	24/02/05	24/02/05	24/02/05
Client Id		Ex Works	BH 1	BH 7	BH 9	BH 11	B/Angel Creek	BH 12	Ex Works	Bore Hole 1	Bore Hole 2	Bore Hole 4	Bore Hole 5	Bore Hole 6	Bore Hole 7	Bore Hole 9	Bore Hole 11	Bore Hole 12
Laboratory Id		W11016/001	W11016/002	W11016/003	W11016/004	W11016/005	W11016/006	W11016/007	W11511/001	W11511/002	W11511/003	W11511/004	W11511/005	W11511/006	W11511/007	W11511/008	W11511/009	W11511/010
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	560	1030	160	860	1110	+20000	430	540	370	NR	NR	NR	NR	150	380	1510	810
Groundwater level (RL)																		
Method:	Units:m	-	0.48	-0.46	-1.15	-1.53	-	-0.40	-	1.83	-	-	-	-	-0.01	-0.60	-1.28	-
pH																		
Method:APHA 4500 H B	Units:pH units	7.8	6.6	5.7	6.4	6.4	6.9	5.4	7.5	5.7	-	-	-	-	5.6	6.5	4.9	6.3

Notes	Report Number:	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2033-1	W05/2358	W05/2358	W05/2358	W05/2358	W05/2358
Results:	Sample Received:	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	26/05/05	22/06/05	22/06/05	22/06/05	22/06/05	22/06/05
Client Id		Ex-Works	BH 1	BH 2	BH 4	BH 5	BH 6	BH 7	BH 9	BH 11	B/Angel Creek	BH 12	BH 14	Ex Works	BH 1	BH 2	BH 4	BH 5
Laboratory Id		W12828/001	W12828/002	W12828/003	W12828/004	W12828/005	W12828/006	W12828/007	W12828/008	W12828/009	W12828/010	W12828/011	W12828/012	W13143/001	W13143/002	W13143/003	W13143/004	W13143/005
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	540	340	NR	NR	NR	NR	190	250	1900	4240	380	NR	560	360	NR	NR	NR
Groundwater level (RL)																		
Method:	Units:m	-	+1.73	-	-	-	-	-0.16	-0.75	-1.33	-	-0.05	-	-	1.33	-	-	-
pH																		
Method:APHA 4500 H B	Units:pH units	6.8	5.8	-	-	-	-	5.8	6.1	4.6	6.4	5.8	-	6.7	5.8	-	-	-

Notes	Report Number:	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3572-2	W05/3963	W05/3963	W05/3963	W05/3963
Results:	Sample Received:	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/09/05	21/10/05	21/10/05	21/10/05	21/10/05
Client Id		Ex Works	BH 1	BH 1A	BH 4	BH 5	BH 6	BH 7	BH 9	BH 11	B/Angel Creek	BH 12	BH 2A	BH 3A	Ex Works	BH 1	BH 1A	BH 4
Laboratory Id		W14389/001	W14389/002	W14389/003	W14389/004	W14389/005	W14389/006	W14389/007	W14389/008	W14389/009	W14389/010	W14389/011	W14389/012	W14389/013	W14768/001	W14768/002	W14768/003	W14768/004
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	580	640	NR	750	NR	NR	160	270	1280	18030	770	NR	NR	600	1010	Dry	Dry
Groundwater level (RL)																		
Method:	Units:m	-	1.39	-	-0.33	-	-	-0.29	-0.87	-1.42	-	-0.26	-	-	-	1.05	-	-
pH																		
Method:APHA 4500 H B	Units:pH units	6.7	5.8	-	6.9	-	-	5.5	6.0	5.3	6.8	5.3	-	-	6.9	6.0	-	-

YEARLY SAMPLING

	Report Number:	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442	W05/4442
Results:	Sample Received:	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05	21/11/05
Client Id		Ex-Works	BH 1	BH 3A	BH 4	BH 5	BH 6	BH7	BH 9	BH 11	Bore Angle Creek	BH 12	BH 2A	BH 1A
Laboratory Id		W15175/001	W15175/002	W15175/003	W15175/004	W15175/005	W15175/006	W15175/007	W15175/008	W15175/009	W15175/010	W15175/011	W15175/012	W15175/013
Cl : SO4 Ratio														
Method:	Units:-	0.53	4.4	NR	5.1	NR	NR	3.3	0.88	3.6	7.4	0.56	NR	NR
Conductivity (uS/cm)														
Method:APHA 2510 B	Units:uS/cm@25 °C	690	590	-	1080	-	-	170	410	1180	>20,000	570	-	-
Groundwater level (RL)														
Method:	Units:m	-	1.33	-	0.57	-	-	-0.42	-1.08	-1.30	-	-0.31	-	-
pH														
Method:APHA 4500 H B	Units:pH units	7.7	6.9	-	7.9	-	-	6.9	7.3	6.8	7.7	6.5	-	-

Analytical Report - Enviro-Managers	
Client:	Cleary Bros (Bombo) Pty Ltd
	Springhill Rd
Contact Name:	Mr Ron Bryant
Client Reference:	Gerroa Bores

NR = No Result - Dry

Notes	Report Number:	W05/0671	W05/0671	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1086-1	W05/1620	W05/1620	W05/1620
Results:	Sample Received:	24/02/05	24/02/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	22/03/05	27/04/05	27/04/05	27/04/05
Client Id		Bore Hole 12	Bore Hole 14	Ex Works	BH 1	BH 2	BH 4	BH 5	BH 6	BH 7	BH 9	BH 11	ue Angle cre	BH 12	BH 14	Ex-Works	BH1	BH2
Laboratory Id		W11511/011	W11511/012	W11945/001	W11945/002	W11945/003	W11945/004	W11945/005	W11945/006	W11945/007	W11945/008	W11945/009	W11945/010	W11945/011	W11945/012	W12413/001	W12413/002	W12413/003
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	350	NR	530	290	NR	NR	NR	NR	160	450	820	9140	330	NR	510	300	NR
Groundwater level (RL)																		
Method:	Units:m	-0.15	-	-	1.73	-	-	-	-	-0.16	-0.80	-1.48	-	-0.20	-	-	+1.53	-
pH																		
Method:APHA 4500 H B	Units:pH units	5.3	-	6.6	6.0	-	-	-	-	5.9	6.9	5.9	6.7	5.3	-	7.3	6.5	-

Notes	Report Number:	W05/2358	W05/2358	W05/2358	W05/2358	W05/2358	W05/2358	W05/2358	W05/2358	W05/2774	W05/2774	W05/2774	W05/2774	W05/2774	W05/2774	W05/2774	W05/2774	W05/2774
Results:	Sample Received:	22/06/05	22/06/05	22/06/05	22/06/05	22/06/05	22/06/05	22/06/05	22/06/05	21/07/05	21/07/05	21/07/05	21/07/05	21/07/05	21/07/05	21/07/05	21/07/05	21/07/05
Client Id		BH 6	BH 7	BH 9	BH 11	ue Angel Cre	BH 12	BH 14	Ex Works	BH 1	BH 2	BH 4	BH 5	BH 6	BH 7	BH 9	BH 11	ue Angel Cre
Laboratory Id		W13143/006	W13143/007	W13143/008	W13143/009	W13143/010	W13143/011	W13143/012	W13573/001	W13573/002	W13573/003	W13573/004	W13573/005	W13573/006	W13573/007	W13573/008	W13573/009	W13573/010
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	NR	210	220	900	>20,000	NR	NR	550	440	NR	740	100	NR	160	220	2150	5200
Groundwater level (RL)																		
Method:	Units:m	-	-0.31	-0.95	-0.88	-	-	-	-	1.73	-	0.07	0.23	-	0.09	-0.50	-1.48	-
pH																		
Method:APHA 4500 H B	Units:pH units	-	5.6	6.0	5.4	6.5	-	-	7.0	5.7	-	6.4	5.0	-	5.4	5.7	4.9	6.4

Notes	Report Number:	W05/3963	W05/3963	W05/3963	W05/3963	W05/3963	W05/3963	W05/3963	W05/3963	W05/3963	W05/4819	W05/4819	W05/4819	W05/4819	W05/4819	W05/4819	W05/4819	W05/4819
Results:	Sample Received:	21/10/05	21/10/05	21/10/05	21/10/05	21/10/05	21/10/05	21/10/05	21/10/05	21/10/05	20/12/05	20/12/05	20/12/05	20/12/05	20/12/05	20/12/05	20/12/05	20/12/05
Client Id		BH 5	BH 6	BH 7	BH 9	BH 11	ue Angle Cre	BH 12	BH 2A	BH 3A	Ex-Works	BH 1	BH 1A	BH 4	BH 5	BH 6	BH 7	BH 9
Laboratory Id		W14768/005	W14768/006	W14768/007	W14768/008	W14768/009	W14768/010	W14768/011	W14768/012	W14768/013	W15693/001	W15693/002	W15693/003	W15693/004	W15693/005	W15693/006	W15693/007	W15693/008
Conductivity (uS/cm)																		
Method:APHA 2510 B	Units:uS/cm@25 °C	Dry	Lost	170	260	1010	>20,000	620	Dry	Dry	670	470	Dry	1110	Dry	NR	140	380
Groundwater level (RL)																		
Method:	Units:m	-	-	-0.41	-1.07	-1.33	-	-0.37	-	-	-	1.21	-	-0.43	-	-	-0.40	-0.98
pH																		
Method:APHA 4500 H B	Units:pH units	-	-	5.6	5.6	5.2	6.6	5.3	-	-	7.7	6.1	-	7.2	-	-	5.9	6.7

YEARLY SAMPLING

	Report Number:
Results:	Sample Received:
Client Id	
Laboratory Id	
Cl : SO4 Ratio	
Method:	Units:-
Conductivity (uS/cm)	
Method:APHA 2510 B	Units:uS/cm@25 °C
Groundwater level (RL)	
Method:	Units:m
pH	
Method:APHA 4500 H B	Units:pH units

Analytical Report - Enviro-Managers	
Client:	Cleary Bros (Bombo) Pty Ltd
Contact Name:	Springhill Rd Mr Ron Bryant
Client Reference:	Gerroa Bores

NR = No Result - Dry

Notes	Report Number:	W05/1620	W05/1620	W05/1620	W05/1620	W05/1620	W05/1620	W05/1620	W05/1620	W05/1620
Results:	Sample Received:	27/04/05	27/04/05	27/04/05	27/04/05	27/04/05	27/04/05	27/04/05	27/04/05	27/04/05
Client Id		BH4	BH5	BH6	BH7	BH9	BH11	B/Angle Creek	BH12	BH14
Laboratory Id		W12413/004	W12413/005	W12413/006	W12413/007	W12413/008	W12413/009	W12413/010	W12413/011	W12413/012
Conductivity (uS/cm)										
Method:APHA 2510 B	Units:uS/cm@25 °C	NR	NR	NR	140	400	790	7380	410	NR
Groundwater level (RL)										
Method:	Units:m	-	-	-	-0.31	-0.95	-1.53	-	-1.30	-
pH										
Method:APHA 4500 H B	Units:pH units	-	-	-	5.6	6.5	5.6	6.9	5.9	-

Notes	Report Number:	W05/2774	W05/2774	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172	W05/3172
Results:	Sample Received:	21/07/05	21/07/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05	22/08/05
Client Id		BH 12	BH 14	WM1A	existing Work	WM1	WM2A	WM4	WM5	WM3A	WM7	WM9	WM11	ue Angle Cre
Laboratory Id		W13973/011	W13973/012	W13973/001	W13973/002	W13973/003	W13973/004	W13973/005	W13973/006	W13973/007	W13973/008	W13973/009	W13973/010	W13973/011
Conductivity (uS/cm)														
Method:APHA 2510 B	Units:uS/cm@25 °C	NR	NR	NR	560	670	NR	780	NR	NR	160	250	1360	8540
Groundwater level (RL)														
Method:	Units:m	-	-	-	-	1.12	-	0.78	-	-	-0.14	-0.72	-1.29	-
pH														
Method:APHA 4500 H B	Units:pH units	-	-	-	7.0	6.0	-	6.8	-	-	5.6	5.5	4.5	6.7

Notes	Report Number:	W05/4819	W05/4819	W05/4819	W05/4819	W05/4819
Results:	Sample Received:	20/12/05	20/12/05	20/12/05	20/12/05	20/12/05
Client Id		BH 11	ue Angle Cre	BH 12	BH 2A	BH 3A
Laboratory Id		W15693/009	W15693/010	W15693/011	W15693/012	W15693/013
Conductivity (uS/cm)						
Method:APHA 2510 B	Units:uS/cm@25 °C	1230	17420	590	Dry	Dry
Groundwater level (RL)						
Method:	Units:m	-1.44	-	-0.17	-	-
pH						
Method:APHA 4500 H B	Units:pH units	5.7	7.0	5.3	-	-

YEARLY SAMPLING

	Report Number:
Results:	Sample Received:
Client Id	
Laboratory Id	
Cl : SO4 Ratio	
Method:	Units:-
Conductivity (uS/cm)	
Method:APHA 2510 B	Units:uS/cm@25 °C
Groundwater level (RL)	
Method:	Units:m
pH	
Method:APHA 4500 H B	Units:pH units

Monthly Water Monitoring Results: 2017 and 2018

Date	Location	Parameter	Unit	2017												2018													
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
100.0	North	Temperature	°C	10.5	11.2	12.1	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	10.8	11.5	12.4	13.3	14.3	15.3	16.3	17.3	18.3	19.3	20.3	21.3	22.0	
		pH		7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	
		Dissolved Oxygen	mg/L	8.5	8.8	9.1	9.4	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	8.6	8.9	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	
		Conductivity	µS/cm	150	155	160	165	170	175	180	185	190	195	200	205	152	157	162	167	172	177	182	187	192	197	202	207	212	
100.5	North	Temperature	°C	10.8	11.5	12.4	13.3	14.3	15.3	16.3	17.3	18.3	19.3	20.3	21.3	11.1	11.8	12.7	13.6	14.6	15.6	16.6	17.6	18.6	19.6	20.6	21.6	22.3	
		pH		7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	
		Dissolved Oxygen	mg/L	8.8	9.1	9.4	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	8.9	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	
		Conductivity	µS/cm	155	160	165	170	175	180	185	190	195	200	205	210	157	162	167	172	177	182	187	192	197	202	207	212	217	
101.0	North	Temperature	°C	11.1	11.8	12.7	13.6	14.6	15.6	16.6	17.6	18.6	19.6	20.6	21.6	11.4	12.1	13.0	13.9	14.9	15.9	16.9	17.9	18.9	19.9	20.9	21.9	22.6	
		pH		7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	
		Dissolved Oxygen	mg/L	9.1	9.4	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	
		Conductivity	µS/cm	160	165	170	175	180	185	190	195	200	205	210	215	162	167	172	177	182	187	192	197	202	207	212	217	222	
101.5	North	Temperature	°C	11.4	12.1	13.0	13.9	14.9	15.9	16.9	17.9	18.9	19.9	20.9	21.9	11.7	12.4	13.3	14.2	15.2	16.2	17.2	18.2	19.2	20.2	21.2	22.2	22.9	
		pH		7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	
		Dissolved Oxygen	mg/L	9.4	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	
		Conductivity	µS/cm	165	170	175	180	185	190	195	200	205	210	215	220	167	172	177	182	187	192	197	202	207	212	217	222	227	
102.0	North	Temperature	°C	11.7	12.4	13.3	14.2	15.2	16.2	17.2	18.2	19.2	20.2	21.2	22.2	12.0	12.7	13.6	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.2	
		pH		7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	
		Dissolved Oxygen	mg/L	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	
		Conductivity	µS/cm	170	175	180	185	190	195	200	205	210	215	220	225	172	177	182	187	192	197	202	207	212	217	222	227	232	
102.5	North	Temperature	°C	12.0	12.7	13.6	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	12.3	13.0	13.9	14.8	15.8	16.8	17.8	18.8	19.8	20.8	21.8	22.8	23.5	
		pH		7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	
		Dissolved Oxygen	mg/L	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	
		Conductivity	µS/cm	175	180	185	190	195	200	205	210	215	220	225	230	177	182	187	192	197	202	207	212	217	222	227	232	237	
103.0	North	Temperature	°C	12.3	13.0	13.9	14.8	15.8	16.8	17.8	18.8	19.8	20.8	21.8	22.8	12.6	13.3	14.2	15.1	16.1	17.1	18.1	19.1	20.1	21.1	22.1	23.1	23.8	
		pH		7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	
		Dissolved Oxygen	mg/L	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	
		Conductivity	µS/cm	180	185	190	195	200	205	210	215	220	225	230	235	182	187	192	197	202	207	212	217	222	227	232	237	242	
103.5	North	Temperature	°C	12.6	13.3	14.2	15.1	16.1	17.1	18.1	19.1	20.1	21.1	22.1	23.1	12.9	13.6	14.5	15.4	16.4	17.4	18.4	19.4	20.4	21.4	22.4	23.4	24.1	
		pH		7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	
		Dissolved Oxygen	mg/L	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.3	
		Conductivity	µS/cm	185	190	195	200	205	210	215	220	225	230	235	240	187	192	197	202	207	212	217	222	227	232	237	242	247	
104.0	North	Temperature	°C	12.9	13.6	14.5	15.4	16.4	17.4	18.4	19.4	20.4	21.4	22.4	23.4	13.2	13.9	14.8	15.7	16.7	17.7	18.7	19.7	20.7	21.7	22.7	23.7	24.4	
		pH		8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	
		Dissolved Oxygen	mg/L	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	14.2	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.3	14.6	
		Conductivity	µS/cm	190	195	200	205	210	215	220	225	230	235	240	245	192	197	202	207	212	217	222	227	232	237	242	247	252	
104.5	North	Temperature	°C	13.2	13.9	14.8	15.7	16.7	17.7	18.7	19.7	20.7	21.7	22.7	23.7	13.5	14.2	15.1	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	24.7	
		pH		8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	
		Dissolved Oxygen	mg/L	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	14.2	14.5	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.3	14.6	14.9	
		Conductivity	µS/cm	195	200	205	210	215	220	225	230	235	240	245	250	197	202	207	212	217	222	227	232	237	242	247	252	257	
105.0	North	Temperature	°C	13.5	14.2	15.1	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	13.8	14.5	15.4	16.3	17.3	18.3	19.3	20.3	21.3	22.3	23.3	24.3	25.0	
		pH		8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	
		Dissolved Oxygen	mg/L	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	14.2	14.5	14.8	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.3	14.6	14.9	15.2	
		Conductivity	µS/cm	200	205	210	215	220	225	230	235	240	245	250	255	202	207	212	217	222	227	232	237	242	247	252	257	262	
105.5	North	Temperature	°C	13.8	14.5	15.4	16.3	17.3	18.3	19.3	20.3	21.3	22.3	23.3	24.3	14.1	14.8	15.7	16.6	17.6	18.6	19.6	20.6	21.6	22.6	23.6	24.6	25.3	
		pH		8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	
		Dissolved Oxygen	mg/L	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.9	14.2	14.5	14.8	15.1	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.3	14.6	14.9	15.2	15.5	

