Lot 6 DP244030 & Lot 9 DP250425 Diamond Beach Road, Diamond Beach

Machiko Pty Ltd

Environmental Assessment and Land Capability Study

GEOTTUN01754AA-AD

30 November 2008

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
1/4 Douglas Avenue, TUNCURRY NSW 2428 Australia

30 November 2008

Machiko Pty Ltd
C/- Orogen Pty Ltd
PO Box 280
TUNCURRY NSW 2428

Attention: Tony Fish

Dear Tony,

RE: LOT 6 DP244030 & LOT 9 DP250425 DIAMOND BEACH ROAD, DIAMOND BEACH

PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT AND LAND CAPABILTY STUDY

Coffey Geotechnics Pty Ltd (Coffey) is pleased to provide our Preliminary Environmental Site Assessment (PESA) and Land Capability Study (LCS) report for the above site.

We draw your attention to the enclosed sheet entitled *'Important Information about your Environmental Report'*, which should be read in conjunction with this report.

If you have any questions regarding this matter, please do not hesitate to contact Tim Morris or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd

Steve Morton

Principal

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1 INTRODUCTION

1.1 General

This report presents the results of a Stage 1 Preliminary Environmental Site Assessment (PESA) carried out by Coffey Geotechnics Pty Ltd (Coffey) for Orogen Pty Ltd at Lot 6 DP244030 and Lot 9 DP250425 Diamond Beach Road, Diamond Beach, as shown in Figure 1.

The site is irregular in shape and is bound to the west by Diamond Beach Road, residential properties of the north, Hallidays Point Primary School to the south and a caravan park and the Pacific Ocean to the east. The site occupies an approximate area of 10.5 hectares and is Zone 2(a1), Residential.

The purpose of the investigations was to alert the parties involved in the project to the environmental issues at this site and provide data in a format that will assess capability / suitability of the land for urban uses.

1.2 Objectives and Scope of Work

The objectives of the work were to provide an assessment of the following:

- Potentially contaminating activities that are currently being performed on the site and that may have been performed on the site in the past;
- Preliminary assessment of site contamination;
- Need for further investigations.
- Suitability for future subdivision usage with regard to potential human health and environmental impacts of soil contamination.
- Risks associated with slope instability;
- Erosion characteristics and susceptibility to erosion;
- Presence of Acid sulphate soils (ASS);
- General foundation conditions;
- Preliminary Site Classification as per AS 2870;
- Excavatability and presence of rock;
- General pavement subgrade and road construction conditions.
- Drainage and water table depth;

The Preliminary Environmental Site Assessment meets the requirements of a Stage 1 Preliminary Environmental Site Assessment (PESA) as detailed in the NSW EPA *Guidelines for Consultants Reporting on Contaminated Sites*.

The work was carried out in accordance with the following guidelines:

- NSW EPA Guidelines for Consultants Reporting on Contaminated Sites, 1997;
- NSW EPA Guidelines for the NSW Site Auditor Scheme, 1998;
- NEPM Guideline on Investigation levels for Soil & Groundwater, December, 1999;
- NSW EPA Guidelines for Assessing and Managing Service Station Sites, 1994; and

- NSW EPA Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.

2 SITE IDENTIFICATION

2.1 Location and Setting

The site is located to the east of Diamond Beach Road, south of its intersection with Edgewater Drive. At the time of the field work it was densely vegetated with paper bark trees over three quarters of the site and an abandoned single storey weather board house in poor condition was present in the cleared area in the west of the site. The site was accessed from Diamond Beach Road, on the western frontage of the site. We understand that approximately 85 residential lots with associated access roads are proposed for the site. The site has a total area of approximate of 11.1ha.

The site is located in a region of gently to moderately undulating topography, situated on the upper convex slopes to mid and lower concave slopes of an east facing hill that breaks in the north east of the site to a flat coastal sand plain, draining to the east. Over the majority of the site the land surface has an overall slope of 15^{o} from west to east with elevations ranging from 27m AHD at the western boundary to 5m AHD in the centre of an intermittent drainage line before gradually rising up towards sand dunes present on the eastern boundary of the site that have a maximum elevation of 9m AHD.

The western part of the site is used for grazing horses. To the east, the slopes on the lower half of the site are densely vegetated which restricted access at the time of the investigation.

Surface drainage appears to be predominantly by way of overland flow following the natural contours of the land towards the intermittent drainage line that flows north. Infiltration would occur in the east of the site where surface sands are present. An earth embankment dam was present mid slope on the property, surrounded by trees and was full at the time of the investigation.

Trafficability at the time of the investigation was only possible by tracked excavator due to soft ground conditions in the low lying area of the site and the stands of thick vegetation.

2.2 Current Surrounding Land Use

Surrounding land uses include:

- Hallidays Point Primary School on the southern boundary of the property;
- An existing caravan park to the east and south east of the site;
- Diamond Beach Road on the western boundary;
- Rural residential subdivisions along Edgewater Drive to the north and;
- Diamond Beach bounds the east of the site.

2.3 Local Geology

The site is underlain by weathered siltstone and sandstone covered by residual clayey soils on the elevated slope in the west of the site with shallow colluvial/alluvial clays in the depression in the centre of the site, with aeolian sands to the east of the depression. An approximate boundary between these terrain units is delineated on Figure 1.

2.4 Local Hydrogeology

A groundwater bore search indicated that no licensed bore is located on the site, or near to the site.