Table 1D - Gerroa Monthly Groundwater Results (BH 1-6)

Client Reference: **Gerroa Bores**

NR = No Result - Dry

Notes	Report Number:	W05/0186	W05/0671	W05/1086-1	W05/1620	W05/2033-1	W05/2358	W05/2774	W05/3172	W05/3572-2	W05/3963	W05/4442	W05/4819			
Results:	Sample Receive	20/01/2005	24/02/2005	22/03/2005	27/04/2005	26/05/2005	22/06/2005	21/07/2005	22/08/2005	21/09/2005	21/10/2005	21/11/2005	20/12/2005			
Client Id		BH 1	BH 1	BH 1	BH1	BH 1	BH 1	BH 1	WM1	BH 1	BH 1	BH 1	BH 1	Minimum	Average	Maximim
Laboratory Id		W11016/002	W11511/002	W11945/002	W12413/002	W12828/002	W13143/002	W13573/002	W13973/003	W14389/002	W14768/002	W15175/002	W15693/002			
Conductivity (uS/cm)																
Method:APHA 2510 B	Units:uS/cm@25	1030	370	290	300	340	360	440	670	640	1010	590	470	290	531	1030
Groundwater level (RL)																
Method:	Units:m	0.48	1.83	1.73	1.53	1.73	1.33	1.73	1.12	1.39	1.05	1.33	1.21	0.48	1.39	1.83
pH																
Method:APHA 4500 H B	Units:pH units	6.60	5.70	6.00	6.50	5.80	5.80	5.70	6.0	5.80	6.00	6.90	6.1	5.70	6.08	6.90

Notes	Report Number:	W05/3172	W05/3572-2	W05/3963	W05/4442	W05/4819	W05/0671	W05/1086-1	W05/1620	W05/2033-1	W05/2358	W05/2774	W05/3172	W05/3572-2	W05/3963	W05/4442
Results:	Sample Receive	22/08/2005	21/09/2005	21/10/2005	21/11/2005	20/12/2005	24/02/2005	22/03/2005	27/04/2005	26/05/2005	22/06/2005	21/07/2005	22/08/2005	21/09/2005	21/10/2005	21/11/2005
Client Id		WM3A	BH 3A	BH 3A	BH3A	BH 3A	BH 4	BH 4	BH4	BH 4	BH 4	BH 4	WM4	BH 4	BH 4	BH4
Laboratory Id		W13973/007	W14389/013	W14768/013	W15175/003	W15693/013	W11511/004	W11945/004	W12413/004	W12828/004	W13143/004	W13573/004	W13973/005	W14389/004	W14768/004	W15175/004
Conductivity (uS/cm)																
Method:APHA 2510 B	Units:uS/cm@25	NR	NR	Dry	NR	Dry	NR	NR	NR	NR	NR	740	780	750	Dry	1080
Groundwater level (RL)																
Method:	Units:m	-	-	-	-	-	-	-	-	-	-	0.07	0.78	-0.33	-	0.57
pH																
Method:APHA 4500 H B	Units:pH units	-	-	-	-	-	-	-	-	-	-	6.4	6.8	6.9	-	7.90

Notes	Report Number:	W05/0671	W05/1086-1	W05/1620	W05/2033-1	W05/2358	W05/2774	W05/3572-2	W05/3963	W05/4442	W05/4819
Results:	Sample Receive	24/02/2005	22/03/2005	27/04/2005	26/05/2005	22/06/2005	21/07/2005	21/09/2005	21/10/2005	21/11/2005	20/12/2005
Client Id		BH 6	BH 6	BH6	BH 6	BH 6	BH 6	BH 6	BH 6	BH6	BH 6
Laboratory Id		W11511/006	W11945/006	W12413/006	W12828/006	W13143/006	W13573/006	W14389/006	W14768/006	W15175/006	W15693/006
Conductivity (uS/cm)											
Method:APHA 2510 B	Units:uS/cm@25	NR	NR	NR	NR	NR	NR	NR	Lost	NR	NR
Groundwater level (RL)											
Method:	Units:m	-	-	-	-	-	-	-	-	-	-
pH											
Method:APHA 4500 H B	Units:pH units	-	-	-	-	-	-	-	-	-	-

Table 1D - Gerroa Mon

Client Reference: Gerroa Bor

NR = No Result - Dry

Notes	Report Number:	W05/3172	W05/3572-2	W05/3963	W05/4442	W05/0671	W05/1086-1	W05/1620	W05/2033-1	W05/2358	W05/2774	W05/3572-2	W05/3963	W05/4442	W05/4819
Results:	Sample Receive	22/08/2005	21/09/2005	21/10/2005	21/11/2005	24/02/2005	22/03/2005	27/04/2005	26/05/2005	22/06/2005	21/07/2005	21/09/2005	21/10/2005	21/11/2005	20/12/2005
Client Id		WM1A	BH 1A	BH 1A	BH 1A	BH 2	BH 2	BH2	BH 2	BH 2	BH 2	BH 2A	BH 2A	BH 2A	BH 2A
Laboratory Id		W13973/001	W14389/003	W14768/003	W15175/013	W11511/003	W11945/003	W12413/003	W12828/003	W13143/003	W13573/003	W14389/012	W14768/012	W15175/012	W15693/012
Conductivity (uS/cm)															
Method:APHA 2510 B	Units:uS/cm@25	NR	NR	Dry	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NR	Dry
Groundwater level (RL)															
Method:	Units:m	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH															
Method:APHA 4500 H B	Units:pH units	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes	Report Number:	W05/4819				W05/0671	W05/1086-1	W05/1620	W05/2033-1	W05/2358	W05/2774	W05/3172	W05/3572-2	W05/3963	W05/4442	W05/4819
Results:	Sample Receive	20/12/2005				24/02/2005	22/03/2005	27/04/2005	26/05/2005	22/06/2005	21/07/2005	22/08/2005	21/09/2005	21/10/2005	21/11/2005	20/12/2005
Client Id		BH 4	Minimum	Average	Maximim	BH 5	BH 5	BH5	BH 5	BH 5	BH 5	WM5	BH 5	BH 5	BH5	BH 5
Laboratory Id		W15693/004				W11511/005	W11945/005	W12413/005	W12828/005	W13143/005	W13573/005	W13973/006	W14389/005	W14768/005	W15175/005	W15693/005
Conductivity (uS/cm)																
Method:APHA 2510 B	Units:uS/cm@25	1110	740	892	1110	NR	NR	NR	NR	NR	100	NR	NR	Dry	NR	Dry
Groundwater level (RL)																
Method:	Units:m	-0.43	-0.43	0.13	0.57	-	-	-	-	-	0.23	-	-	-	-	-
pH																
Method:APHA 4500 H B	Units:pH units	7.2	6.4	7.04	7.90	-	-	-	-	-	5.0	-	-	-	-	-

Notes	Report Number:
Results:	Sample Receive
Client Id	
Laboratory Id	
Conductivity (uS/cm)	
Method:APHA 2510 B	Units:uS/cm@25
Groundwater level (RL)	
Method:	Units:m
pH	
Method:APHA 4500 H B	Units:pH units

Foys Swamp, Blue Angle Creek and Gerroa Sand Quarry

Note:
SAR Hazard ranking based on Fetter, 1994.
Low = 2 to 10, Med = 7 to 18, High= 11 to 26, V High= 26+
nr - no recommended NSW guidelines NA - Not Available
*TDS= EC*0.67 (approximate) calculation in italics (Data from Sept to Dec05)*

TABLE 1: Surface Water Analytical Results

Foys Swamp, Blue Angle Creek and Gerroa Sand Quarry

Cleary Bros (Bombo) Pty Ltd				Sample ID	BA Creek	BA Creek	BA Creek	BA Creek	SW Drain	SW Drain	SW Drain
	Water Monitoring Program			Sample ID	Blue Angle Creek	Blue Angle Creek	Blue Angle Creek	Blue Angle Creek	SW Drain	SW Drain	SW Drain
	Units	LOR	ANZECC 2000 Guidelines		Dry Weather	Dry Weather	Dry Weather	Dry Weather	Wet Weather	Dry Weather	Dry Weather
Metals (total)			Marine	Fresh	3/08/05	21/09/05	21/10/06	21/11/05	27/01/05	2/06/05	21/11/2005
Aluminium (PH>6.5,)	mg/L	0.0001	ID	0.055	1.47			0.02			
Arsenic	mg/L	0.001	ID	0.013	0.003			<0.001	0.004		
Beryllium	mg/L	0.001	ID	ID					<0.001		
Barium	mg/L	0.001	ID	ID					0.019		
Cadmium	mg/L	0.0001	0.0007	0.0002	<0.0001			<0.001	<0.0001		
Chromium (Total)	mg/L	0.001	0.0274	ID	0.001				0.003		
Cobalt	mg/L	0.001	0.001	ID					0.002		
Copper	mg/L	0.001	0.0013	0.0014	0.008			<0.001	0.002		
Lead	mg/L	0.001	0.0044	0.0034	<0.001			<0.001	<0.001		
Zinc	mg/L	0.005	0.015	0.008	0.016			<0.005	0.412		
Manganese	mg/L	0.001	ID	1.9					0.003		
Nickel	mg/L	0.001	0.007	0.011					<0.01		
Vanadium	mg/L	0.01	0.1	ID					<0.005		
Total Iron	mg/L	0.005	ID	ID	7.12			0.28	2.16		
Mercury	mg/L	0.0001	0.0001	0.00006	<0.0001			<0.0005	<0.0001		
Weak Acid Dissociable Cyanide	mg/L	0.005	0.004	0.007					- - -		
Nutrients											
Fluoride	mg/L	0.1							- - -		
Ammonia as N	mg/L	0.01	0.91	0.9	0.652	0.22	0.12	0.26	0.074	0.096	0.15
Nitrate as N	mg/L	0.01	ID	0.7	0.231	0.05	0.08	<0.04	<0.010	0.016	<0.04
Nitrite as N	mg/L	0.01			0.114	0.005	0.021	0.004	0.012	<0.010	0.11
Total Kjeldahl Nitrogen as N	mg/L	0.10			0.90	0.73	0.58	0.44	- - -	1.50	1.5
Total Phosphorus as P	mg/L	0.01		0.05	0.05	<0.005	<0.005	<0.005	0.31	0.13	0.05
Reactive Phosphorus	mg/L	0.01			<0.010	<0.004	<0.004	<0.004	- - -	0.123	0.043
PH (lab)	pH Unit	0.01			6.89	7.00	6.90	6.70	- - -	6.87	7.5
Total Dissolved Solids (TDS)	mg/L	1			3620	3752	7624.6	4107.1	203	243	520
Electrical Conductivity	uS/cm	1				5600	11380	6130			
Suspended Solids (SS)	mg/L	1			26				20		
Total Hardness	mg/L	1							52		
Major Ions											
Calcium	mg/L	1						63	10		
Magnesium	mg/L	1						111	7		
Sodium	mg/L	1						808	26		
Potassium	mg/L	1						37	7		
Bicarbonate as CaCO3	mg/L	1							39		
Total Alkalinity	mg/L	1							39		
Sulphate as SO4	mg/L	1						345	8		
Chloride	mg/L	1						1635	49		
SAR											
Calcium + Magnesium (meq/L)								12.27	1.07		
Sodium (meq/L)								35.15	1.13		
SAR= Na / Sqrt (Ca+ Mg) / 2)								2.48	0.73		
SAR- Sodium Absorption Ratio								14.19	1.54		
SAR Hazard Ranking								Med	Low		

Note:

SAR Hazard ranking based on Fetter, 1994.

Low = 2 to 10, Med = 7 to 18, High= 11 to 26, V High= 26+

nr - no recommended NSW guidelines NA - Not Available

TDS= EC*0.67 (approximate) calculation in italics (Data from Sept to Dec05)

TABLE 1: Surface Water Analytical Results

Foys Swamp, Blue Angle Creek and Gerroa Sand Quarry

Cleary Bros (Bombo) Pty Ltd					Sample ID	W Drain	W Drain	W Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	Dredge Pond	Dredge Pond	Dredge Pond	Dredge Pond	Dredge Pond	Dredge Pond
	Water Monitoring Program				Sample ID	W Drain	W Drain	W Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	NW Drain	MD Pond	MD Pond	MD Pond	MD Pond	MD Pond	MD Pond
	Units	LOR	ANZECC 2000 Guidelines		Wet Weather	Dry Weather	Dry Weather	Wet Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Wet Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather	Dry Weather
Metals (total)			Marine	Fresh	27/01/2005	2/06/2005	21/11/2005	27/01/2005	2/06/05	3/08/05	21/09/05	21/10/05	21/11/05	27/01/05	2/06/05	3/08/05	21/09/05	21/10/05	21/11/05		
Aluminium (PH>6.5,)	mg/L	0.0001	ID	0.055					3.04	2.83			18		1.42	1.28				1.9	
Arsenic	mg/L	0.001	ID	0.013	0.003			<0.001	<0.001	<0.001			<0.001	0.004	0.003	0.002				<0.001	
Beryllium	mg/L	0.001	ID	ID	<0.001			0.002						<0.001							
Barium	mg/L	0.001	ID	ID	0.03			0.028						0.01							
Cadmium	mg/L	0.0001	0.0007	0.0002	0.0005			0.0003	<0.0001	<0.0001			<0.001	0.0002	<0.0001	<0.0001				<0.001	
Chromium (Total)	mg/L	0.001	0.0274	ID	0.003			0.002	<0.001	<0.001				0.004	0.002	0.001					
Cobalt	mg/L	0.001	0.001	ID	<0.001			0.038						<0.001							
Copper	mg/L	0.001	0.0013	0.0014	0.025			0.003	0.002	0.004			0.002	<0.001	0.002	0.003				<0.001	
Lead	mg/L	0.001	0.0044	0.0034	0.001			<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001				<0.001	
Zinc	mg/L	0.005	0.015	0.008	0.072			1.72	0.035	0.019			0.053	0.015	0.05	0.012				<0.005	
Manganese	mg/L	0.001	ID	1.9	0.004			0.028						0.003							
Nickel	mg/L	0.001	0.007	0.011	<0.01			<0.01						<0.01							
Vanadium	mg/L	0.01	0.1	ID	0.022			0.045						<0.005							
Total Iron	mg/L	0.005	ID	ID	0.83			8.64	0.39	1.4			0.58	0.77	1.14	0.78				0.57	
Mercury	mg/L	0.0001	0.0001	0.00006	<0.0001			0.0016	<0.0001	<0.0001			<0.0005	<0.0001	<0.0001	<0.0001				<0.0005	
Weak Acid Dissociable Cyanide	mg/L	0.005	0.004	0.007	- - -			- - -						<0.0050							
Nutrients																					
Fluoride	mg/L	0.1			- - -			- - -						0.2							
Ammonia as N	mg/L	0.01	0.91	0.9	0.055	0.043	0.35	0.066	0.046	0.059	0.23	<0.02	0.31	0.063	0.038	<0.010	0.20	0.03	0.19		
Nitrate as N	mg/L	0.01	ID	0.7	0.011	<0.010	<0.04	<0.010	0.301	<0.010	<0.04	<0.04	<0.04	0.023	<0.010	0.025	<0.04	0.04	<0.04		
Nitrite as N	mg/L	0.01			<0.010	<0.010	0.022	<0.010	<0.010	<0.010	<0.002	0.014	<0.002	<0.010	<0.010	<0.010	0.034	0.022	0.027		
Total Kjeldahl Nitrogen as N	mg/L	0.10			- - -	1.00	5.7	- - -	1.20	2.10	0.62	0.50	0.46	0.60	0.60	0.40	0.57	0.46	0.39		
Total Phosphorus as P	mg/L	0.01		0.05	0.18	0.12	0.4	0.08	0.03	0.35	0.006	<0.005	<0.005	0.02	0.02	<0.01	0.014	0.026	<0.005		
Reactive Phosphorus	mg/L	0.01			- - -	0.066	<0.004	- - -	<0.010	<0.010	<0.004	<0.004	<0.004	- - -	0.01	<0.010	<0.004	0.016	<0.004		
PH (lab)	pH Unit	0.01			- - -	7.43	8.20	- - -	4.43	5.06	6.40	6.40	3.80	- - -	7.06	7.47	7.60	7.40	7.50		
Total Dissolved Solids (TDS)	mg/L	1			306	220	720	914	406	410	1742	2639.8	1815.7	360	324	336	406.69	425.45	589.6		
Electrical Conductivity	uS/cm	1									2600	3940	2710				607	635	880		
Suspended Solids (SS)	mg/L	1			21			31		50				11		7					
Total Hardness	mg/L	1			103			212						- - -							
Major Ions																					
Calcium	mg/L	1			24			32	18				60	43	42				47		
Magnesium	mg/L	1			10			32	17				65	12	11				14		
Sodium	mg/L	1			41			123	78				257	46	42				51		
Potassium	mg/L	1			7			10	4				12	4	4				5.2		
Bicarbonate as CaCO3	mg/L	1			75			<1	<1					48	47						
Total Alkalinity	mg/L	1			75			<1	<1					48	47						
Sulphate as SO4	mg/L	1			32			264	140				533	109	104				134		
Chloride	mg/L	1			61.1			166	110				445	65.5	71				82		
SAR																					
Calcium + Magnesium (meq/L)					2.02			4.23	2.30				8.34	3.13	3.00				3.50		
Sodium (meq/L)					1.78			5.35	3.39				11.18	2.00	1.83				2.22		
SAR= Na / Sqrt (Ca+ Mg) / 2)					1.01			1.45	1.07				2.04	1.25	1.22				1.32		
SAR- Sodium Absorption Ratio					1.77			3.68	3.17				5.47	1.60	1.49				1.68		
SAR Hazard Ranking					Low			Low	Low				Low	Low	Low				Low		

Note:

SAR Hazard ranking based on Fetter, 1994.

Low = 2 to 10, Med = 7 to 18, High= 11 to 26, V High= 26+

nr - no recommended NSW guidelines NA - Not Available

TDS= EC*0.67 (approximate) calculation in italics (Data from Sept to Dec05)

Table 4- Field Chemistry Measurements- Surface Waters

Dredge Pond, Foy's Swamp and Blue Angle Creek

Water Body	Lab Sample ID	Field Sample ID	Date	Description	pH	Redox (mV)	EC (uS/cm)	TDS (mg/L)- #	DO (%)	Temp	Comments
Main Dredge Pond	M.D.Pond	FC-13	24/01/2005	Clear water	6.19	222	503	337	65	27.5	Groundwater
	M.D.Pond	FC-13	27/01/2005	Clear water	6.15	265	562	377	70	24.9	
	M.D.Pond	FC-13	2/06/2005	Clear water	6.35	190	655	439	80	8.3	(EC=1614m at 1.2m, pH 7.47)
	M.D.Pond	FC-13	3/08/2005	Clear water	6.3	185	528	354	65	17.2	dry period, low water level
	M.D.Pond	FC-13	21/10/2005	Clear water	7.73	92	298	200	95	20.92	Enviromanagers
	M.D.Pond	FC-13	21/11/2005	Clear water	7.58	96	617	413	100	23.32	Enviromanagers
	M.D.Pond	FC-13	20/12/2005	Clear water	7.86	82	647	433	99	22.83	Enviromanagers
South Dredge Pond	S.D Pond	FC-14	27/01/2005	Clear, >1m depth, no visible flow, vegetated	6.49	142	237	159	39	24.5	Vegetated, collects runoff?
	S.D Pond	FC-14	31/01/2005	Clear, >1m depth, no visible flow, vegetated	5.58	311	222	149	98	30	Vegetated, collects runoff?
GW Drain-1		FC-23	24/01/2005	clear, no visible flow, >1.5m depth 5m wide,	5.17	233	769	515	20	23.9	water level ~0.5m bgl
		FC-23	27/01/2005	clear, no visible flow, >1.5m depth 5m wide,	5.8	337	747	500	31	26.1	water level ~0.5m bgl
		FC-23	2/06/2005	clear, no visible flow, >1.5m depth 5m wide,	6.38	136	1164	780	47	14.1	water level ~0.5m bgl
		FC-27	3/08/2005	clear, no visible flow, >1.5m depth 5m wide,	6.64	-8	764	512	75	13.6	dry weather, low drain level
		FC-23	21/10/2005		7.95	73	2437	1633	100	21.24	Enviromanagers
		FC-23	21/11/2005		7.5	97	1247	835	100	21.44	Enviromanagers
		FC-23	20/12/2005		7.06	113	900	603	88	21.69	Enviromanagers
GW Drain-2		FC-18	24/01/2005	clear, no visible flow, >1.5m depth 5m wide,	6.31	158	1505	1008	50	25.3	water level ~0.5m bgl
		FC-18	27/01/2005	clear, no visible flow, >1.5m depth 5m wide,	6.3	278	1546	1036	35	26	water level ~0.5m bgl
		FC-18	3/02/2005	clear, no visible flow, >1.5m depth 5m wide,	6.19	103	1104	740	40	25	water level ~0.2m bgl
		FC-18	2/06/2005	clear, no visible flow, >1.5m depth 5m wide,	6.38	134	946	634	55	14.3	water level ~0.5m bgl
		FC-18	3/08/2005	clear, no visible flow, >1.5m depth 5m wide,	5.9	107	4070	2727	60	14.7	dry weather, low drain level
		FC-18	31/01/2005	clear, no visible flow, >1.5m depth 5m wide,	5.23	227	1534	1028	65	28.4	wet weather
	GW Drain-2	FC-19	24/01/2005	clear, no visible flow, >1.5m depth 5m wide,	6.64	162	1579	1058	55	24.1	
	GW Drain-2	FC-19	4/02/2005	clear, no visible flow, >1.5m depth 5m wide,	6.29	155	967	648	37	19.3	clear water
		FC-8	28/01/2005	shallow ditch near trees	3.62	353	3090	2070	60	29	drainage ditch, no flow
		FC-8	3/02/2005	shallow ditch near trees	4.6	14	323	216	32	27	wet weather
		FC-9	28/01/2005	shallow ditch near trees	3.33	453	2590	1735	45	33	Heavy vegetation
		FC-9	31/01/2005	shallow ditch near trees	3.34	227	1776	1190	37	31	Heavy vegetation
		FC-9	3/02/2005	shallow ditch near trees	4.73	117	288	193	47	23	wet weather
		FC-15	3/02/2005	clear, no visible flow, >1.5m depth,5m wide,	5.99	100	865	580	33	22.8	water level ~0.2m bgl
	GW Drain-2	FC-18	21/10/2005		7.85	99	7857	5264	100	20.61	Enviromanagers
	GW Drain-2	FC-18	21/11/2005		6.89	28	6574	4405	100	21.41	Enviromanagers
	GW Drain-2	FC-18	20/12/2005		7.26	118	4821	3230	85	21.69	Enviromanagers
GW Drain-3	GW Drain-3	FC-16	24/01/2005	clear, no visible flow, >1.5m depth,5m wide,	6.14	159	1320	884	60	24.6	water level ~0.5m bgl
	GW Drain-3	FC-16	2/06/2005	clear, no visible flow, >1.5m depth,5m wide,	5.02	125	1137	762	60	14.7	water level ~0.5m bgl
	GW Drain-3	FC-16	3/08/2005	clear, no visible flow, >1.5m depth,5m wide,	3.82	156	4020	2693	70	14.8	dry weather, low drain level
	GW Drain-3	FC-16	21/10/2005		8.3	94	7875	5276	100	21	Enviromanagers
	GW Drain-3	FC-16	21/11/2005		6.46	46	7976	5344	100	22.04	Enviromanagers
	GW Drain-3	FC-16	20/12/2005		7.22	102	5871	3934	90	22.87	Enviromanagers

Table 4- Field Chemistry Measurements- Surface Waters

Dredge Pond, Foy's Swamp and Blue Angle Creek

Water Body	Lab Sample ID	Field Sample ID	Date	Description	pH	Redox (mV)	EC (uS/cm)	TDS (mg/L)- #	DO (%)	Temp	Comments
GW Drain-4		FC-20	24/01/2005	Shallow <0.2m dish drain, stagnant water	3.58	339	1795	1203	50	26.1	acid waters
		FC-20	27/01/2005	Shallow <0.2m dish drain, stagnant water	3.36	475	1131	758	45	30	acid waters, rusty on bank
		FC-20	2/06/2005	Shallow <0.2m dish drain, stagnant water	4.17	310	1438	963	73	17.37	acidic, rusty on bank
	GW Drain-4	FC-10	28/01/2005	shallow drain, no flow	3.03	381	4680	3136	15	35.1	drainage ditch, no flow
		FC-11	28/01/2005	shallow drain, no flow	3.83	390	1227	822	50	34	drainage ditch, no flow
	GW Drain-4	FC-10	21/10/2005		7.7	108	12310	8248	100	21.27	Enviromanagers
	GW Drain-4	FC-10	21/11/2005		3.76	362	923	618	100	23.79	Enviromanagers
	GW Drain-4	FC-10	20/12/2005	dry							
GW Drain-5	GW Drain-5	FC-26	27/01/2005	clear, no visible flow, >1.5m depth, 5m wide.	6.79	356	2117	1418	50	28	clear water
	GW Drain-5	FC-26	3/02/2005	clear, no visible flow, >1.5m depth, 5m wide, full	6.39	75	1563	1047	46	21.8	clear water, wet weather flow, full drain
	GW Drain-5	FC-26	2/06/2005	clear, no visible flow, >1.5m depth, 5m wide, full	7.32	173	1554	1041	51	11.4	clear water
	GW Drain-5	FC-26	3/08/2005	clear, no visible flow, >1.5m depth, 5m wide	6.63	192	3250	2178	60	14.6	dry weather, low water level
		FC-7	28/01/2005	south end of drain 5	6.23	99	505	338	100	24	groundwater, deep drain, clear water
		FC-7	31/01/2005	south end of drain 5	5.41	261	863	578	50	26	groundwater, deep drain, clear water
		FC-7	3/02/2005	south end of drain 5	5.85	89	1082	725	36	19.6	groundwater, deep drain, clear water
	GW Drain-5	FC-26	21/10/2005		7.57	129	8242	5522	96	21.33	Enviromanagers
	GW Drain-5	FC-26	21/11/2005		7.54	116	7289	4884	98	22.35	Enviromanagers
	GW Drain-5	FC-26	20/12/2005		7.54	109	5331	3572	76	23.09	Enviromanagers
Drain-6	GWDrain-6		3/08/2005	slight flow (1L/min)	6.93	103	2120	1420	75	14.3	dry weather, low water level
	GWDrain-6		2/06/2005	slight flow (1L/min)	7.11	156	1173	786	60	9.4	slow flow
	GWDrain-6		21/10/2005		7.71	109	2394	1604	100	21.68	Enviromanagers
	GWDrain-6		21/11/2005		7.86	102	1949	1306	100	21.21	Enviromanagers
	GWDrain-6		20/12/2005		7.75	100	2131	1428	72	19.26	Enviromanagers
SW Drain	SW Drain	FC-29	27/01/2005	Shallow drain (<1m), flowing (~1L/sec), heavy vegetation, cow dung	6.48	171	256	172	10	23.3	cow dung, odour, turbid, gw seepage
	SW Drain	FC-29	2/06/2005	Shallow drain (<1m), flowing (~1L/sec), heavy vegetation, cow dung	6.83	127	312	209	47	14.7	cow dung, odour, turbid, gw seepage
	SW Drain	FC-29	3/08/2005	Shallow drain (<1m), flowing no flow, heavy vegetation, cow dung	7.11	5	340	228	70	15.3	dry weather, low drain levels- stagnant
	SW Drain	FC-29	21/10/2005		7.65	87	465	312	92	20.66	Enviromanagers
	SW Drain	FC-29	21/11/2005		7.98	80	389	261	100	20.91	Enviromanagers
	SW Drain	FC-29	20/12/2005		7.6	82	373	250	81	17.36	Enviromanagers
W Drain	W Drain	FC-28	27/01/2005	3m wide, approx 1m deep, still water	7.08	185	417	279	38	22.8	slight turbid, brown, vegetated drain
	W Drain	FC-28	2/06/2005	3m wide, approx 1m deep, still water	7.49	120	448	300	70	17.4	slight turbid, brown, vegetated drain
	W Drain	FC-28	3/08/2005	3m wide, approx 1m deep, still water	7.4	11	440	295	75	15.8	slight turbid, brown, vegetated, stagnant
	W Drain	FC-28	21/10/2005	dry							
	W Drain	FC-28	21/11/2005		8.14	79	689	462	154	19.45	Enviromanagers
	W Drain	FC-28	20/12/2005		7.56	87	539	361	59	15.56	Enviromanagers

Table 4- Field Chemistry Measurements- Surface Waters

Dredge Pond, Foy's Swamp and Blue Angle Creek

Water Body	Lab Sample ID	Field Sample ID	Date	Description	pH	Redox (mV)	EC (uS/cm)	TDS (mg/L)- #	DO (%)	Temp	Comments
NW Drain	NW Drain	FC-3	27/01/2005	3m wide, approx 1m deep, still water, heavy vegetation	4.1	188	1103	739	16	24.2	still water, vegetation in drain, slight turbid
		FC-1	27/01/2005	shallow drain, no flow	3.54	355	1114	746	26	25.3	acid waters
		FC-2	27/01/2005	deep drain, no flow	3.22	462	1642	1100	40	25.8	acid waters
	NW Drain	FC-3	27/01/2005	deep drain, no flow	3.4	463	1390	931	28	26.5	acid waters
		FC-4	27/01/2005	deep drain, no flow	3.16	470	2099	1406	30	27.3	acid waters
		FC-5	27/01/2005	shallow drain, no flow	3.33	406	4810	3223	41	30	acid waters
	NW Drain	FC-3	2/06/2005	deep drain, no flow	4.81	258	720	482	47	12.7	Heavy vegetation
		FC-4	3/08/2005	deep drain, no flow	4.82	74	1918	1285	73	13.6	dry weather, low drain levels
	NW Drain	FC-3	3/08/2005	deep drain, no flow	4.98	81	672	450	65	14.6	dry weather, low drain levels
	NW Drain	FC-3	21/10/2005		6.91	128	3214	2153	67	21.32	Enviromanagers
	NW Drain	FC-3	21/11/2005		4.11	337	2079	1393	100	22.6	Enviromanagers
	NW Drain	FC-3	20/12/2005		6.56	90	1636	1096	79	21.22	Enviromanagers
Main Drain (up stream)	MDrain-1	FC-17	24/01/2005	clear, no visible flow, >1.5m depth, 5m wide.	5.73	158	781	523	35	25.3	water level ~0.5m bgl
	MDrain-1	FC-17	27/01/2005	clear, no visible flow, >1.5m depth, 5m wide.	5.42	276	805	539	34	26.6	water level ~0.5m bgl
	MDrain-1	FC-17	31/01/2005	clear, no visible flow, >1.5m depth, 5m wide.	5.35	130	1034	693	61	28	wet weather
	MDrain-1	FC-17	2/06/2005	clear, no visible flow, >1.5m depth, 5m wide.	6.38	136	1164	780	47	12.6	water level ~0.5m bgl
	MDrain-1	FC-17	3/08/2005	clear, no visible flow, >1.5m depth, 5m wide.	6.3	26	2101	1408	33	13.2	dry weather, low drain levels
	MDrain-1	FC-17	21/10/2005		7.27	97	7293	4886	62	21.55	Enviromanagers
	MDrain-1	FC-17	21/11/2005		7.28	109	2506	1679	111	21.22	Enviromanagers
	MDrain-1	FC-17	20/12/2005		7.24	115	3192	2139	77	21.41	Enviromanagers
Main Drain (dn stream)	MDrain-2	FC-32	27/01/2005	clear, no visible flow, >1.5m depth, 4m wide.	6.52	222	1309	877	24	27.8	water level ~0.5m bgl
	MDrain-2	FC-32	4/02/2005	shallow drain, no flow	5.5	180	960	643	35	19.3	clear water
	MDrain-2	FC-32	2/06/2005	moderately full	7.06	166	1194	800	42	10.9	clear water, drain almost full
	MDrain-2	FC-32	3/08/2005	clear water, no visible flow, >1.5m depth, 4m wide.	6.98	112	2330	1561	63	14.1	clear water. Dry weather - low level
	MDrain-2	FC-32	21/10/2005		7.34	130	6827	4574	70	22.97	Enviromanagers
	MDrain-2	FC-32	21/11/2005		6.89	28	6574	4405	125	21.41	Enviromanagers
	MDrain-2	FC-32	20/12/2005		7.43	107	3485	2335	74	23.5	Enviromanagers
Large Dam	LD-2/ M Dam	FC-30	27/01/2005	Full dam next to Beach Rd, 300 MG capacity	7.01	160	154	103	50	24.8	slight turbid, brown.
	M Dam	FC-30	2/06/2005	Full dam next to Beach Rd, 300 MG capacity	8.42	162	177	119	95	17.2	slight turbid, brown.
	LD-2/ M Dam	FC-30	3/08/2005	Full dam next to Beach Rd, 300 MG capacity	6.12	78	170	114	80	14.5	slight turbid, brown.
	M Dam	FC-30	21/10/2005		8.32	62	294	197	100	20.09	Enviromanagers
	M Dam	FC-30	21/11/2005		6.77	95	186	125	100	22.55	Enviromanagers
	M Dam	FC-30	20/12/2005		7.73	80	194	130	100	21.85	Enviromanagers
Small Dams		FC-22	24/01/2005	clear, small, vegetated, <0.7m deep	6.35	199	87	58	50	27	very shallow, no flow.
		FC-21	24/01/2005	Clear water, dam next to Beach Rd, 10 MG capacity	6.4	200	232	155	65	25.8	~0.5 mbg, 50m by 50m, 3.5m deep
		FC-24	24/01/2005	Clear water, dam downhill of large dam	6.95	170	159	107	85	26.1	~0.5 mbg, captures leakage from large dam
		FC-31	24/01/2005	Clear water, small straw dam next to beach rd, vegetated	6.15	216	143	96	55	25.3	Heavy vegetation
Blue Angle Creek (dn)	BA Creek	FC-25	31/01/2005	5-10m wide, next to flood gates	4.79	275	1351	905	26	25.8	slightly turbid, brown, wet weather
	BA Creek	FC-25	3/02/2005	5-10m wide, next to flood gates- moderate flow	6.69	392	392	263	50	26	slight-mod turbid, brown- wet weather flows
	BA Creek	FC-25	2/06/2005	5-10m wide, next to flood gates- moderate flow	6.7	174	21820	14619	43	15.5	high tide
	BA Creek	FC-25	3/08/2005	5-10m wide, next to flood gates- low flow	6.58	109	6320	4234	33	16.2	Low tide, mouth open, slight turbidity

Table 4- Field Chemistry Measurements- Surface Waters

Dredge Pond, Foy's Swamp and Blue Angle Creek

Water Body	Lab Sample ID	Field Sample ID	Date	Decription	pH	Redox (mV)	EC (uS/cm)	TDS (mg/L)- #	DO (%)	Temp	Comments
	BA Creek	FC-25	21/10/2005		7.28	138	9981	6687	81	22.69	Enviromanagers
	BA Creek	FC-25	21/11/2005		7.15	85	5229	3503	92	21.35	Enviromanagers
	BA Creek	FC-25	20/12/2005		7.32	85	10460	7008	73	17.48	Enviromanagers

Notes:

E2W Field Equipment Calibrated: Field Kit 90 FLMVSA (EnviroEquip Pty Ltd)

nbgf= metres below ground level

Enviromanagers conducted sampling from September 2005 onwards

Min

Max

Average

3.03

8.42

6.24

5

475

171

87

21820

2353

58

14619

1577

10

154

65

8

35

22

Table 5- Groundwater Field Chemical Parameters

Cleary Bros - Beach Road, Berry.