Regional groundwater flow in the vicinity of the site would be expected to flow in a similar direction to the slope of the hills towards the east.

One small farm dam is located at the approximate centre of the site, close to the bottom of the east facing slope and appears to be recharged by the collection of water from overland flow.

3 POTENTIAL FOR SITE CONTAMINATION

3.1 Scope

The site history study undertaken by Coffey included:

- A site visit by a Coffey Principal Engineering Geologist and Senior Technical Officer;
- A review of previous site ownership (Title Search);
- A review of historical aerial photography over the past 30 years
- A review of EPA notices under the Contaminated Land Management Act (1997);
- A review of published information related to soils geology, hydrogeology and also a groundwater bore search of the site.

3.2 Site Visit

A Coffey Principal Engineering Geologist visited the site on 28 August 2008. Observations made during the site visits are summarised below. The main features of the site were as follows:

- A former dwelling near the western boundary of the site.
- A sewer main crosses the eastern half of the site, in a north-south direction;
- Isolated piles of dumped rubbish, bulky household waste, minor building rubble and former farm equipment were observed in isolated locations on the site.

3.3 Titles Search

A list of past registered proprietors and lessors of the site was obtained from the Land Titles Office. The current title details and cadastral plan are included in Appendix A.

The title history search for Lot 6 DP 244030 revealed the following:

- Between 1910 and 1948 the property was Crown Land held as Conditional Purchase Lease before passing onto the Rural Bank of New South Wales from 1948 to 1951.
- Between 1951 to 1971 the property was owned by various farmers.
- From 1971 to 2004 the property has had three groups of owners.
- In 2004 the property was purchased by its current owner Machiko Pty Ltd.

3.4 Aerial Photograph Review

Aerial Photographs of the site were purchased from the Department of Land and Water Conservation and reviewed by a Coffey Geologist. The results of the assessment are summarised in Table 1.

TABLE 1 – AERIAL PHOTOGRAPH REVIEW

Year	Site	Surrounding Land
1952	Cottage visible with densely wooded area to north, east and south of site.	Road alignment separates cottage from larger grouping of buildings to the west which appear to be associated with surrounding farm land
1963	As above.	Land appears cleared in future caravan park area to east of site and area to south of site, behind future school site has been cleared and subdivision road alignment is proceeding.
1980	As above.	Caravan park appears to be under construction and subdivision has approximately twenty houses constructed along road alignment. School site appears to have structure on it.
1991	Cottage still visible with little disturbance to trees on site. Sheds have been erected to east of cottage.	Caravan park clearly developed and subdivision increasing in size. School site only has one structure on it in photo. Area to the north of the site is showing signs development, possibly resort. Building directly to west of site are removed and semi rural development of western area appears to be taking place.
2003	As above.	Caravan park has increased in size and subdivision has also increased in size. School site has been developed and now has large school building visible. Area to west of site has increased development size with more complex infrastructure and increased density of housing. Road alignment for subdivision to north of site appears in photo.
2006	As above.	Caravan park has increased in size and subdivision has also increased in size. School site remains developed. Area to west of site continues to grow with increased development size and more complex infrastructure. Subdivision to north of site has been developed with six dwelling appearing in the photo.

3.5 NSW EPA Records

A check with the NSW EPA website (www.environment.nsw.gov.au) revealed that no notices have been issued on the site under the Contaminated Land Management Act (1997).

3.6 Potential Areas and Chemicals of Concern

Based on the site walkover and the site history assessment, the main visible potential contamination sources on the Site are outlined in Table 2 below.

TABLE 2 – SUMMARY OF AREAS OF CONCERN AND CHEMICALS OF CONCERN

AREA OF CONCERN	DESCRIPTION OF POTENTIALLY CONTAMINATING ACTIVITY	CoCs*	LIKELIHOOD OF CONTAMINATION (BASED ON SITE HISTORY STUDY ONLY)**	COMMENTS
1 Residence	Minor storage of	Asbestos	High	Minor fuels oils or pesticides
2. Paddocks	Use of agricultural chemicals for pasture improvement	Herbicides	Low	

NOTE:

**CoC - Chemicals of Concern*

*** It is important to note that this is not an assessment of the financial risk associated with the AEC in the event contamination is detected, but a qualitative assessment of the potential for contamination being detected at the potential AEC based on the site history study.*
Heavy Metals - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc
BTEX - Benzene, Toluene, Ethylbenzene and Xylene, TPH - Total Petroleum Hydrocarbons
PAH – Polycyclic Aromatic Hydrocarbons
OC/OPP – Organochlorine and Organophosphorus Pesticides

3.7 Conclusions from Environmental Site Assessment

Based on the site walkover and the site history assessment, it is considered that the majority of the site was used in the past for general grazing, and there has not been significant change to the site since 1965. It is considered unlikely, based on the available information, that the site would contain contamination likely to impact on potential future residential usage.

There are some areas of environmental concern as outlined in Table 2, with the main areas of concern being due to minor storage and use of farm chemicals near the residence and possible spraying of pesticides and herbicides around the site.

In these areas there is a potential for localised soil contamination exceeding the residential guidelines (NEHF F) from the NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme, although such contamination would be considered highly unlikely given the site conditions and usage observed.

It is further recommended that a hazardous building survey is carried out prior to any proposed building demolition to assess the building materials. Should asbestos be present then a suitably qualified demolition contractor, experienced in asbestos removal and disposal, should be engaged to carry out the work.