Well ID	Date	Time	SWL (m bgl)	Stick up (m)	BOH (m bgl)	Volume Purged (L)	pH	Redox (mV)	EC (uS/cm)	TDS (mg/L)- #	DO (%)	Comments
New Wells (Jan 05)												period of wet weather and boggy ground slight turbidity, brown, rapid recovery (high K), some sw ingress
GW-A	3/02/2005	8.19 am	0.00	0.70	2.20	50	6.02	37	140	94	30	trace H2S odour (field chem only)
	31/01/2005	1.30pm	0.10	0.70		1	6.82	95	337	226	4	excavation area
	8/02/2005	9.30 am	0.30	0.70								no field chem (lab analyses)
	28/04/2005	9.30 am	0.72	0.70	2.30							
	2/06/2005	9.15 am	0.24	0.70	2.30							
	3/08/2005	12.15 pm	0.58	0.70	0.92	2						insufficient sample- slow recovery when purged
	21/11/2005	1pm	0.91	0.70			6.66	-29	555	372	67.4	Enviromanagers
	20/12/2005	2pm	0.96	0.70								Enviromanagers
GW-B	3/02/2005	8.19 pm	0.00	0.77	2.20	15	4.21	143	2228	1493	49	clear water, moderate recovery, some sw ingress
	31/01/2005	2.30pm	0.00	0.77		1	4.17	302	3460	2318	15	slight turbidity, brown
	15/02/2005	2.00 pm	0.70	0.77								water level measured during dry period
	2/06/2005	11.30am	0.60	0.77								
	3/08/2005	2.20pm	0.48	0.77	1.98	2	5.31	-36	3310	2218	10	turbid, H2S odour
	21/11/2005	11am	0.63	0.77			4.27	30	2806	1880	65	Enviromanagers
	20/12/2005	2.50pm	0.63	0.77								Enviromanagers
GW-C	4/02/2005	8.30am	0.00	0.73	2.20	8	3.75	200	7540	5052	28	slightly turbid- brown, slow gw recovery
	15/02/2005	2.00 pm	0.71	0.73								water level measured during dry period
	28/04/2005	11.30am	0.49	0.73	2.20							no field chem (lab analyses)
	2/06/2005	11.40am	0.48	0.73								
	3/08/2005	2.30pm	0.58	0.73	2.58	2	5.5	-108	7690	5152	9.5	turbid, H2S odour
	21/11/2005	1.30am	0.58	0.73			4.55	28	6114	4096	56.7	Enviromanagers
	20/12/2005	3pm	0.71	0.73								Enviromanagers
GW-D	4/02/2005	9.00am	0.00	0.50	2.20	10	3.81	232	7510	5032	14	test
	15/02/2005	2.15 pm	0.77	0.50								water level measured during dry period
	2/06/2005	3.20pm	0.49	0.50								
	3/08/2005	1.40pm	0.60	0.50	2.13	2	5.81	-23	3510	2352	8	turbid water, slow recovery
	21/11/2005	11am	0.76	0.50			3.91	103	3267	2189	40.7	Enviromanagers
	20/12/2005	3.30pm	0.93	0.50								Enviromanagers
GW-E	4/02/2005	9.40am	1.40	0.71	2.03	1	4.27	193	2560	1715	30	mod turbid - brown, v slow gw recovery
	15/02/2005	3.00pm	1.41	0.71								higher ground
	2/06/2005	3.30pm	0.58	0.71								
	3/08/2005	2.00pm	0.63	0.71	1.97	2	5.62	-33	3730	2499	10	turbid water, slow recovery
	21/11/2005	11.20am	0.91	0.71			4.67	63	4126	2764	51.4	Enviromanagers
	20/12/2005	4pm	1.04	0.71								Enviromanagers
GW-F	3/08/2005	12.30pm	0.42	1.15	1.77	2	6.14	122	502	336	33.3	turbid water, slow recovery
	28/04/2005	9.30am	0.58	1.15	1.77							dry weather
	2/06/2005	10.10am	0.21	1.15								
	21/11/2005	1.10pm	0.68	1.15			6.4	5	545	365	77.3	Enviromanagers
	20/12/2005	4.30pm	0.81	1.15								Enviromanagers
GW-G	28/04/2005	9.45 am	0.62	1.15	1.32							dry weather
	2/06/2005	10am	0.18	1.15								
	3/08/2005	1.00pm	0.55	1.15	1.32	2	6.86	89	630	422	25	turbid water, slow recovery
	21/11/2005	4:48	0.77	1.15			6.98	-86	400	268	36.9	Enviromanagers
	20/12/2005	1pm	0.88	1.15								Enviromanagers
Existing Wells												
MW-2R	28/04/2005	12.30pm	0.60	0.66	1.22							dry weather
	3/08/2005	11.45am	0.70	0.66	1.22	2	NA					insufficient sample- slow recovery when purged
	21/11/2005	dry		0.66								
	20/12/2005	2pm	dry	0.66								Enviromanagers
MW-1#	3/02/2005	3.00pm	0.61	0.23	3.85	10	6.27	74	452	303	19.9	Very turbid, grey (frogs inside well)

Notes:

E2W - Field parameters (ph, EC etc) noted are at end of purging and start of sampling.

E2W Field Equipment Calibrated: Field Kit 90 FLMVSA (EnviroEquip)

SWL= standing water level

BOH= bottom of bore

mbgl= metres below ground level

TDS = EC*0.67 (approximate)

APPENDIX B
ASSMP

APPENDIX B
ACID SULPHATE MANAGEMENT PLAN
PROPOSED NORTHERN EXTENSION OF GERROA SAND QUARRY
GERROA AND BEACH ROADS, GERROA

1. INTRODUCTION

Coastal, low-lying alluvial soils, lying below about RL 5, generally contain framboidal pyrite or other sulphides. These are rounded, microbially generated microscopic mineral grains, which are stable in soils below the water table, or in dense clay-rich soils that are periodically re-wetted. In such situations, where the sulphides are kept out of contact with air, they are relatively stable, and generally in "equilibrium" with the local environment. Soils, which have appreciable pyrite or other sulphides which have not yet reacted significantly with air, are referred to as Potential Acid Sulfate Soils, or PASS.

If such sulphide-bearing or pyritic soils are disturbed by excavation, thereby allowing ready access of oxygen to the sulphides from air, a spontaneous or irreversible natural oxidation reaction takes place. This results in the generation of sulphuric acid or acid sulphates. (Pyritic soils, which have begun to generate acid, are referred to as Actual Acid Sulfate Soils or AASS). The acid is transported by water, and if allowed to build up sufficient concentration, poses a direct environmental threat to organisms that come in contact with such waters.

Additionally, increasingly acidic waters can dissolve many metal ions which would otherwise remain insoluble and hence not available for uptake by organisms. These ions comprise aluminium and iron, plus a suite of heavy metals such as zinc, lead and cadmium, which at elevated levels can be toxic to plants, animals and humans.

The measure of acidity in waters is pH; pure therefore neutral water has a pH of 7; pH values below 7 are acidic, pH values above 7 are basic or alkaline. A decrease of 1 pH unit represents a 10-fold increase in the concentration of dissolved hydrogen ions, which is what produces acidity. Further, the pH scale is not linear; the change in pH of a natural body of water from 5 to 4 is 10 times as undesirable as a change from 6 to 5; the change from 5 to 3 is 100 times as undesirable.

Most organisms can cope with pH in the range 5.5 to 8.5 - pH values in natural waters below 5 are undesirable; below 4, they are unacceptable.

This acid sulfate soil management plan (ASSMP) is aimed at remediating or controlling the generation of acid sulfates during the excavation of (actual and potential) acid sulfate soils.

The key to optimal performance in managing the acid sulfate soil risk, and minimising the impact on the environment, is to comprehensively assess the spatial nature before any excavation is commenced. Only in this way can the ASS risk be best quantified, and the appropriate remediation procedure formulated (and incorporated into the staged ASSMP).

Attention is drawn to the fact that ASS testing generally requires 5 to 10 working days, and therefore should not be left to the last minute. The above does not reduce the need for monitoring during and after construction.

A clear line of communication and command should be set up, so that non-compliances, or performance below defined guidelines, can be immediately reported to the Cleary Bros (Bombo) Pty Ltd (CB) project manager (PM), who in turn can issue relevant directives to rectify the situation. Note however, that this does not preclude the independent monitoring consultants from direct communication with the CB site staff.

It is considered that lengthy, overly complicated and generalised ASSMPs are more difficult to comprehend and carry out, and may leave too many interpretations and decisions to the contractors. This ASSMP template, for implementation of dredging, associated disposal of reject materials and restoration and it is therefore brief and focused, with little left for interpretation.

RESPONSIBILITIES OF THE OPERATOR

- 2.1** The operator (CB) is responsible for the correct implementation of the ASS management protocols presented in this ASSMP. The CB site staff is not empowered to vary any of the listed specific procedures in Section 5, unless explicit written approval has been given by the PM.

Where ambiguity or conflict exists as to the procedure to be followed, it is the CB site staff's responsibility to seek clarification from the PM, in writing if necessary.

- 2.2** With respect to ASS management, CB site staff is responsible for a degree of self-monitoring, to a level and schedule agreed to in writing with the PM, or to that stated in the individual protocols of Section 5. Daily logs of such monitoring will be kept by the contractor, and signed copies will be forwarded to the PM weekly, or as requested.

It is the responsibility of CB site staff, independent monitoring consultants (as applicable) to inform the PM immediately on discovery of non-compliances or exceedence and with the latter's approval, to implement immediate remedial measures.

It is expected that independent monitoring consultants will inspect the site on both a regular and random basis, and carry out such sampling and/or in-situ measurements as are necessary to check compliance with the ASSMP.

The requirements of ASS management are in addition to, but do not override any other standard procedures such as safety considerations. Where conflict results, or may result from, the implementation of ASS management as against other performance criteria, it is the CB site staff's responsibility to obtain directives from the PM.

3. WATER AND LEACHATE MONITORING AND DISCHARGE

If left unmanaged, the acidity and heavy metal contamination of pyritic ASS and PASS materials is generated in, and transported by water. Such waters can contaminate both groundwater and surface waters, eventually entering rivers and estuaries.

The aim of the ASSMP is to minimise the impact on the environment and to ensure that ASS leachate, which enter and mix with natural waters, meet acceptable guidelines. In addition, one of the measures of the performance of the management procedures lies in the water quality of leachate and surface runoff from processed sand stockpiles, and the quality of local groundwater into which leachate have mixed. Monitoring of the water mass up-gradient, within and downstream of the dredge pond will be required to demonstrate that target criteria are met.

Although the volume of the dredge pond and bunded nature of the quarry area is expected to be sufficient to contain runoff from processed sand stockpiles and direct rainfall to the pond surface during even heavy or sustained rainfall, there is very limited potential for discharge during flooding events (infrequent) of Foy's Swamp. While such discharges will enter natural waterways and they will be diluted, it is still a requirement of the ASSMP that water quality be as good as possible prior to discharge. Management by natural dilution is not acceptable.

It is for the above reasons that water quality in the dredge pond be kept as good as practicable at all times. In this way, even unexpected heavy rainfall presents no immediate problem for leachate overflows.

3.1 Target water quality of dredge pond

pH between 6.5 and 9

Dissolved oxygen (DO) > 6 mg/L (> 80 – 90% saturation)

Total dissolved solids (TDS) < 1500 mg/L

Total suspended solids < 50 mg/L

Fe (total) < 0.5 mg/L and Al (total) < 0.055 mg/L for pH > 6.5.

(Note: natural concentrations of Fe in the surface water in adjacent drains, canal and groundwater are expected to be in excess of the target range; however operations should be managed to maintain values are within natural ranges).

3.2 Target main canal and Blue Angle Creek water quality

pH <0.2 unit change

Total dissolved solids (TDS) >1 500 mg/L

Dissolved oxygen (DO) >6 mg/L.

3.3 Monitoring frequency

Unless otherwise indicated in the specific protocols of Section 5, the general rule here is to monitor daily all those temporary processed sand stockpiles from which leachate is weeping. This monitoring is continued until a time trend is built up demonstrating targeted performance of the sand processing methodology (at which time monitoring frequency can be progressively decreased) or until leachate flow has ceased.

After all but the lightest rainfall, all stockpiles should be inspected and the leachate tested. As well, all stockpiles should be inspected on Mondays to record the results of any rain events that occurred over the weekends. Weekly measurements of water quality in the dredge pond should also be carried out.

Monitoring of water quality within the dredge pond should be carried out on a weekly basis while monitoring of downstream water bodies and groundwater monitoring bores should be carried out monthly, with a progressive reduction in monitoring frequency once time trends are established. Monitoring of the downstream waters should continue for a period of two years after completion of quarrying.

A written log of results should be kept, and passed weekly to the PM.

3.4 Discharges from dredge pond

Discharges (considered unlikely) of water, complying with quality criteria, from the dredge pond should be controlled. Water quality should be checked several days before projected discharge, to allow for any additional remediation if required. The pH and DO should also be checked just prior to discharge.

4. NEUTRALISING MATERIALS

- 4.1** Medium-fine aglime will be used for lining of processing/stockpile areas and potential for co-interment or as a layer of neutralising agent at the fines-water interface in the reject material disposal areas within the base of the dredge pond. Dolomitic aglime, or magnesium-blend aglime, should not be used. The aglime grind should have at least 85% by weight passing 1 mm, and 100% passing 2.5 mm; in general a finer grind is better.

The aglime purity should preferably be 90% or better, (that is, NV>90), unless there is a significant savings to be made by use of less pure aglime. In the latter case, however, the individual lime dosing rates as listed in the next sections will need to be increased by a factor of 90/NV.

The requirement for greater amounts of aglime of lower purity should be borne in mind when assessing the supplies of this material, as the cost savings from less pure material may be offset by the need for more, and correspondingly higher total transport costs.

It is recommended that an aglime dump is set up at the site. Aglime is non-corrosive, and requires no special handling - it may be necessary to cover the stockpile with a tarpaulin to prevent it blowing away by strong winds, and from wetting, since it is then more difficult to spread.

- 4.2** in general, ponded leachate from excavated and processed (PASS) sands should not be appreciably acidic, since the management protocols have been formulated to prevent buildup of acidity. However, unforeseen events such as intersection of high sulphide content feed materials may result in the stockpiling of sand with unacceptable for use as a concrete aggregate. If left to oxidise, especially over weekends, there may be production of leachate which have unacceptable acidity; i.e. a pH less than 5.

In the above instance, and in cases where ponded leachate needs 'finishing' before discharge to the dredge pond, a calcium hydroxide solution may be used for rapid neutralisation. This may be made from slaked lime, or from quicklime, by stirring about 0.3 kilogram of either into water, in a container of sufficient volume such as a used

plastic 200 litre drum. The slurry should be allowed to settle, and the clear solution (which will be caustic, with a pH of around 12.2) can be pumped or sprayed into the standing water in small amounts, with some agitation and monitoring, until the pH is brought to acceptable levels. Do not overdose.

It is recommended that the operator always have several bags of quicklime or slaked lime on hand, with necessary equipment to make, transport and apply the hydroxide solution as required.

Quicklime is very reactive and quite corrosive (caustic) - special handling and safety procedures are required. When mixed with water, reaction generates much heat, so that the 0.3 kg amount should be added slowly to a large amount of water.

5. MANAGEMENT OF EXCAVATION AND PROCESSING/STOCKPILE AREAS

- 5.1** The discharge point at the southwestern section of the existing dredge pond should be maintained at current levels which have resulted in no previous requirement for discharge.
- 5.2** Select a processing/stockpile site adjacent to a deeper (preferably > 4 m) section of the dredge pond suitable for reburial of reject materials.
- 5.3** Prepare a processing/stockpile site (one of more area of sufficient size to treat sandy materials at the proposed excavation rate and to store sufficient for aggregate for the period required to carry out verification testing). The area should be on gently sloping ground with a natural or engineered fall to a drain for return of dredge water and any leachates to the dredge pond. Do not excavate the processing/stockpile site as the underlying sandy profile is expected to be permeable and as such, the preparation of the area will require the placement of a select clayey layer (minimum 300 mm thick) or a plastic liner to prevent infiltration of any leachate. Lime the base of the pad (a guard layer) 5 kg/m² per metre height of the expected processed sand stockpile.
- 5.4** Bund off the processing/stockpile area to prevent runoff to areas other than the dredge pond using clayey, non-ASS material.
- 5.5** Monitor leachate from stockpile areas daily, testing for pH (should not fall below 5.5). If there are weeping points for any acidic leachate which has washed away the aglime, add extra lime aggregate to flow path.
- 5.6** Continue to monitor leachate weeping points and ponded leachate daily, until no more leachate is generated. If ponded leachate pH falls slightly below 5.5, add aglime directly over the surface of the leachate drain. In the unlikely event that pH falls significantly, neutralisation with calcium hydroxide solution may be required. The intent of this treatment is to minimise changes to the dredge pond water quality.
- 5.7** Following any rain, recommence the monitoring cycle, and treat accordingly.
- 5.8** Progressively test (SPOCAS method) in a NATA registered laboratory the processed sand at an initial rate of 1 sample per 1000 m³ or additionally if required for verification of

suitability for use as concrete aggregate.

- 5.9** If testing indicates unacceptable sulphide content in processed sand, re-process (potentially requiring variation in the processing methodology) and verify acceptable values have been obtained.

6. REBURIAL OF TREATED REJECT MATERIAL

- 6.1** Select and record locations of areas (water depth preferably > 4 m over emplaced material) for reburial of sulphidic fines and PASS clay from Unit 3.
- 6.2** Sluice or pump processing fines to emplacement area.
- 6.3** If clay from Unit 3 cannot be reburied below water within 2 days, retain the material on prepared liming/treatment pads for classification of the material and treatment prior to final reburial.
- 6.4** Monitor water quality (vertical profile) over emplacement site within the dredge pond.
- 6.5** If oxidation of reburied material is indicated and posing a risk to water quality within the dredge pond, investigate and institute appropriate remedial measure (e.g. spreading of fine ground aglime or capping with sand layer).
- 6.6** Continue current monitoring of dredge pond water quality to verify that the burial has not environmental effects. Monitoring should be continued for at least two years following completion of quarrying and remedial works instituted if appropriate.
- 6.7** All records applicable to acid sulphate testing and treatment shall be collated to substantiate treatment.