4 FIELD INVESTIGATIONS

Investigation of subsurface conditions involved the following:

- Drilling three boreholes using a 4WD mounted drilling rig. Temporary standpipe piezometers were installed in each of the boreholes to allow monitoring of groundwater levels and testing of in situ permeability;
- Ten test pits excavated using a tracked mini-excavator. These test pits were sampled and logged by a Senior Geotechnician.

Engineering logs of the boreholes and test pits are presented in Appendix B together with explanation sheets defining the term and symbols used in their preparation. The locations of the investigations are shown on Figure 1. They were located by measuring relative to features shown on the site plan provided.

5 SITE CONDITIONS

5.1 Geotechnical Terrain Units

The proposed development site has been divided into three geotechnical terrain units based on the subsurface investigation and likely surface and subsurface conditions. The classification into geotechnical units is based on the extent that conditions will impact on potential development. The geotechnical units are described below and delineated over the site in Figure 1.

- Terrain Unit A – Well structured clays underlain by slightly weathered silty sandstone are located on the mid to upper slopes and covers the majority of the site.
- Terrain Unit B – Alluvial plain, with some low lying areas in the east of the site.
- Terrain Unit C – Aeolian Sand dunes.

5.1.1 Terrain A

Is situated on the moderately undulating ridge and upper slopes along the western boundary down to the mid and lower slopes, with surface slopes of between 10° and 15°, and elevations of between 5m and 26m.

Investigations revealed a profile of approximately 0.3m of hard silty topsoil, overlying well structured hard residual clays to approximate depths of 2.5m on the lower slope, which decrease in depth up slope to depths of approximately 0.8m in the west of the site, overlying extremely weathered silty sandstone. Surface soils appear well structured and drained. Minor erosion was noticed in areas of poor grass cover.

Terrain A is vegetated mostly by mature trees with improved pasture grass. Trafficability of this terrain unit was poor due to thick vegetation.

5.1.2 Terrain B

Terrain B is situated on the alluvial plains to the east of the site below the 5.5m RL contour. Investigations revealed colluvial clay soils overlying alluvial clays with lenses of aeolian sands that have blown over from adjacent sand dunes to the east. Groundwater inflow was observed at the interface of the clay and sand horizons. Vegetation present comprised swamp forest species, including paper barks which are indicative of poor drainage. Trafficability of this terrain was poor or non-trafficable due to soft ground conditions and thick vegetation.

5.1.3 Terrain C

Terrain C consists of aeolian sand dunes and is situated in the east of the site as interpreted from the available aerial photographs. Site access was restricted by thick vegetation.

5.2 Subsurface Conditions

A summary of the soil types encountered over the site is presented in Tables 3 and 4.

TABLE 3 - SUMMARY OF SOIL TYPES ENCOUNTERED

GEOLOGICAL UNIT	SOIL/ROCK TYPE	MATERIAL DESCRIPTION
UNIT 1	TOPSOIL	SILT and CLAY , low to medium plasticity, brown/grey, some organics (rootlets), trace fine grained sand, hard consistency
UNIT 2A	COLLUVIAL	CLAY, medium to high plasticity, pale brown/brown, trace organics (rootlets) and fine grained sub-angular gravel, very stiff consistency
UNIT 2B	COLLUVIAL	CLAY, medium to high plasticity, pale grey with red and pale brown mottling ,some fine grained sand, trace organics (rootlets) and low plasticity silt, very stiff consistency
UNIT 3A	ALLUVIAL	Sandy CLAY, low to medium plasticity, grey, trace low plasticity silt and organics (rootlets), very stiff consistency
UNIT 3B	ALLUVIAL	Clayey SAND, fine to medium grained, pale brown/yellow, some low plasticity silt, medium dense
UNIT 3C	ALLUVIAL	CLAY, medium to high plasticity, grey/blue, some fine grained sand, very stiff consistency
UNIT 3D	ALLUVIAL	SAND, fine to medium grained, dark brown, trace of organics (roots) and medium shell grit
UNIT 4A	RESIDUAL	CLAY, high plasticity, orange/red with grey mottling, some fine grained sub-rounded gravel, trace organics (rootlets) and low plasticity silt, hard consistency
UNIT 4B	RESIDUAL	CLAY, high plasticity, pale grey, trace fine grained sub angular gravel and low plasticity silt, very stiff consistency
UNIT 5	HIGHLY WEATHERED SILTY SANDSTONE	Silty SANDSTONE, medium grained, pale grey with orange/brown and green mottling, 3mm low plasticity clay and silt unfiled seams, bedding plane 65^{o},low to very low strength

TABLE 4 – SOIL TYPES AT TEST PIT LOCATIONS (Depths in Metres)

LOCATION	UNIT 1A TOPSOIL	UNIT 2A COLLUVIAL CLAY	UNIT 2B COLLUVIAL CLAY	UNIT 3A ALLUVIAL SANDY CLAY	UNIT 3B ALLUVIAL CLAYEY SAND	UNIT 3C ALLUVIAL CLAY	UNIT 3D ALLUVIAL SAND	UNIT 4A RESIDUAL CLAY	UNIT 4B RESIDUAL CLAY	UNIT 5 HIGHLY WEATHERED SANDSTONE	GROUND WATER
Terrain A											
TP 4	0.0 – 0.4	0.4 – 0.72	-	-	-	-	-	0.72 – 1.4	-	1.4 – 2.1	-
TP 6	0.0 –0.25	-	-	-	-	-	-	0.25 – 1.85	-	-	-
TP 7	0.0 – 0.4	0.4 – 0.63	-	-	-	-	-	0.63 - 1.48	-	1.48 – 1.79	-
TP 8	0.0 – 0.3	-	-	-	-	-	-	0.3 – 0.7	-	0.7 – 0.9	-
TP9	0.0 –0.18	0.18 – 0.6	-	-	-	-	-	-	-	0.6 – 0.9	-
TP10	0.0 -0.15	0.15 – 0.37	-	-	-	-	-	-	-	0.37 – 0.64	-
TP11	0.0 – 0.2	-	-	-	-	-	-	0.2 – 0.85	0.85 – 1.0	1.0 – 1.15	-
Terrain B											
BH 1	-	-	-	0.0 – 1.1	1.1 – 2.5	2.5 – 3.0		-	-	-	1.45
BH 2	0.0 – 0.3	-	-	0.3 – 0.5	-	0.5 – 1.5	1.5 – 2.5	-	-	-	1.50
BH 3	0 - 0.15	-	-	-	-	0.15 – 0.4	-	0.4 – 0.9	0.9 – 5.0	-	-
TP5	0.0 –0.29	0.29 – 0.58	0.58 – 1.5	1.5 – 2.1							2.05
TP12	0.0- 0.29	0.29 – 0.9	-	0.9 – 1.2	1.2 – 1.8	-	-	-	-	-	1.2
TP13	0.0 -0.38	0.38 – 0.74	-	0.74 –1.55	1.55 – 1.8	-	1.8 – 2.1	-	-	-	1.8

5.1 Water Levels

Groundwater was encountered at the depths summarised in Table 4. The groundwater was typically encountered within the interbedded alluvial sands and clays of Terrain B at depths of between 1m and 2m below ground surface. No groundwater was observed during the investigation in the higher westerly part of the site (Terrain A).

Depth to the water table will vary with rainfall and other similar factors, the influence of which may not have been apparent at the time of field work. The field investigation was conducted following a period of wet weather.

6 LABORATORY TESTING

Samples obtained during the field investigations were returned to Coffey's NATA registered Tuncurry Laboratory or dispatched to the Scone Soil Research Laboratory for testing. The testing program comprised of:

- 4 x CBR tests;
- 4 x shrink / swell tests;
- 6 x field moisture tests;
- 4 x particle size distribution tests;
- 2 x Earthworks Suites that included particle size analysis, unified soil classification system, dispersion percentage, Emerson aggregate, volume expansion.

The results of the laboratory testing are presented in Appendix C.

7 SLOPE STABILITY

7.1 Risk assessment

This report provides an assessment of the risk of slope instability on the property and immediate surrounding area. The report also recommends some geotechnical constraints for the site development in light of the assessed risk of slope instability. The onus is on the owner, potential owner or interested party to decide whether the assessed level of risk is acceptable taking into account likely economic consequences of the risk and the recommended geotechnical constraints.

Risk assessment is a process where potential hazards are observed and / or assessed, a judgement made as to the likelihood of that event occurring, and an assessment made of what the consequences of such an event might be. The 'risk' assigned is a way of explaining the combination of likelihood and consequences in a simple form.

For land capability studies of this nature there are many unknowns in terms of what the ultimate development of the site will entail, and therefore elements at risk and subsequent consequence assessments are not feasible. Therefore, to assess the potential for slope instability to impact on urban land capability, a hazard zoning study has been undertaken. This study identifies and delineates potential landslide hazards at the site, and assesses their likelihood and potential to impact on future residential development.

For the purposes of this assessment slope instability hazards have been identified from the observed site conditions using methods consistent with those formulated by the Australian Geomechanics Society and published in Australian Geomechanics (Vol. 42, No.1) “Guidelines for Landslide Susceptibility, Hazard, and Risk Zoning for Landuse Planning”. The report also recommends some geotechnical constraints for the site development in light of the assessed slope instability hazards.

7.2 Evidence of Slope Instability (at the time of investigation)

No evidence of slope instability was observed on the site at the time of the fieldwork.

7.3 Assessed Hazards

Slope stability is controlled by slope angle, material strength, subsoil profile and surface and subsurface water concentration. In the sloping areas of the site (Terrain A) large scale slope instability is not expected to occur. There is the potential for some soil creep to occur. Creep movements are imperceptibly slow movements that occur within the upper part of the soil profile on sloping sites. There is also the potential for instability in poorly managed or unretained cuts and fills in this part of the site.

No specific slope stability hazards were encountered in Terrain B.

No specific slope stability hazards are anticipated in Terrain C while development is restricted to the area west of the toe of the sand dunes, however there is the potential for instability in poorly managed or unretained cuts and fills in this part of the site.

The risk of slope instability in both terrain areas can be managed by normal good hillside construction practices. It would be normal for development to proceed on slopes of this nature.

7.4 Recommended Geotechnical Constraints for Residential Development

For Terrains A, B and C there are no particular constraints on the type of structure considered appropriate for the site from a slope stability point of view. Development should be undertaken in accordance with good hillside construction practice and sound engineering principles.

8 SOIL EROSION

8.1 Soil Erodibility / Dispersivity

Dispersible soils greatly limit water movement through the soil, resulting in poor drainage and water logging. The Emerson Aggregate Class is used as a general guide to sodicity and dispersibility of a soil; however dispersion is also influenced by factors such as soil type, exchangeable cations, salinity and sodicity. When wet, sodic soils lose their structure and disperse into very small particles that fill pore spaces and create an impermeable layer that can severely impede water movement through the soil profile. Thus, dispersible soils often result in poor drainage and waterlogging.