7. CONTINGENCY PLANNING

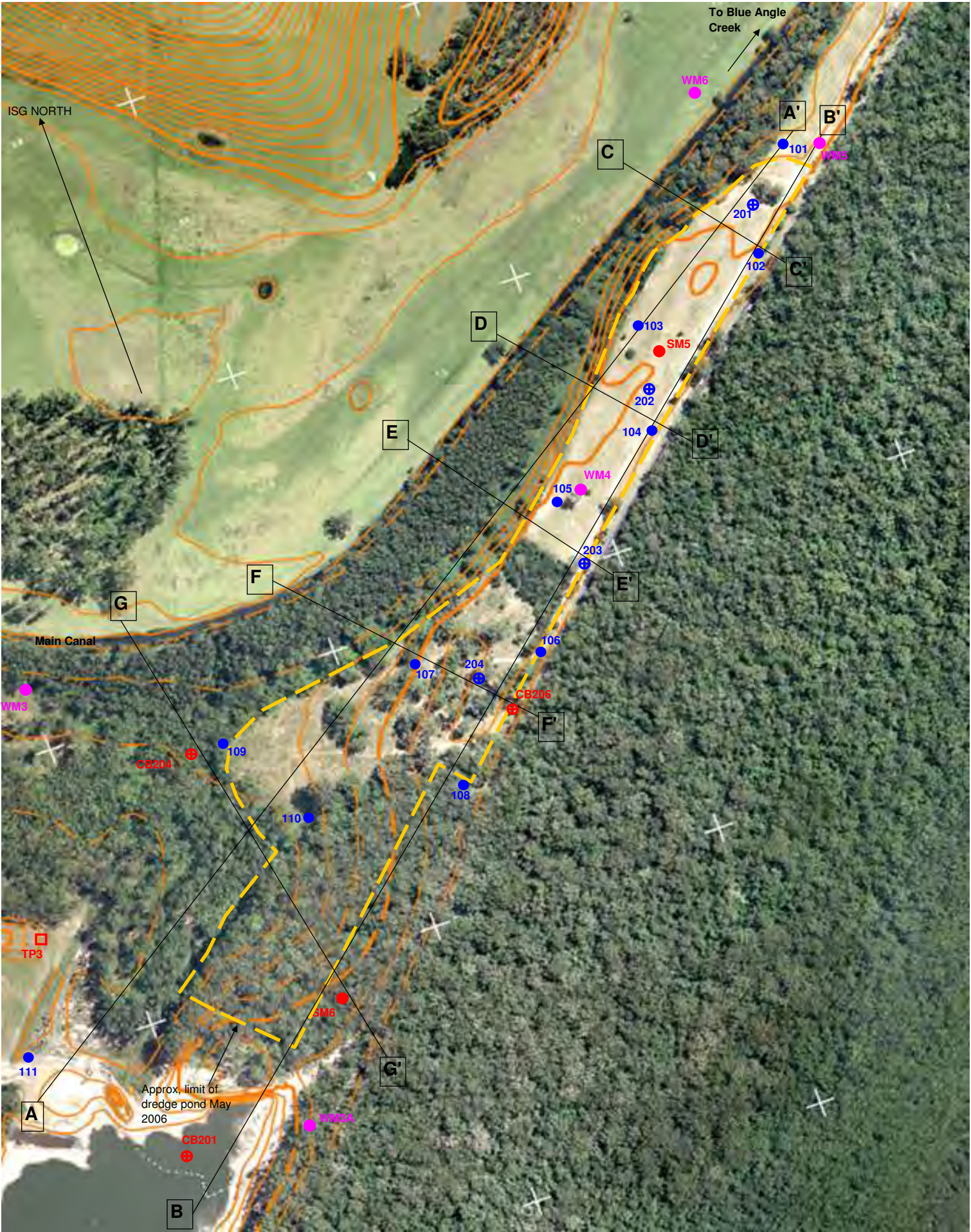
Contingency measures are included within the quarrying, monitoring, processing, treatment, restoration and reporting protocols detailed above. These protocols are designed to provide an early detection of a non-conformance and a consequent corrective action.

Any modification of the protocols required to meet unexpected conditions shall be agreed to by the PM. Monitoring shall be used to confirm the effectiveness of any changes.

The principal contingency during the operational and restoration phases of quarrying is by control of water quality of the dredge pond and timing of any discharge from the site. The discharge of water/leachate will be halted where a non-conformance is identified, the source investigated and corrective actions implemented.

The preparation of processing and stockpile areas, including the placement of lime layers below these areas, will provide a contingency against leachate passing through the subgrade without having been monitored and treated if required.

DRAWINGS



0m → 250m
SCALE

LEGEND

- TEST PIT (CLEARY BROS)
- ⊕ BORE (CLEARY BROS)
- BORE (DEPARTMENT OF MINERAL RESOURCES)
- CONE PENETRATION TEST (DOUGLAS PARTNERS)
- ⊕ BORE (DOUGLAS PARTNERS)
- SURFACE CONTOUR (1m INTERVAL)
- APPROXIMATE OUTLINE OF PROPOSED SAND QUARRY APPLICATION
- GROUNDWATER MONITORING BORE (APPROX. LOCATION ONLY)

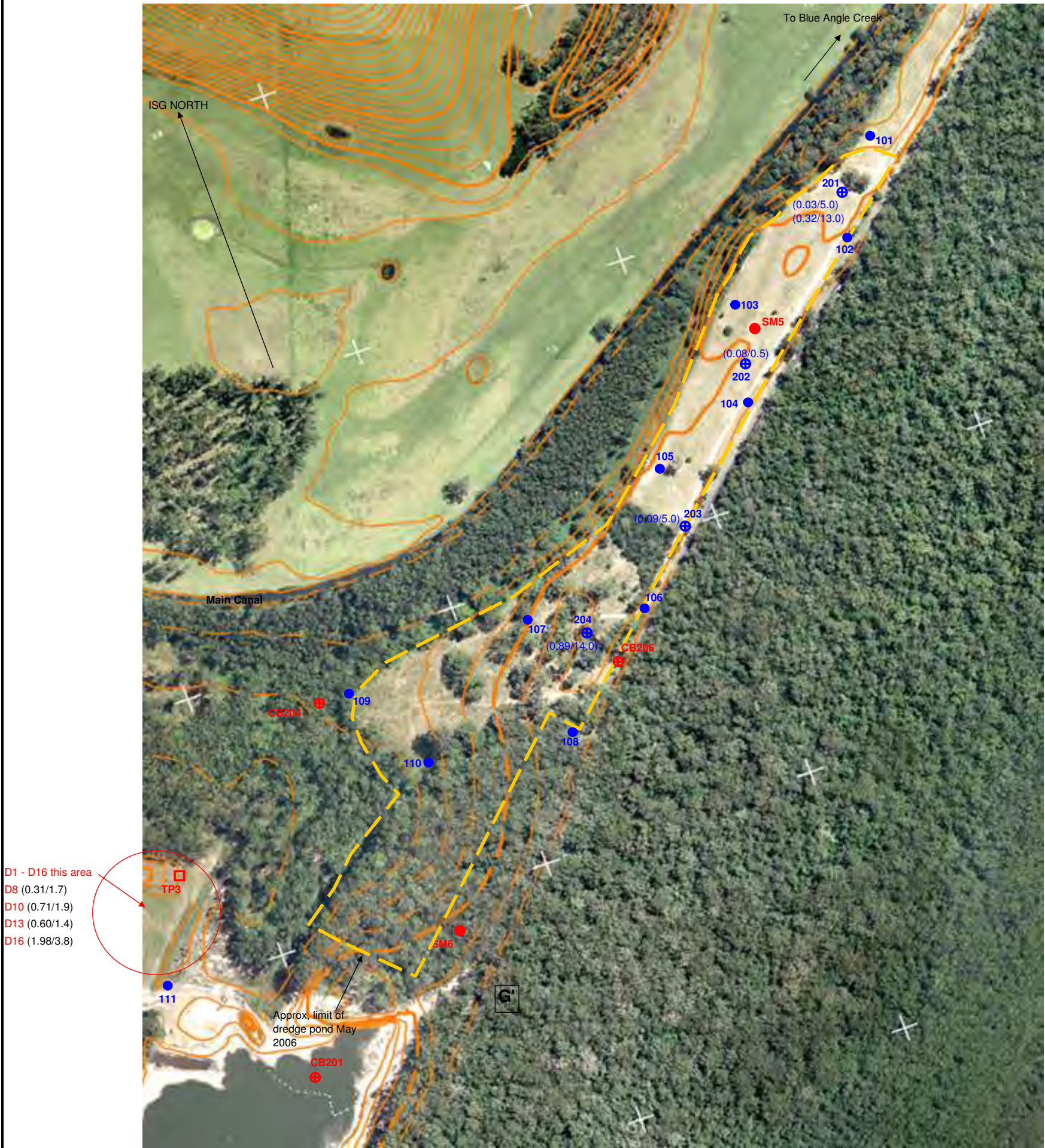
NOTE: FOR DETAILS OF SECTIONS A-A' & B-B' SEE DRAWING 3
FOR DETAILS OF SECTIONS C-C' TO G-G' SEE DRAWING 4



Sydney, Newcastle, Brisbane
Melbourne, Perth, Wollongong
Campbelltown, Cairns, Darwin
Townsville

Title
**LOCATION OF INVESTIGATION
PROPOSED NORTHERN EXTENSION
ACID SULPHATE SOIL MANAGEMENT PLAN
GERROA SAND QUARRY
GERROA**

Client: CLEARY BROS (BOMBO) PTY LTD				
Drawn By: GRW	Scale: As shown	Project No. 37673B	Office: Sydney	
Approved By: GRW		Date 5/05/2006	Drawing No. 1	



D1 - D16 this area
D8 (0.31/1.7)
D10 (0.71/1.9)
D13 (0.60/1.4)
D16 (1.98/3.8)

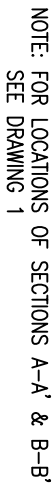
LEGEND

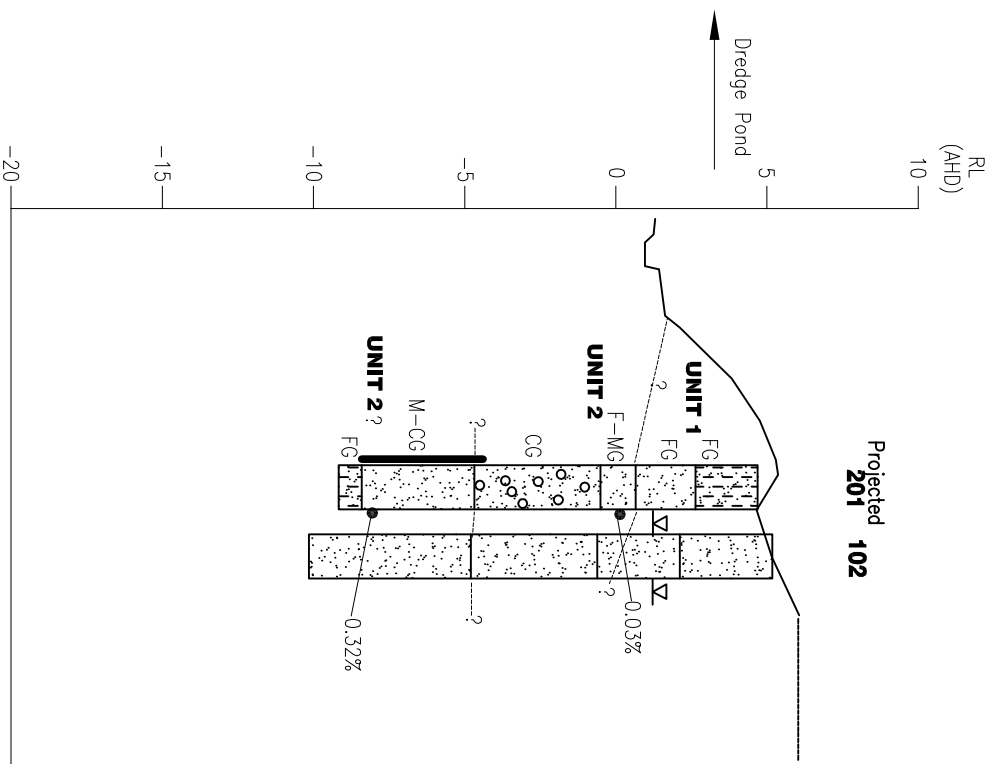
0m 250m
SCALE

- (0.02/0.1) Scr% / depth at top of test interval
(0.21/1.4) Spos% / depth at top of test interval
AASS Actual acid sulphate soil
TEST PIT (CLEARY BROS)
BORE (CLEARY BROS)
BORE (DEPARTMENT OF MINERAL RESOURCES)
CONE PENETRATION TEST (DOUGLAS PARTNERS)
BORE (DOUGLAS PARTNERS)
SURFACE CONTOUR (1m INTERVAL)
APPROXIMATE OUTLINE OF PROPOSED SAND QUARRY APPLICATION

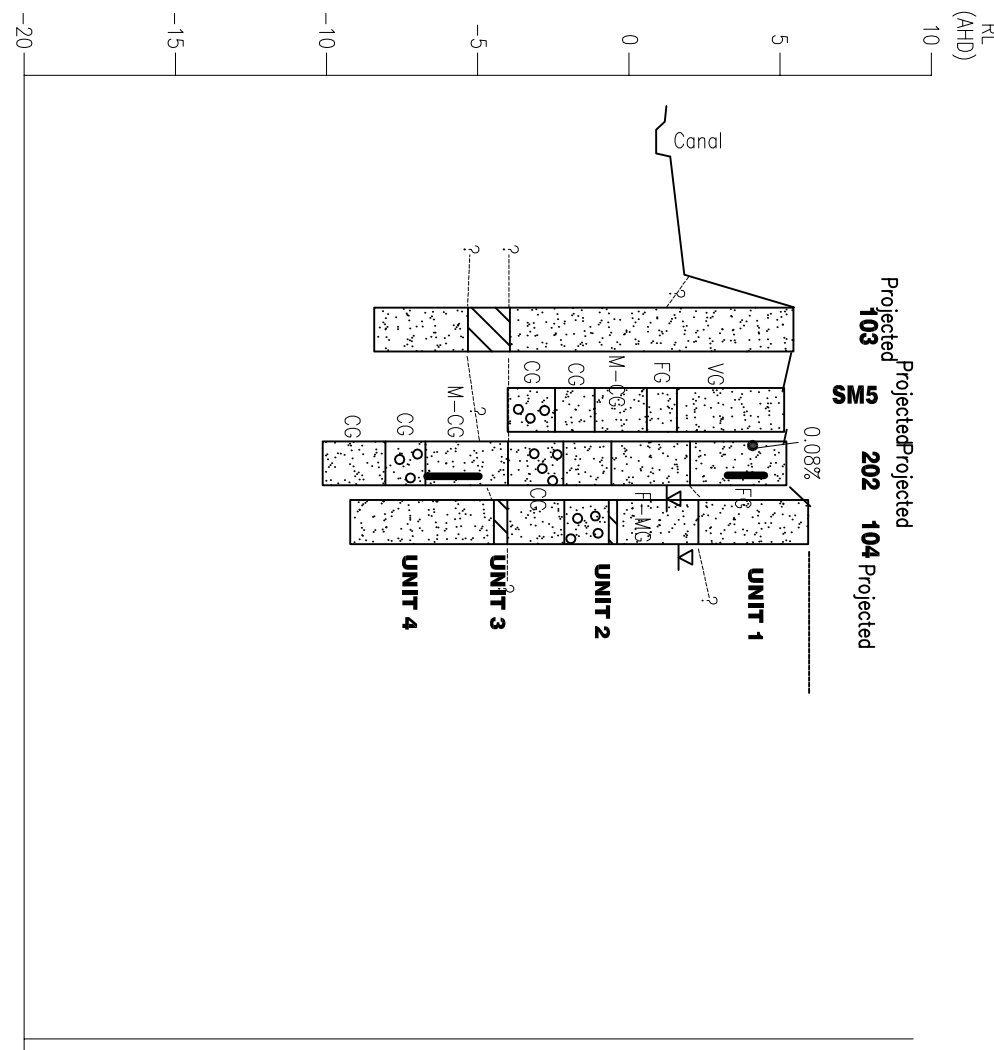
NOTE: FOR DETAILS OF SECTIONS A-A' & B-B' SEE DRAWING 3
FOR DETAILS OF SECTIONS C-C' TO G-G' SEE DRAWING 4

		Sydney, Newcastle, Brisbane Melbourne, Perth, Wollongong Campbelltown, Cairns, Darwin Townsville	
Title SUMMARY OF ACID SULPHATE LABORATORY TESTING PROPOSED NORTHERN EXTENSION ACID SULPHATE SOIL MANAGEMENT PLAN GERROA SAND QUARRY GERROA			
Client: CLEARY BROS (BOMBO) PTY LTD			
Drawn By: GRW	Scale: As shown	Project No. 37673B	Office: Sydney
Approved By: GRW		Date 5/05/2006	Drawing No. 2