Emerson Aggregate Class numbers are presented in Appendix C and summarised in Table 6.

TABLE 6 - SUMMARY OF SOIL DISPERSIBILITY TESTING

TEST PIT LOCATION	SAMPLE DEPTH (m)	UNIT	CLAY %	EMERSON AGGREGATE CLASS	DISPERSIBILITY	INDICATIVE DISPERSION	INDICATIVE SODICITY
TP11	0.2 – 0.3	4A	74	6	5%	Negligible	Non-sodic
TP13	0.4 – 0.5	2A	34	3(1)	33%	Moderate	Unlilkely

TABLE 7 - SUMMARY OF PARTICLE SIZE DISTRIBUTION

Soil Type	Fraction	Material Passing Sieve Size (mm)	TP6 0.3 – 0.6 Unit 4A	TP8 0.3 – 0.7 Unit 4A	TP10 0.15 – 0.37 Unit 5	TP12 0.3 – 0.6 Unit 2A
Gravel		19.0	100	100	100	100
		13.2	100	100	99	100
		9.5	99	99	95	100
		6.7	98	98	92	99
		4.75	97	97	89	99
Sand	Coarse grained	2.36	96	95	85	99
		1.18	95	93	82	99
		0.600	94	92	81	97
Sand	Medium grained	0.425	93	91	80	94
		0.300	93	91	79	80
Sand	Fine grained	0.150	91	89	76	60
Clay / Silt	Fines	0.075	90	89	76	59

Based on the results of laboratory testing, soils in Terrain A and B are unlikely to be sodic or significantly dispersive.

8.2 Management of Erosion

Soil erosion during and after construction on the site will require careful management. Levels of erosion should be able to be maintained within normally acceptable levels by adopting good soil erosion and sedimentation control practices, including:

- Plan for soil and water management concurrently with engineering design and in advance of any earthworks;

- Minimise the area and duration of soil exposure by staged development and controlled clearing;
- Stockpile stripped soil for reuse and protect from erosion;
- Control stormwater run-off by diverting clean run-off from denuded areas, minimising slope gradient, length and run-off velocities;
- Trap soil and water pollutants using silt traps, sediment basins, perimeter banks, silt fences and nutrient traps as appropriate;
- Promote regeneration of native vegetation in gullies and on steep slopes (>10°) and in areas previously cleared;
- Quick rehabilitation of disturbed areas.

All personnel on the site involved with earthworks, land clearing or construction should be made fully aware of the issues associated with sediment and erosion control.

8.3 Management of Site Drainage

Adequate surface and stormwater drainage should be installed and maintained on the building sites. The site has low-lying areas and geotechnical Terrain Unit B is poorly drained.

Dispersible soils such as those present in Terrain Unit A greatly limit water movement through the soil, resulting in poor drainage and waterlogging. To limit water logging, and rising water table, the following principles should be considered in development of the site:

- Planting of deep rooted native trees to prevent rising of the water table in the gullies;
- Retaining or planting native vegetation where possible;
- Treating potentially sodic soils with gypsum before landscaping;
- Designing storm water detention ponds and water features to reduce infiltration;
- Minimising soils disturbance, including reduced cut and fill;
- Improving or maintaining drainage around gully regions or natural drainage paths.

Provision of site stormwater management may incorporate some subsurface infiltration. For the purposes of subsurface infiltration design in situ permeability testing was undertaken in boreholes BH1 to 3. Results are presented in Appendix D and summarised in Table 8.

Table 8. Results of in situ Permeability Testing

Location	Permeability
BH1	6×10^{-5} m/sec
BH2	1×10^{-4} m/sec
BH3	2×10^{-6} m/sec

9 ACID SULPHATE SOILS

9.1 Background Information

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of pyrite which, when exposed to oxygen, in the presence of sufficient moisture, oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as Potential ASS.

When the soils are exposed, the oxidation of pyrite occurs and sulphuric acids are generated, the soils are said to be actual ASS.

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period (ie 10,000 years ago to present day) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (ie >10,000 years ago) would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen.

9.2 Significance of ASS

Disturbance or poorly managed development and use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off-site into aquatic ecosystems can have detrimental effect on aquatic ecosystems.

9.3 ASS Risk Map

Reference to the Nabiac/Hallidays Point 1:25,000 Acid Sulfate Soil Risk Map published by the DLWC indicates where the majority of the site is situated on residual soil slopes or elevated aeolian dunes, with no known occurrence of ASS. However there is a low risk of acid sulphate soils within 3m of the ground surface associated with the low lying depression in the east of the site.

9.4 ASS Sampling and Laboratory Testing

Acid Sulfate Soils (ASS) samples were obtained at varying depths in the boreholes. The samples were tightly sealed in plastic bags, placed on ice and transported to our Port Macquarie laboratory.

To assess the probability of ASS a sample was submitted for detailed analysis by the Chromium Reducible Inorganic Sulfur technique. The testing was undertaken by Southern Cross University Environmental Analysis Laboratory, a NATA accredited specialist chemical laboratory. The test results are presented in Appendix B and are summarised in Table 9.

TABLE 9 - RESULTS OF CHROMIUM REDUCIBLE SULFER ANALYSIS

SAMPLE LOCATION	SAMPLE DEPTH (m)	TEXTURE	TITRATIBLE ACTUAL ACIDITY (mole H+ /ton)	REDUCED INORGANIC SULFUR (%S_{cr})	LIME CALCULATION (kg $CaCO_3$ / m^3)
BH2	1.50 – 2.00	Coarse	22	<0.005	3

9.5 ASS Conclusions

Results of the CRS Analysis indicate that Chromium reducible Sulfur (S_{CR}) analysis results did not exceed the relevant ASSMAC Action Criteria Value, however the Titratible Actual Acidity value did exceed the relevant ASSMAC Action Criteria Value in BH2, indicating the possible presence of Actual ASS or naturally acidic soils. Naturally acidic soils are common in coastal environments on the mid-north coast of NSW, such as the coastal terrain represented by Terrain B on this site.

Initial testing indicates the site soils are not likely to be ASS. It is recommended, however, that wherever excavations are to take place in low lying Terrain B areas, some further specific ASS sampling and testing should be undertaken to determine whether an ASS Management Plan is required.

10 GEOTECHNICAL CONSTRAINTS ON DEVELOPMENT

The following geotechnical constraints are based on slope stability and soil erosion considerations. The constraints are aimed at providing broad guidelines to assist in development planning. It is envisaged that further refinement and delineation of geotechnical constraints, including pavement and foundation designs, will occur with more detailed assessment of separate areas of the site as development proceeds.

10.1 Area for Development

Areas occupied by Terrain A and Terrain C are considered suitable for development from a geotechnical viewpoint. The low lying areas within Terrain B may be suitable for development provided natural surface and subsurface drainage paths are modified and controlled appropriately.

Development of the site should be undertaken in accordance with good hillside construction practice and sound engineering principles. Development in gully areas should minimise disturbance to slopes, and general constraints and recommendations in this report would apply.

10.2 Type of Structure and Foundations

There are no particular geotechnical constraints on the type of structures considered appropriate for the site provided they are founded on footings designed and constructed in accordance with the principals of AS2870-1996, '*Residential Slabs and Footings'*. Where clays soils were present in Terrains A and B, they

were moderately to highly reactive as indicated by laboratory shrink-swell testing presented in Appendix C and summarised in Table 10.

TABLE 10 – SUMMARY OF SHRINK / SWELL (I_{ss}) INDEX TEST RESULTS

LOCATION	DEPTH (m)	UNIT	I_{ss} (%)
Terrain Unit A			
TP4	0.4 - 0.7	2A	3.6
TP7	0.65 - 1.1	4A	5.0
TP11	0.2 - 0.6	4A	3.7
Terrain Unit B			
TP12	0.3 – 0.7	2A	2.6

A site classification should be undertaken once site layout and regrade designs are known. Provided footings are designed in accordance with AS2870-1996, high level footings would be appropriate for Geotechnical Terrains A, B and C.

Site classification to AS2870-1996 “Residential Slabs and Footings” would be expected to be predominantly Class H (Highly Reactive) in Terrain A and predominantly Class M (Moderately Reactive) in Terrain B. Reuse of highly reactive residual clay from Terrain A in fill platforms may result in Class H sites. Terrain Unit C would be expected to be Class A (Non- Reactive), however density testing of the sands would be required to ensure no loose sand zones are present and investigation would also be required to ensure no underlying residual clays are present within 1.5m of surface.

10.3 Excavation

Where excavation is required, it is anticipated that all materials could be excavated by conventional dozer blade or backhoe bucket at least to the depths indicated on the attached field logs.

The near surface soils on-site particularly in Terrain B are expected to be moisture sensitive and it is also possible that water inflows or seepages may be encountered within the depth of the excavation. Therefore, if wet weather is encountered prior to or during earthworks, over-excavation and placement of a working platform of granular fill will be required to allow site trafficability. Filling might be required to bring subgrade back to design level. Dewatering may also be required, depending on the depth of excavation.

Excavation wall collapse in Terrain C, such as for service trenching, may be a problem in the aeolian sands. For shallow excavations such as trenches, dewatering may also be required and could consist of localised shallow spear points within the water table, with shoring used to support the trench.

Excavations should preferably not exceed 1.5m in depth and should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion.

10.4 Reuse of Materials

The following comments are made regarding the suitability of the site materials for reuse in filled areas:

- Where site regrade is proposed, all existing topsoil, vegetation or other potentially deleterious material should be removed to spoil or stockpiled for reuse as landscaping materials only;
- Stripping is generally expected to be required to depths of about 0.1m to 0.4m (topsoil layer), but may be significantly deeper where wet, silty soils are encountered;
- Underlying very stiff clays should be carefully stripped as necessary and stockpiled for reuse as general site fill;
- The clayey soils on-site are expected to be highly reactive (susceptible to volume changes with variation in moisture content) and will need to be placed and compacted to a minimum density ratio of 95% Standard Compaction within ±2% of OMC to minimise reactive soil movements;
- Where excavation of weathered rock is required there may be some oversize material that requires sorting prior to re-use as an engineering fill.

10.5 Filling

Filling should be undertaken in accordance with sound engineering principles as set out in AS3798.

The residual clay soils that would be derived from cuts on the site are typically useful for site regrade fill with good moisture control during placement and compaction. The topsoil and colluvial soils are generally suitable for landscaping use only.