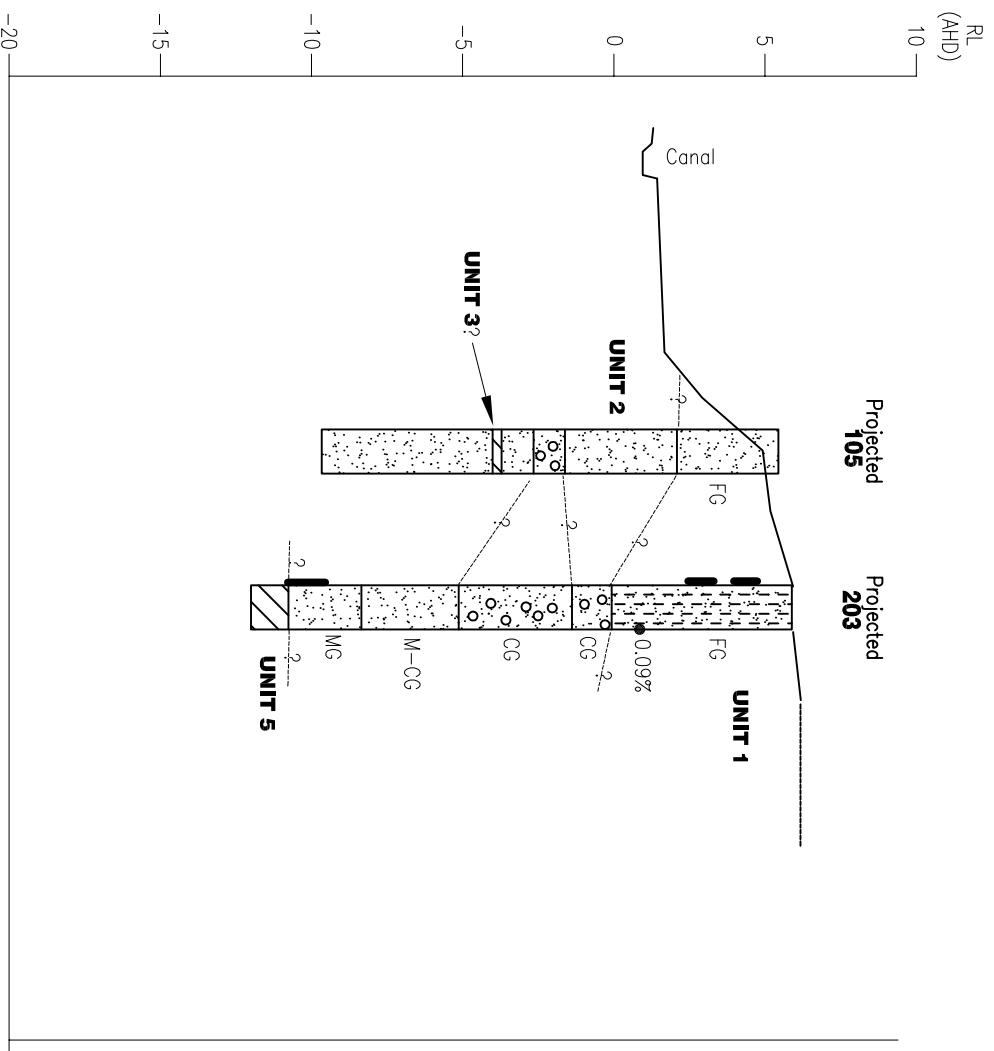




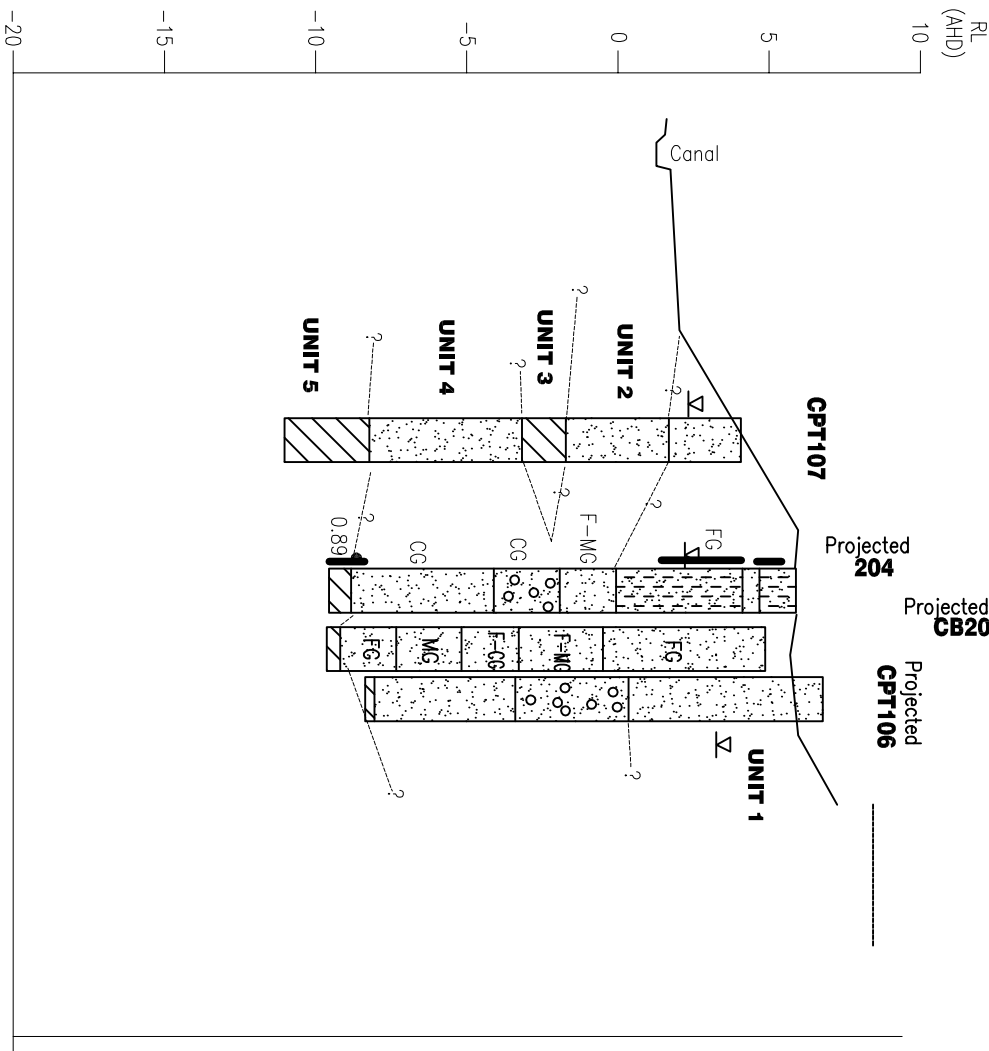
SECTION C-C'



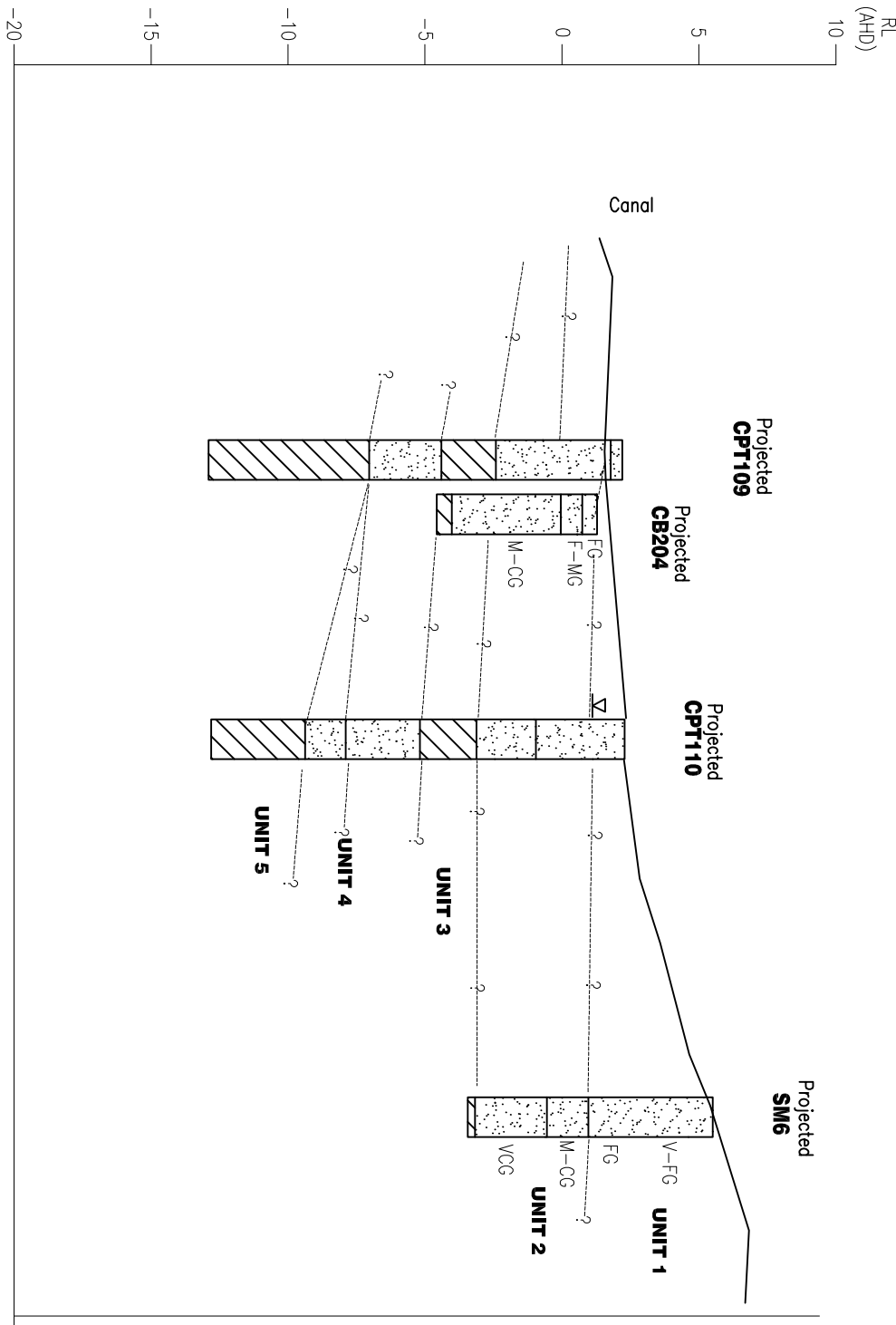
SECTION D-D'



SECTION E-E'



SECTION F-F'



SECTION G-G'

LEGEND

- SAND
- SILT SAND
- SANDY CLAY
- CLAY
- SANDY GRAVEL/GRAVELLY SAND
- SILT SAND GRAVEL
- POSITIVE FIELD SCREENING RESULTS
- WATER LEVEL
- INTERPRETED BOUNDARY

NOTE: FOR LOCATIONS OF SECTIONS C-C' TO G-G' SEE DRAWING 1

Appendix G

ABORIGINAL HERITAGE MANAGEMENT PLAN

Gerroa Sand Mine Extension

Aboriginal Cultural Heritage Management Plan

Report for Cleary Brothers

February 2009

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EXECUTIVE SUMMARY

This Aboriginal Cultural Heritage Management Plan (ACHMP) describes the process for the ongoing management of Aboriginal cultural heritage sites located within the Gerroa Sand Mine Extension and has been prepared to supplement the Environment Management Plan (EMP) for the project.

The Plan has been developed based on the findings of the previously prepared archaeological and cultural heritage survey assessments and sub-surface investigations at the Gerroa Sand Mine Extension.

Cleary Brothers (Bombo) Pty. Ltd have received approval from the Land and Environment Court for the extension of the Gerroa Sand Mine. This will involve the extraction of sand deposits to the north of the currently mined area (Figure 1).

The initial and subsequent archaeological investigations undertaken across the proposed sand mine extension area (Paton 1992; Barber 2002; Navin Officer 2005, 2006) identified a total of 5 Aboriginal archaeological sites within the proposed sand mine extension area.

The proposed mine extension area will impact upon these Aboriginal archaeological sites and part of an area of Aboriginal archaeological sensitivity known as Conservation Area B. It should be noted, however, that Aboriginal archaeological sensitivity Conservation Area A will be avoided entirely by the proposed works and retained as an area of conservation.

This Aboriginal Cultural Heritage Management Plan (ACHMP) describes the process for the ongoing management of recorded Aboriginal archaeological sites, and identified areas of conservation within the proposed sand mine extension area.

Through ongoing consultation, the ACHMP also details the inclusion of relevant Aboriginal stakeholders in the management of their cultural heritage, including archaeological sites and Aboriginal resources.

The ACHMP has been developed in consultation with the Jerrinja Local Aboriginal Land Council and the Department of Environment and Climate Change (DECC).

1.0 INTRODUCTION

1.1 Project Background

This Aboriginal Cultural Heritage Management Plan (ACHMP) was prepared to guide the process for the ongoing management of cultural heritage sites and places located within the proposed Gerroa Sand Mine Extension of an existing sand mining operation owned by Cleary Brothers (Bombo), south of Gerroa (Figure 1).

Since 1988, a number of archaeological assessments have been undertaken within the Cleary Brothers (Bombo) property. These investigations have identified a number of archaeological sites within the property (Colley 1988; Lance 1989, 1990; Paton 1992; Huys 1997; Barber 2001, 2002; Navin Officer 2004, 2005, 2006). Each of these investigations has been undertaken as part of ongoing environmental assessment and management processes following rulings in the Land and Environment Court.

The most recent and relevant of the archaeological and cultural heritage work has been undertaken within the current sand mine extension area (Navin Officer 2005, 2006). The current proposal will involve the extension of the current mine area to the north east of the property. The proposed area extends from Blue Angel Creek channel and the Gerroa-Nowra Road, covering an area of 800 metres in length and between 100-150 metres in width.

This report describes the rationale and methodology for the ongoing management and mitigation strategies for all Aboriginal archaeological sites and areas of Aboriginal archaeological sensitivity within the proposed Gerroa sand mine extension area.

2.0 RATIONALE FOR THE ACHMP

This Aboriginal Cultural Heritage Management Plan is intended to facilitate the implementation of the mitigation and conservation strategies by clearly setting out a process for the management of Aboriginal cultural heritage prior to, during and subsequent to the construction stages of this project. To this end, the ACHMP will be incorporated into the relevant Environmental Management Plan for the Gerroa Sand Mine Extension.

The archaeology and cultural heritage assessment undertaken initially by Paton (1992), and subsequent work completed by Navin Officer (2006), identified potential impacts to Aboriginal cultural heritage associated with the proposed sand excavation within the proposed sand mine extension area. In response to this, the cultural heritage assessments made recommendations to mitigate these impacts. These will be outlined as part of the Aboriginal Cultural Heritage Management Plan for the project.

This ACHMP seeks to implement best practice heritage management. In the first instance, this would involve the avoidance and conservation of Aboriginal archaeological sites. Where sites cannot be avoided, impact would be minimised by:

- development of management and mitigation of Aboriginal cultural heritage drawing on both information provided by the Aboriginal stakeholders and the results of the cultural and archaeological assessments. This might include excavation, salvage and relocation of cultural material.
- ensuring the direct involvement of the relevant Aboriginal stakeholder groups in the development and implementation of this ACHMP. This would be in compliance with the Interim Guidelines.
- promoting conservation of Aboriginal archaeological sites and cultural heritage at all times.

The ACHMP seeks to allow Cleary Brothers (Bombo) Pty Ltd to meet its obligations and requirements whilst working in partnership with the Jerrinja Local Aboriginal Land Council to manage and promote the Aboriginal cultural heritage values of the area.

3.0 LEGISLATIVE FRAMEWORK

3.1 The Minister's Part 3A Approval and the Statement of Commitments

Approval for the proposed Gerroa Sand Mine Extension Area was given by the Land and Environment Court on 2 September 2008 under Section 75J Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Condition 29 of the Courts Approval requires Aboriginal site conservation of Area A, and Condition 30 of the Courts Approval requires the preparation of an Aboriginal Heritage Management Plan.

Condition 29 of the Courts Approval requires that:

29. The proponent shall protect and conserve Area A, as described in the EA (and shown on the plan in Appendix 8), to the satisfaction of the Director-General.

Condition 30 of the Courts Approval requires that:

30. The Proponent shall prepare and implement an Aboriginal Heritage Management Plan for the project to the satisfaction of the Director-General. This plan must:

- be submitted to the Director-General within 3 months of the date of this approval and prior to disturbance of any identified Aboriginal object;
- be prepared in consultation with the DECC and relevant Aboriginal communities; and

include a:

- description of the measures that would be implemented to protect Area A and that part of Area B proposed to be conserved, as described in the EA (and shown on the plan in Appendix 8);
- description of the measures that would be implemented for the mapping and salvage or relocation of the archaeological relics in the site including the shell midden deposit situated at the South Western corner of the extraction area (and shown on the plan in Appendix 8).
- description of the measures that would be implemented if any new Aboriginal objects or relics are discovered during the project; and
- protocol for the ongoing consultation and involvement of the Aboriginal communities in the conservation and management of Aboriginal cultural heritage on the site.

This ACHMP has been prepared in satisfaction of Condition 29 and 30 of the Courts Approval and Statement of Commitments No. 10 and 11.

These commitments are stated as follows:

10. Protect from disturbance Area A (shown on the figure in Appendix 8), of significance for potential Aboriginal relics;
11. Arrange for targeted salvage excavations for Aboriginal artefacts to take place as recommended by Navin Officer and to include the shell midden deposit situated at the South Western corner of the extraction area prior to mining occurring in the nominated locations (shown on the figure in Appendix 8);

4.0 CONSULTATION

4.1 Overview of Aboriginal Community Consultation

Consultation for this project has been undertaken with the identified stakeholders including representative members of the Jerrinja Local Aboriginal Land Council. Aboriginal representatives have been involved in the archaeological and cultural heritage work for the Cleary Brothers (Bombo) sand mine for the past 16 years.

No additional Aboriginal community groups beyond the Jerrinja Local Aboriginal Land Council have been involved in the consultation / assessment process of the subject land, as the land council represents all known traditional owners or interested parties in this region.

Consultation for this ACHMP document has been undertaken with the relevant representatives from the Jerrinja Local Aboriginal Land Council.

Discussions regarding the proposed salvage and relocation methodology (see Section 7.0 below), and a Care and Control Agreement have taken place with the Administrator and Elders from the Jerrinja Local Aboriginal Land Council regarding any cultural material recovered during the sub-surface investigation program. A copy of correspondence received from the Jerrinja Local Aboriginal Land Council is attached in Appendix 1 of this report.

4.2 ACHMP Consultation Framework

As part of the Aboriginal Cultural Heritage Management Plan, consultation with identified Aboriginal stakeholders with regard to managing archaeological sites and cultural heritage values within the proposed Gerroa sand mine extension will be ongoing. It will continue to do so in respect to the following:

- Identified Aboriginal community stakeholder groups to be consulted include the Jerrinja Local Aboriginal Land Council.
- Representatives of the Aboriginal community will be invited to participate in any active management of archaeological sites and objects, including consultation, salvage excavation and relocation.
- Representatives of the Aboriginal community groups will be invited to participate in any active management of other materials of traditional significance.
- Aboriginal community groups will be consulted regarding maintaining cultural values within the Gerroa sand mine extension landscape.
- Systematic review of this Aboriginal Cultural Heritage Management Plan will be performed with the local Aboriginal stakeholder groups.

5.0 ABORIGINAL ARCHAEOLOGICAL CONTEXT

5.1 Previous Archaeological Investigations

The following Table summarises the archaeological studies that have been undertaken within the sand mine property (Table 1). These assessments have involved archaeological survey of proposed sand mining across the property, including surface survey and archaeological sub-surface investigations. This work has resulted in the identification of 8 Aboriginal archaeological sites and the re-assessment of a number of previously recorded sites.

Table 1: Previously completed archaeological assessments for the Gerroa Sand Mine Property.

Author	Year	Findings
Colley, S.	1988	No Aboriginal sites, recommendations made for further archaeological investigation
Lance, A.	1989	Undertook archaeological survey of the sand mine area and completed subsequent sub-surface investigation using an auger. Shell midden deposits were dominant, comprising pipi shell at a depth of 20cm. Archaeological sites identified during the study, however, were deemed to be of low significance.
Paton, R.	1992	Due to objections to Lance (1989) assessment of site significance, further archaeological assessment and sub-surface investigation across the sand mine property. A total of 31 midden sites were identified within the sand mining area. Paton (1992) identified 2 areas of conservation to be excluded from the proposed sand extraction.
Lee	1996	Completed detailed analysis of material recovered from Paton (1992) excavations. The results concluded that the Aboriginal archaeological sites within the sand mine area were used/visited periodically.
Huys, S	1997	Reassessed the sand mining area for ongoing management purposes. Although some sections within the mine area no longer contained archaeological material, a number of other areas remained intact.
Barber, M	2000	Focussed reassessment of some sections of the sand mine area and the two identified areas of conservation. In addition, a new area proposed for mining was surveyed, resulting in the identification of one new Aboriginal archaeological site. Sub-surface investigations of the new area were recommended.
Barber, M	2002	Subsequently, archaeological sub-surface investigations were undertaken. Only 20 of the 220 auger holes excavated contained archaeological or cultural material.
Navin Officer	2004	A monitoring program of the new mining area was then undertaken. This involved monitoring and inspection of topsoil stripping across the area. Only a small number of stone artefacts were recovered.
Navin Officer	2004	Undertook an archaeological assessment of a proposed golf course that encompassed part of the sand mine property and part of the drained Foys Swamp area. The assessment identified one new Aboriginal archaeological site near Blue Angle Creek.
Navin Officer	2005	Conducted an archaeological assessment of the proposed Gerroa Sand Mine Extension area. The surface survey of the area identified one new Aboriginal archaeological site (52-2-0452) and a number of surface expressions of shell midden material. Those areas that remain undisturbed were considered to be of moderate to high archaeological significance, including previously identified conservations areas A and B. Further archaeological investigations were recommended.
Navin Officer	2006	Completed an Aboriginal archaeological subsurface testing program of areas of identified Aboriginal archaeological potential, to determine the presence and extent of cultural material. The excavations resulted in the identification of 5 areas that contained cultural material, comprising pieces of shell and stone tools. It was recommended that these areas are salvaged excavated prior to the commencement of sand extraction.

5.2 Aboriginal Archaeological Sites

A number of Aboriginal archaeological sites have been previously recorded within the Gerroa Sand Mine as a result of surface survey and sub-surface investigations (Figure 2 and 3). Four of these identified sites have been registered on the DECC AHIMS (Table 2). Within the extension area, 5 separate areas have revealed stone artefact material as a result of sub-surface investigations (Figure 4). These five areas will be the focus of the salvage excavations under this Aboriginal Cultural Heritage Management Plan.

Site Number	Name	Content	Location
52-5-0259	Brickies Pit Site	The site consists of at least 15 discrete midden heaps and small clusters of shell material.	The site is located on the margin of a small swamp near Blue Angle Creek. The area has since been extracted and a s90 to Destroy was issued by DECC
52-5-0261	Gerroa	This site comprises a small scatter of stone artefacts and shell	The site occurs across the southern end of a beach sand ridge covering an area approximately 60 x 40 m. The area has since been extracted and a s90 to Destroy was issued by DECC
52-5-0415	CB 2	This site comprises one grey silcrete flake and a number of shell fragments spread across a 40 x 40 m area	Situated below the crest of a sand dune at the southern end of the Gerroa Sand Mine site. The area has since been extracted and a s90 to Destroy was issued by DECC
52-5-0452	Cleary Bros 3	The site comprises scattered shell midden and a small number of stone artefacts	The site is located on the crest of a small dune adjacent to Blue Angle Creek, covering a large area of 700 x 100 m. The area has since been extracted and a s90 to Destroy was issued by DECC
Unregistered	CB Sand Extension 1	Consists of a small number of stone artefacts and associated shell material	The site is situated on the crest of a sand dune
Unregistered	CB Sand Extension 2	Consists of a small number of stone artefacts and associated shell material	The site is situated on the crest of a sand dune
Unregistered	CB Sand Extension 3	Consists of a small number of stone artefacts and associated shell material	The site is situated on the crest of a sand dune
Unregistered	CB Sand Extension 4	Consists of a small number of stone artefacts and associated shell material	The site is situated on the crest of a sand dune
Unregistered	CB Sand Extension 5	Consists of a small number of stone artefacts and associated shell material	The site is situated on the crest of a sand dune
Unregistered	Shell Midden Deposit	Small concentration of shell material	The site is situated on the edge of Conservation Area A in bushland

Table 2: Identified Aboriginal archaeological sites situated within the Gerroa Sand Mine.

6.0 CONSERVATION AND MANAGEMENT

6.1 Heritage Management Principles

Cultural heritage and archaeological sites management often involves mitigation through the salvage of features or artefacts and retrieval of information through excavation or collection, and interpretation. Within the proposed Gerroa sand mine extension area two basic levels of management options are available for the Aboriginal archaeological sites that will be impacted. In order of preference these are:

- Conservation through avoidance, and preservation through ongoing management;
- Destruction mitigated by salvage excavation and interpretation

All management strategies have been formulated in consultation with the Jerrinja Local Aboriginal Land Council.

Cleary Brothers (Bombo) have attempted, where practicable, to avoid impacts to Aboriginal archaeological sites and the two identified areas of Conservation (A and B), through changes to the boundaries of the proposed sand mine extension area.

However, in some instances, avoiding or minimising impacts to archaeological sites may not be possible, due to nature of the sand mining process. Implementation of appropriate mitigation measures if required, including procedures for detailed site recording, collection of cultural material, excavation of cultural deposits, monitoring of initial ground disturbance works and relocation of cultural material. As part of this process, detailed documentation of sites prior to the commencement of any proposed impacts will be undertaken. This work would be undertaken in conjunction with an archaeologist and the relevant Aboriginal stakeholder groups.

7.0 SALVAGE EXCAVATION, RELOCATION METHODS AND PROTOCOLS FOR ACHMP

The archaeological methodology proposed below has been devised in light of the landform attributes, the results of the archaeological survey, and archaeological excavations that have been undertaken within the Gerroa Sand Mine property. This has been undertaken in consultation with the relevant Aboriginal stakeholders.

7.1.1 Conservation of known areas of sensitivity containing cultural material

All of identified Conservation Area A and part of identified Conservation Area B will remain undisturbed and be avoided by the proposed sand mining operations.

These areas will be fenced prior to the commencement of any ground disturbance works to remain undisturbed for the life of the Gerroa Sand Mine. These areas may be considered suitable location or 'keeping place' to which excavation cultural material can be relocated.

7.1.2 Salvage Excavation of Cultural Material and Potential Archaeological Deposits

Conservation principals supporting the excavation of archaeological and cultural material seek to undertake the archaeological salvage excavation within the boundary of the sand mine property only. The excavation of the archaeological cultural material will involve using controlled salvage excavation of pits. This method is outlined below:

Salvage Pits

The controlled excavation of salvage pits will be undertaken at recorded Aboriginal sites and areas of identified cultural material, including midden deposits that have been identified for possible relocation. The salvage pits will be completed to determine the entirety of the remaining cultural material associated with each site or areas of sensitivity. This will involve the excavation of 1 m x 1 m pits at the identified areas of interest.

The following excavation methods will be used for salvage pits:

- Each salvage pit will be excavated using spades and trowels following the identified stratigraphy.
- The soil from each stratigraphic layer will be dry sieved in nested 10 mm and 5 mm sieves and all artefacts collected, bagged and clearly labelled.
- For each salvage pit that is excavated, the following documentation will be made:
 - Unique pit identification number;
 - Soil colour and texture;
 - Amount and location of artefacts within deposit;
 - Nature of disturbance if present;

- Stratigraphy;
- Archaeological features (if present);
- Photographic records; and
- Spit records.

For safety reasons all excavated pits will be backfilled with sieved spoil at the end of the excavation to ensure a level surface within the study area.

All excavated salvage pits will be mapped, along with the extent of any additional cultural material identified as a result of this archaeological work.

If artefact density exceeds 10 artefacts in a single pit, or if distinct archaeological features are present, adjacent pits will be placed to complete the salvage of this site.

7.1.3 Collection and Relocation of Identified Aboriginal Objects

The Aboriginal Objects shall be collected using the following methodology:

- each site will be photographed, its location recorded using GPS and additional information recorded as appropriate;
- the Archaeologist and relevant Aboriginal stakeholders will collect the surface Aboriginal Objects from each site to be impacted;
- the collected Aboriginal Objects will be bagged and temporarily stored in a locked cabinet located at Biosis Research offices in Wollongong;
- upon completion of archaeological works under this ACHMP, the Archaeologist will analyse (see methodology outlined below) the Aboriginal Objects as part of the requirements for this ACHMP;
- following completion of the reporting requirements, collected Aboriginal Objects will be relocated to an appropriate location on-site – generally within close proximity to the original location. New co-ordinates for the relocated material will be taken using a hand-held GPS and the information gathered will be used to update the existing AHIMS Site Cards and resubmitted to DECC.

7.1.4 Topsoil Stripping - Procedure for previously undiscovered Aboriginal Objects

If in the course of construction of topsoil and surface sand stripping an Aboriginal Object is discovered, the following will occur:

- all works within the immediate vicinity should cease until the Aboriginal Object(s) can be assessed and collected for further analysis;

- the extent and significance of the Aboriginal Object(s) will be assessed and recorded. Immediately after collection, stripping may then continue;
- the Aboriginal Object(s) will be relocated, following analysis by a qualified archaeologist, to an appropriate location at the completion of works.

Aboriginal Objects considered to be culturally significant should be assessed by an archaeologist and the cultural values determined by the Aboriginal stakeholder groups.

Should any of these Aboriginal Object(s) be deemed culturally significant, then further investigation with a qualified archaeologist should be undertaken to determine the need for further archaeological investigation. If the Aboriginal Object(s) are not regarded to be significant, these will be collected for analysis, and relocated accordingly.

7.1.5 Discovery of Human Remains

If during the course of construction works Human Remains are uncovered, the following procedure should be followed:

- inform Cleary Brother (Bombo) of the find and cease all works within the vicinity of the remains. Do not further disturb or remove any of the remains.
- inform the Local Police and DECC.
- if the remains are determined to be Aboriginal, then following DECC advice the traditional owners should be informed of their discovery. Detailed excavation of the skeletal remains and any associated Aboriginal Objects should be undertaken by a suitably qualified archaeological or physical anthropologist with the required experience and expertise for Aboriginal remains.
- The repatriation of the remains should then be left up to the Aboriginal stakeholders who will determine a suitable location nearby. It would be preferable if such remains could be repatriated to within the identified areas of Conservation.

7.1.6 Analysis of Aboriginal Objects

Any artefacts recovered from the procedures described above will be collected and analysed. The analysis will be designed to describe stone tool technology and typology. A comparison of findings with other archaeological findings that have been recovered within the mine area will also be carried out. Dependent on assemblage size the analysis will also attempt to expand and refine regional descriptions and predictive modelling. This will also naturally allow the analysis to provide information on the types of activities undertaken in the past within the study area. The analysis will include details of stone type, manufacturing techniques and varieties of tool types. As there has previously been only limited archaeological work in the region, this will enable a baseline reference for comparison against future excavations in the region.

Consultation with Jerrinja Local Aboriginal Land Council is currently being undertaken to determine an appropriate Care Agreement for relocation or storage of any artefacts recovered after the completion of the works.

Based on recent discussions with the Jerrinja Local Aboriginal Land Council, protected Conservation Area A may be used as an area for the relocation of cultural material.

7.2 Contingency Triggers and Management Responses

All contingent management strategies will be developed in consultation with the identified Aboriginal communities, Cleary Brothers and DECC.

Management strategies will be implemented in accordance with current conservation practice and the conservation principles contained within the Australia International Council on Monuments and Sites (ICOMOS) *Burra Charter*, and the NSW DECC *Guidelines for Aboriginal Heritage Impact Assessment* (Draft) and the *Aboriginal Cultural Heritage Standards and Guidelines Kit*. The advice of the identified Aboriginal communities regarding appropriate management methodologies will form an integral part of the development of the management strategies.

7.3 Reporting

Reports will be prepared subsequent to the completion of salvaged excavations and ongoing monitoring. The following reports will be produced in consultation with the identified Aboriginal communities and submitted to DECC:

- Report of findings of the comprehensive salvage excavation works;
- Report documenting salvage excavation findings and cultural material analysis;

The reports will include site and impact specific recommendations for management.

8.0 PROCESS REVIEW AND DOCUMENTATION

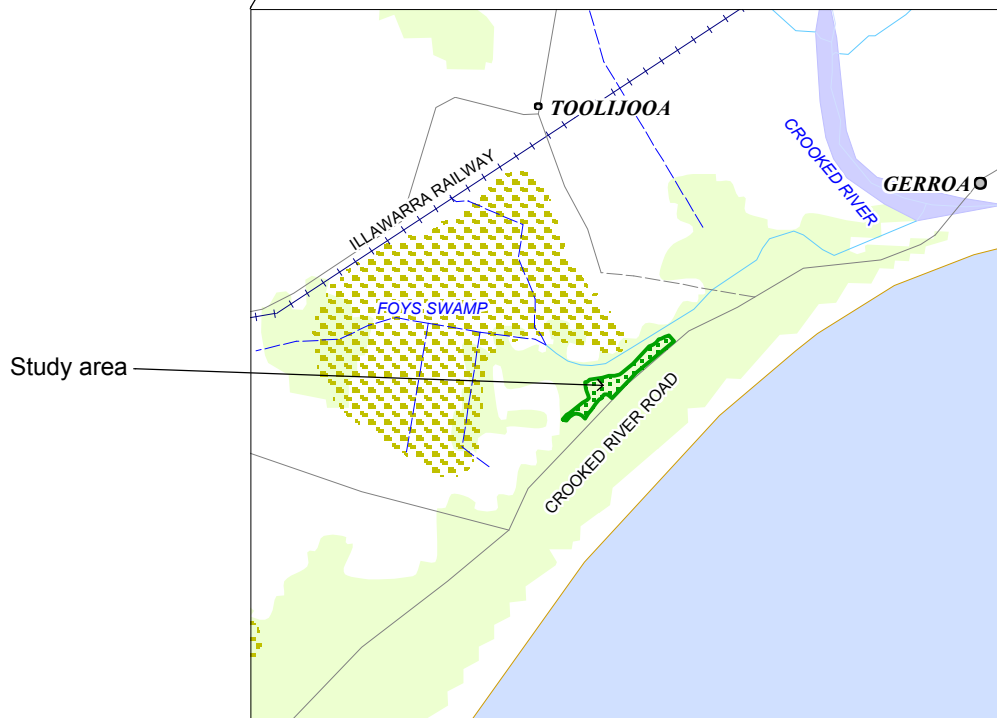
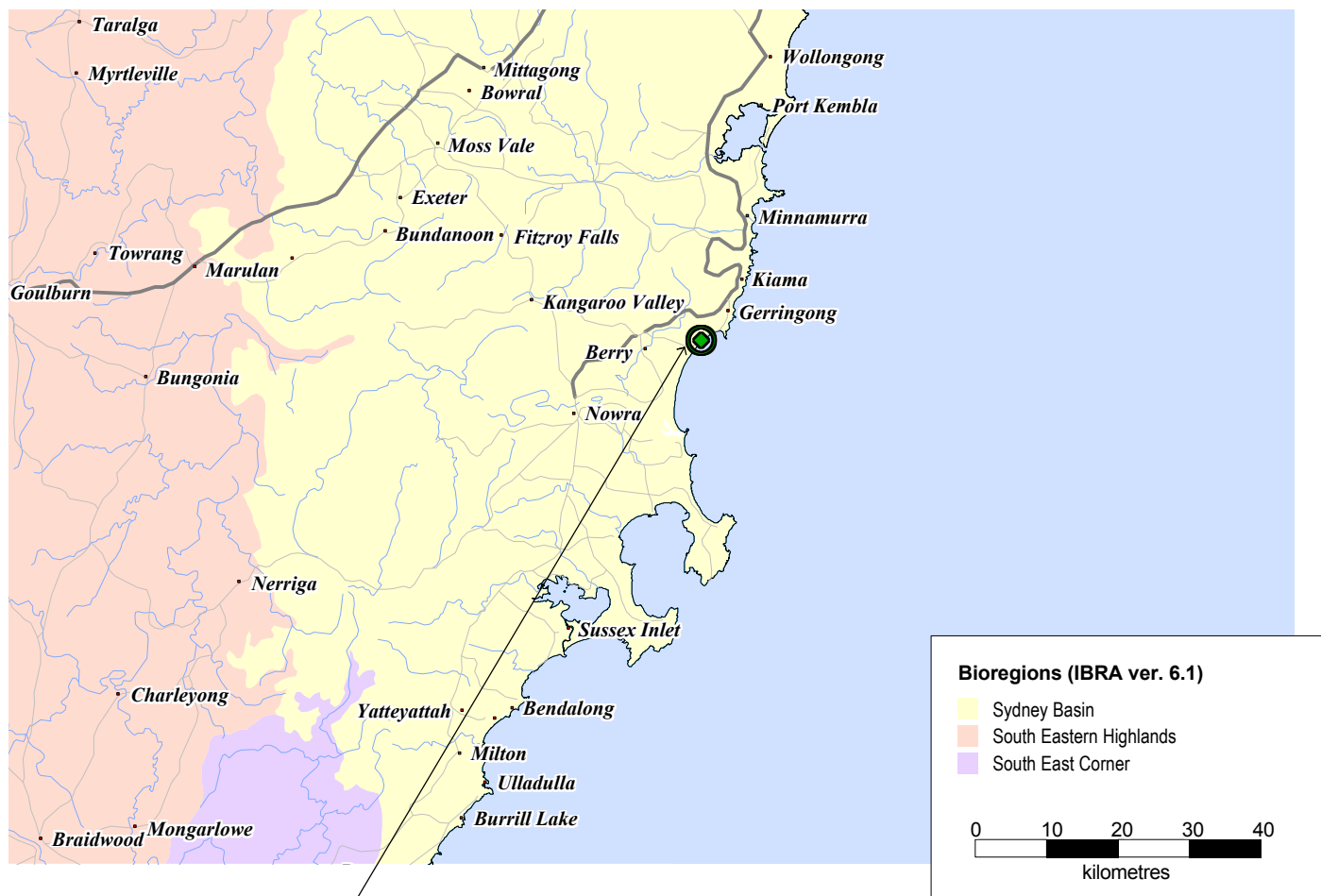
This ACHMP will be reviewed:

- In conjunction with the Environmental Management Plan;
- At anytime with the mutual agreement of the Jerrinja Local Aboriginal Land Council and Cleary Brothers (Bombo).