Where site regrading is proposed, the following general course of action should be taken:

- Strip existing topsoil, root affected material and deleterious material to spoil. Following stripping, the surface should be inspected for trafficability;
- Following stripping, the exposed subgrade materials should be proof rolled to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved select material. The near surface soils onsite are expected to be moisture sensitive and therefore, if wet weather is encountered prior to or during earthworks, over excavation and placement of a working platform of granular fill may be required to assist site trafficability;
- Approved fill should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum dry density ratio of 98% Standard (AS1289 5.1.1 or equivalent) beneath structures and 95% Standard as general site fill.

The expertise of the contractor, the nature of the fill material and the degree of supervision of the filling will determine the footing design required for any structures placed on the fill constructed in the manner discussed above.

Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007, '*Guidelines for Earthworks for Commercial and Residential Developments'*. If specific earthworks

requirements are required for industrial development, then earthworks specification should be designed by an experienced engineer familiar with the site conditions.

10.6 Retaining Walls

Retaining walls should be designed for surcharge loading from slopes, retaining walls, structures and other existing or future improvements in the vicinity of the wall.

Adequate subsurface and surface drainage should be provided behind all retaining walls. All retaining walls in excess of 1.5m should be designed by an experienced engineer familiar with the site conditions.

10.7 Access and Road Construction

Access and site modifications should comply with the recommendations above.

Testing for pavement design included four CBR samples, the results are presented in Appendix B and summarised below in Table 11.

TABLE 11: SUMMARY OF CALIFORNIA BEARING RATIO AND COMPACTION RESULTS

Site	Depth	Unit	Moisture Content (%)		Swell %	CBR (%)
			Field	Optimum		
Terrain Unit A						
TP4	0.4 – 0.7	4A	18.4	21.6	0.1	8
TP7	0.4 – 0.6	4A	27.5	24.5	1.1	6
TP10	0.15 – 0.37	5	28.8	25.9	1.7	3.5
Terrain Unit B						
TP12	0.3 – 0.6	2A	25.5	19.2	0.7	6

Placement of roads through Terrain Unit B is likely to require some over-excavation of wet and/or silty material, and subsequent subgrade replacement or elevation over inundated areas. Water logging of these layers, particularly after wet weather, may require use of geofabric and placement of a granular working platform prior to placement and compaction of subsequent fill or pavement layers. Surface and sub-soil drains will also be required to improve drainage.

Further geotechnical assessment is required to identify areas where specific design requirements will be needed, such as recommendations regarding provision of drainage and evaluation of subgrade conditions for pavement thickness design.

10.8 Drainage

All collected stormwater run-off should be piped into an inter-allotment drainage system utilising the existing watercourse, in a controlled manner that limits erosion. Surface and sub-soil drains will be required to improve drainage.

10.9 Sewage Disposal

Septic wastes should be connected to a reticulated disposal system.

11 DISCUSSION AND CONCLUSIONS

The site history assessment indicated that the site has been a grazing property and that there has not been significant change to the site since 1965.

Based on the site walkover and the site history assessment, it is considered that the majority of the site was used in the past for general grazing, and would not contain contamination likely to impact on potential future residential usage. There are some areas of environmental concern as outlined in Section 4, with the main areas of concern being due to storage and use of farm chemicals on site and presence of possible asbestos cement sheeting products.

In these areas there is a potential for localised soil contamination exceeding the residential guidelines (NEHF F) from the NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme. It is therefore recommended that surface soil sampling be undertaken in the vicinity of the chemical storage areas, with analysis for heavy metals, hydrocarbons, herbicides, pesticides prior to deeming the site suitable for residential land use.

It is further recommended that a hazardous building survey is carried out prior to any proposed building demolition to assess the building materials. Should asbestos be present then a suitably qualified demolition contractor, experienced in asbestos removal and disposal, should be engaged to carry out the work.

Development of the site for residential use is considered feasible from a geotechnical point of view.

The development area is assessed to have an overall low risk of slope instability and it is considered that the site is appropriate for development subject to the geotechnical constraints on development detailed herein.

Minor surface erosion was noted on site however such impacts could be reduced if development is appropriately managed. The site management procedures should be constantly reviewed to ensure that opportunities for erosion are minimised.

Further geotechnical investigations will be required at the design stage to allow pavement design and lot classifications to AS2870-1996.

12 LIMITATIONS

The findings contained within this report are the result of a site history review, site walkover and limited boreholes and test pits. To the best of our knowledge, they represent a reasonable interpretation of the

general condition of the site. Under no circumstances can it be considered that these findings represent the actual state of the site at all points.