REFERENCES

- Barber, M. 2000, *Archaeological Re-assessment and Survey of Cleary Bros Sand Quarry, Gerroa, NSW*. Report to Davron Engineering.
- Barber, M. 2002, *A Subsurface Archaeological Investigation of the Proposed Sand Mining Extension at the Cleary Bros Sand Mine, Gerroa, NSW*. Report to Cleary Bros (Bombo).
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- Huys, S. 1997, *An Archaeological Re-Assessment of the Southern Extraction Area, Gerroa, NSW*. Report by Robert Paton Archaeological Studies Pty Ltd to Cleary Bros (Bombo).
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- Navin Officer Heritage Consultants. 2005, *Gerroa Sand Mine Extension, Aboriginal Cultural Heritage Review*. Report to Perram and Partners.
- Navin Officer Heritage Consultants. 2005, *Gerringong Gerroa Sewerage Scheme Archaeological Salvage Program*. Report to Walter Construction Group Limited.
- Paton, R. 1992, *An Interim Report of an Archaeological Investigation of the Cleary Bros Southern Sand Extraction Area, Gerroa, New South Wales*. Report to Cleary Bros Pty Ltd (Bombo).

FIGURES



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Figure 1: Location of the Study Area in a regional context.

Date: 15 January 2009

Checked by: MT

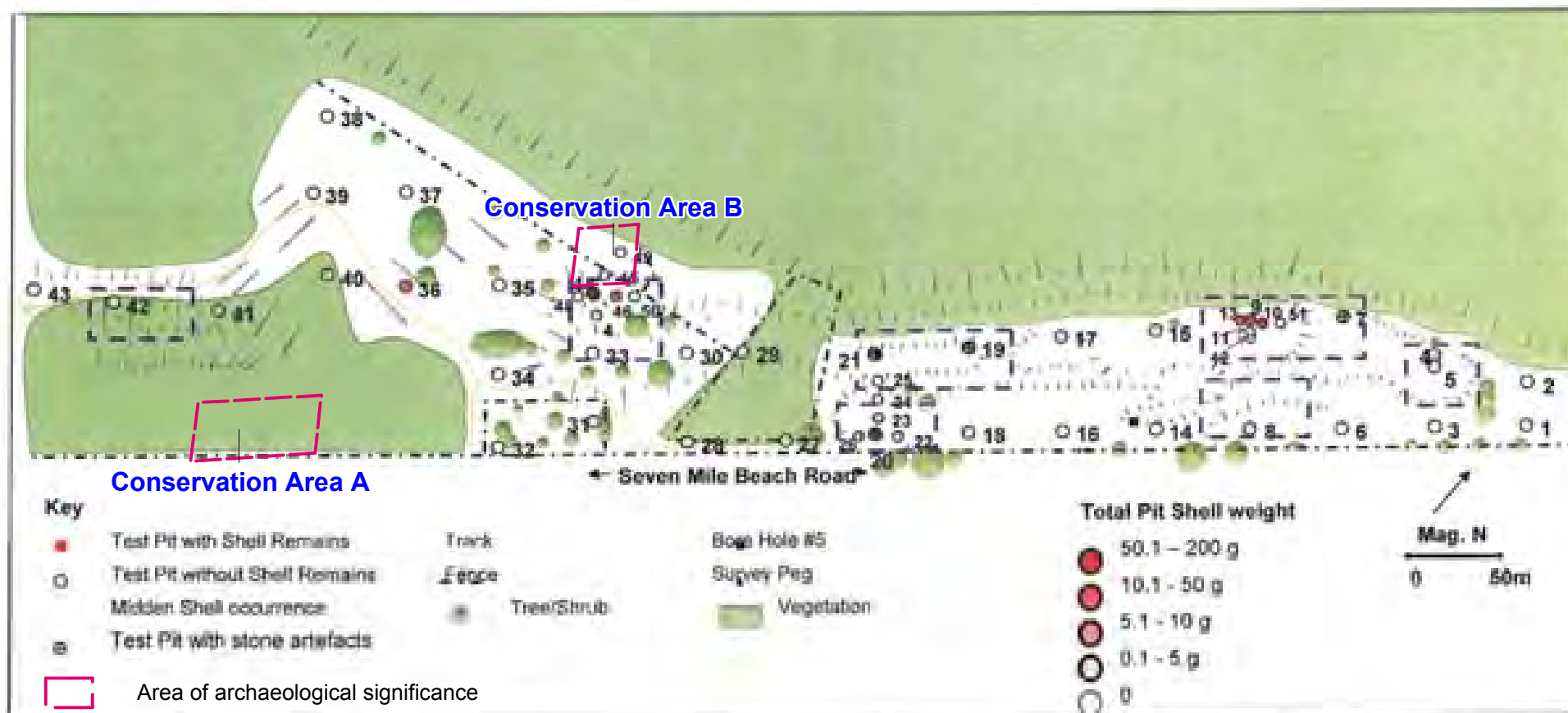
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kilometres





Acknowledgement:
Navin Officer Heritage Consultants
October 2006



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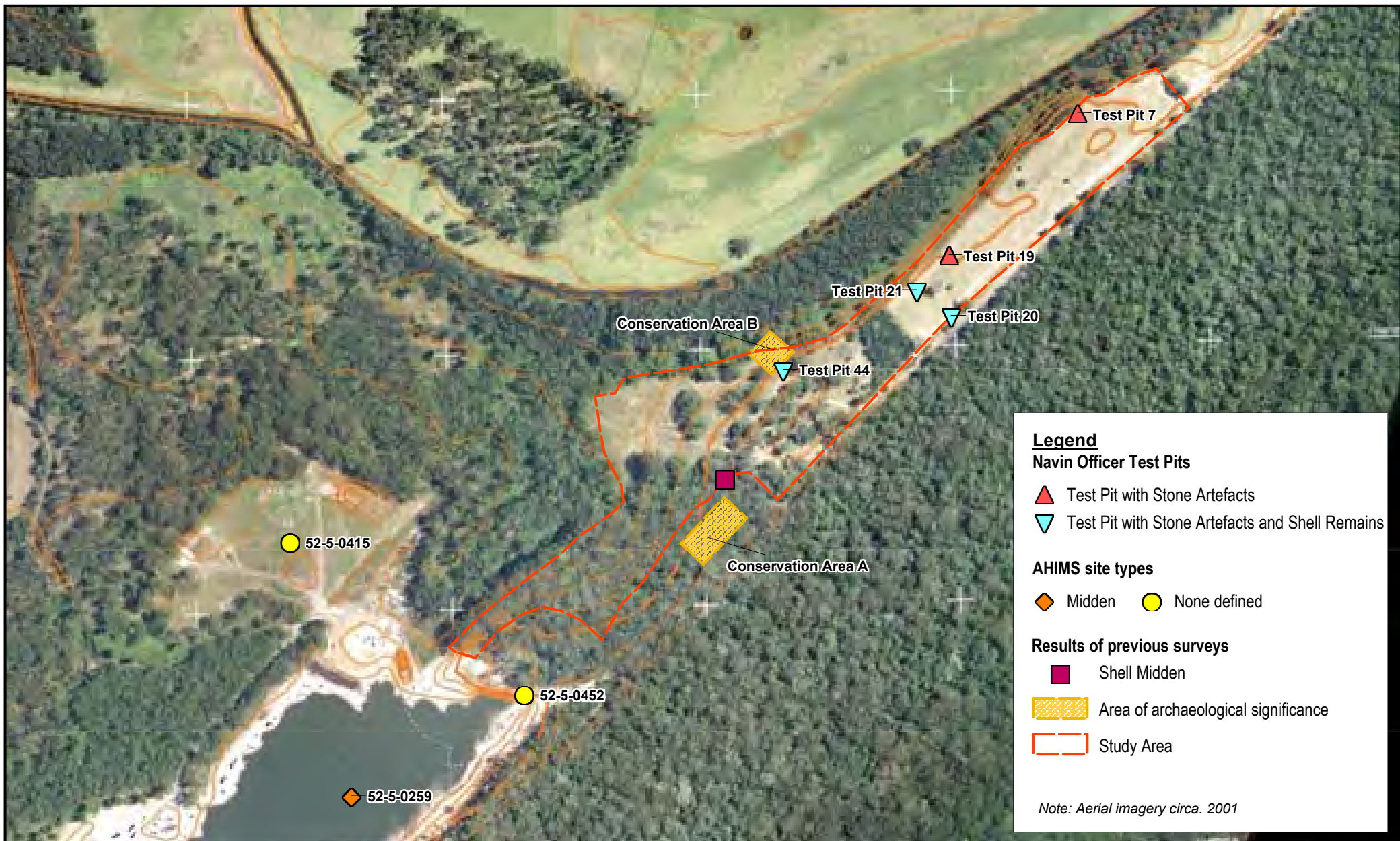
Figure 2: Test pits conducted by Navin Officer

Date: 14 January 2009

Checked by: MT

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Figure 3: Previously recorded Aboriginal archaeological sites and test pits that contained Aboriginal cultural material

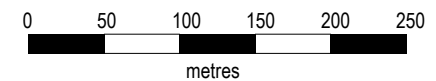
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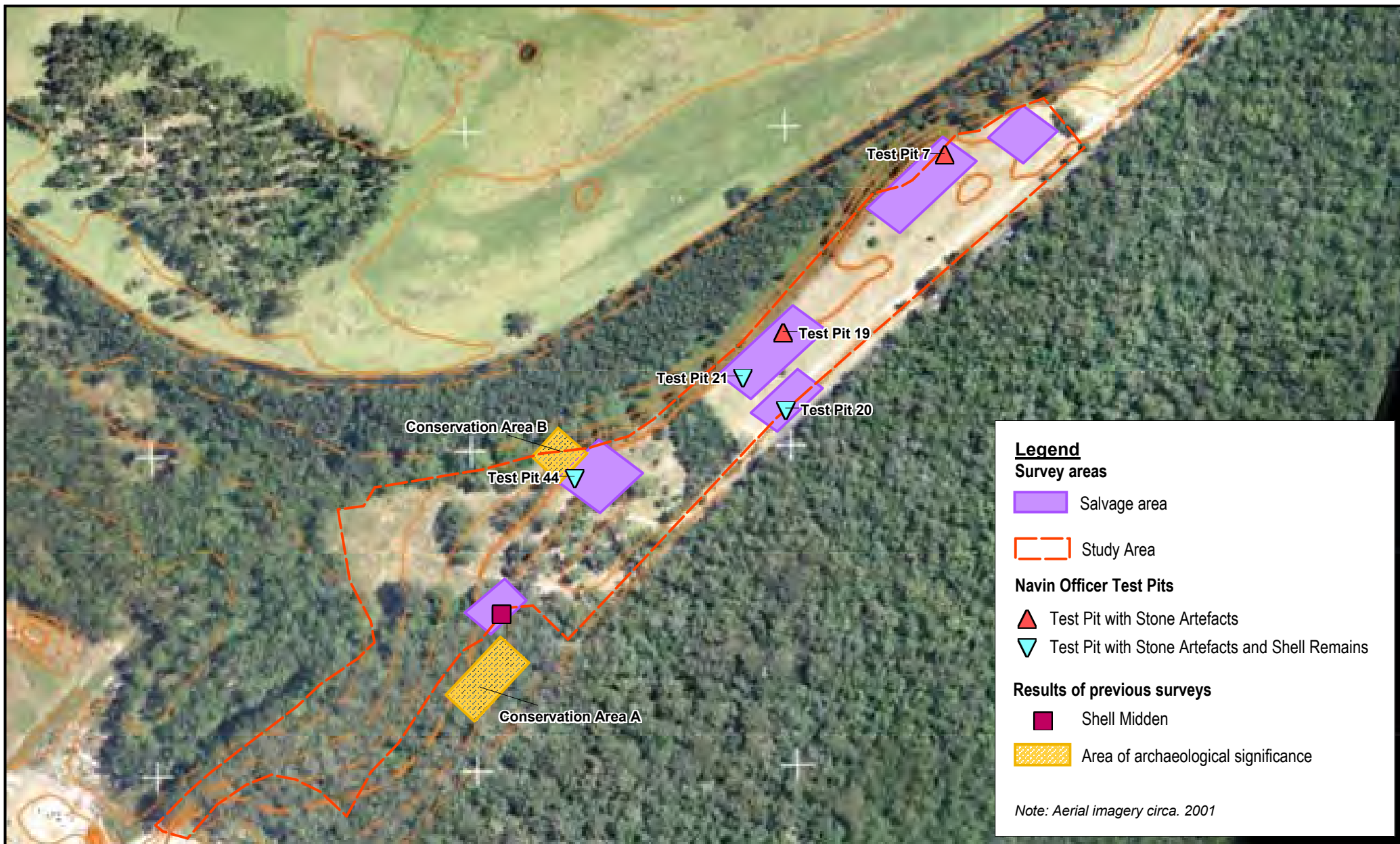
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Figure 4: Proposed areas for salvage excavation

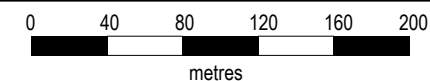
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APPENDICIES

APPENDIX 1

ABORIGINAL COMMUNITY COMMENTS



Jerrinja Local Aboriginal Land Council
PO Box 167
Culburra Beach NSW 2540
January 29, 2009

Melanie Thomson
Biosis Research Pty Limited
8 Tate St
Wollongong NSW 2500

Dear Mel

RE: Gerroa Sand Mine ACHMP

Thank you for the opportunity to review the Gerroa Sand Mine ACHMP.

We have no specific comments to make on the document at this time.

We would however ask that our site officers continue to be involved as early as possible in any site works to ensure that heritage and culturally significant material is recognised, identified and preserved in the best possible manner.

Yours truly,

Louise Tucker
CEO

Jerrinja Local Aboriginal Land Council

Appendix H

MANAGEMENT PLAN CONSULTATION WITH EXTERNAL AGENCIES

PERRAM & PARTNERS

PLANNING AND ENVIRONMENTAL CONSULTANTS

5 February, 2009

Department of Planning
GPO Box 39
SYDNEY NSW 2001

T W PERRAM & PARTNERS Pty Ltd
ACN 072 135 436 as trustee for
Perram & Partners Trust
12 Clanwilliam Street
EASTWOOD NSW 2122

phone: 02 9874 6773
fax: 02 9804 0444
mobile: 0412 023 970
email: tperram@bigpond.net.au

Our Ref: 130L01

Attention: Mr Kane Winwood

Dear Sir

**RE: EXTENSION OF CLEARY BROS'
GERROA SAND QUARRY**

The purpose of this letter is to submit to the Department information and documents relating to Cleary Bros' Gerroa sand quarry as required by the project approval (LEC Approval No 10801 of 2007). The various items listed below are submitted for consideration and approval by the Director-General. All documents, apart from the survey plan, are contained in the accompanying draft Quarry Environmental Management Plan (QEMP). The following information is submitted:

- survey plan (schedule 3 condition 1). The plan is submitted at A3 size. A full scale plan is available if required;
- noise monitoring program (sch. 3 cond. 4) - included in QEMP;
- air quality monitoring program (sch. 3 cond. 7) - included in QEMP;
- water management plan (sch. 3 cond. 11) - included in QEMP;
- landscape and rehabilitation management plan (sch.3 cond. 21) - included in QEMP;
- name of expert to prepare the landscape and rehabilitation management plan (sch.3 cond. 21);
- long term management strategy (sch. 3 cond. 26) - included in QEMP;
- Aboriginal heritage management plan (sch. 3 cond. 30) - included in QEMP;
- environmental management plan (sch.5 cond. 1) - included in QEMP;
- environmental monitoring program (sch.5 cond. 2) - included in QEMP; and
- name and contact details of the Environmental Officer (sch.5 cond. 2A).

The expert nominated to prepare the landscape and rehabilitation management plan is Dr Kevin Mills of Kevin Mills and Associates. The nominated Environmental Officer is Mr Wayde Peterson, an employee of Cleary Bros (02 4275 1000).

The project approval requires a number of the above plans and programs to be prepared in consultation with other bodies. In compliance with this requirement the

draft QEMP is being sent to the following authorities and their attention drawn to the relevant section(s):

- Department of Environment and Climate Change;
- Department of Water and Energy;
- DPI-Fisheries;
- Kiama Council;
- Shoalhaven City Council.

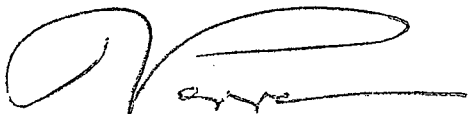
I shall forward to you for consideration any response received from these authorities.

The draft Aboriginal heritage management plan (AHMP) was discussed with representatives of the Jerrinja Local Aboriginal Land Council and a copy given to the land council for further consideration and comment. A letter of response is included in the draft AHMP.

Cleary Bros will approach members of the existing community consultative committee for the quarry to ascertain their willingness to continue as members of the CCC required to be established under the project approval. Nominations for the new CCC will be submitted to the Department for approval in the near future.

Please give me a call if you wish to discuss any aspect.

Yours Faithfully
for Perram & Partners

A handwritten signature in black ink, appearing to read 'Terry Perram', with a large, stylized initial 'P'.

Terry Perram
Principal