Contactors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

For and on behalf of Coffey Geotechnics Pty Ltd

Steven Morton

Principal

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

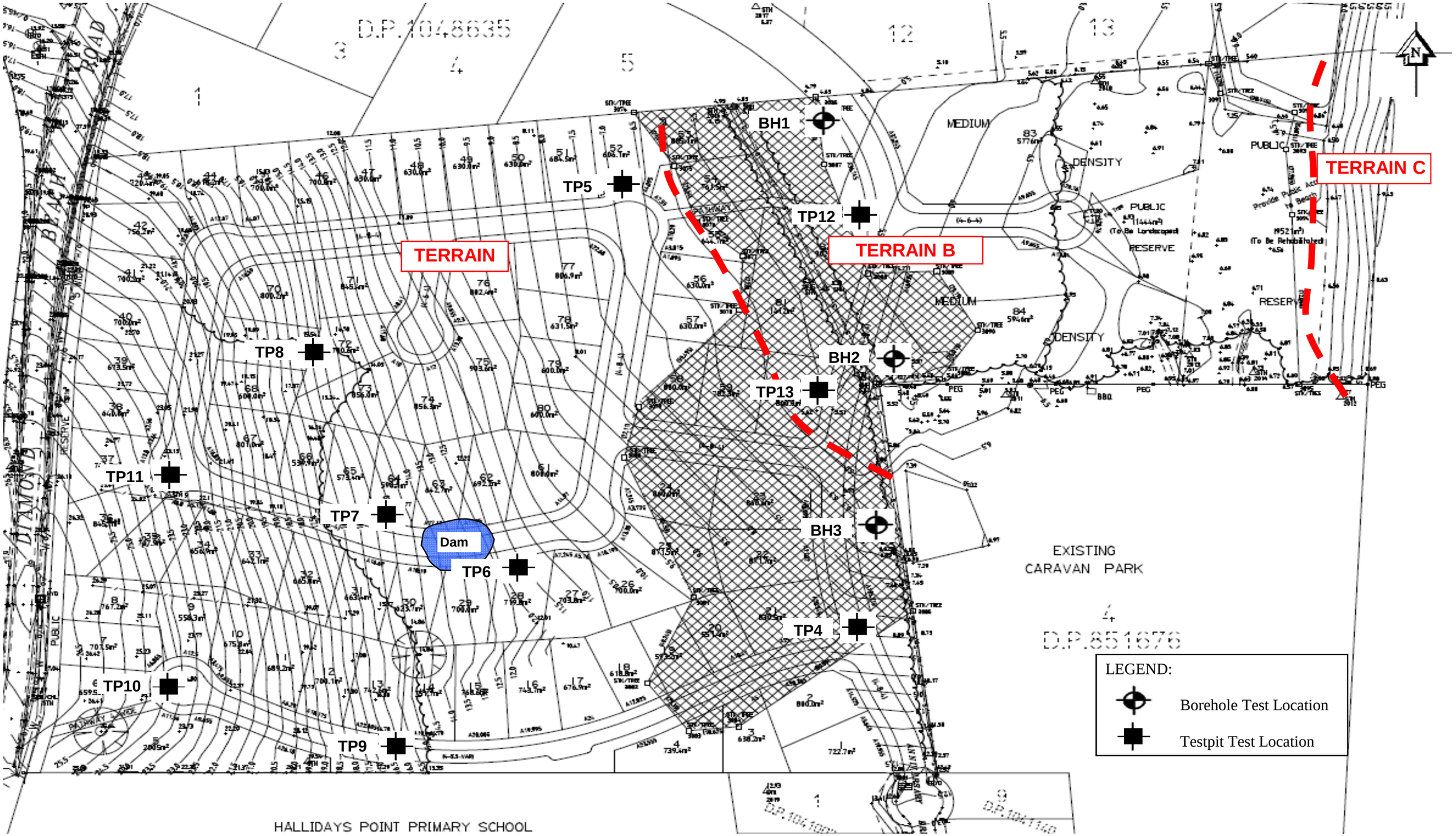
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures



revision	description	drawn	approved	date
	Drawing No. DWG7420D	RD		27.07.06

Scale: 0 10 20 30 40 50 60

drawn	PE
approved	
date	22.11.08
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	Orogen
project:	Proposed Subdivision
title:	Lot 6 DP244030 and Lot 9 DP 250425 Diamond Beach Road, Diamond Beach
project no:	GEOTTUNC01754AA
figure no:	FIGURE 1

F:\GEOT\TUNC-Data\GEOT\TUNC job files\GEOTTUNC\TUNC01700-1799\TUNC01750-01799\TUNC01754AA\Report and appendices\[GEOTTUNC01754AA Figure 1.xls]A3 Landscape Figure

Appendix A

Title History Search

Information Provided Through
Advance Legal Search Pty Ltd
Ph. 0297541590 *Fax.* 0297541364

Title Search

LEAP Legal
An Approved LPI *NSW*
Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 6/244030

SEARCH DATE	TIME	EDITION NO	DATE
24/9/2008	5:59 PM	5	19/7/2007

LAND

LOT 6 IN DEPOSITED PLAN 244030
AT RED HEAD
LOCAL GOVERNMENT AREA GREATER TAREE
PARISH OF BERYAN COUNTY OF GLOUCESTER
TITLE DIAGRAM DP244030

FIRST SCHEDULE

MACHIKO PTY LTD (T AA417658)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 AD282000 MORTGAGE TO NATIONAL AUSTRALIA BANK LIMITED

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

COFFEY - DIAMOND BEACH ALSP PRINTED ON 24/9/2008

ADVANCE LEGAL SEARCH PTY LIMITED

(ACN 077 067 068)
ABN 49 077 067 068

P.O. Box 149
Yagoona NSW 2199

Telephone: +612 9754 1590
Mobile: 0412 169 809
Facsimile: +612 9754 1364
Email: alsearch@optusnet.com.au

29th. September, 2008

COFFEY GEOTECHNICS
1/4 Douglas Avenue,
Tuncurry, NSW 2428

Attention: Paul Edmed

RE: **Diamond Beach Road**
Diamond Beach
PO 08336

Current Search

Folio Identifier 6/244030 (title attached)
DP 244030 (plan attached)
Dated 24th. September, 2008
Registered Proprietor:
MACHIKO PTY LTD

Title Tree
Lot 6 DP 244030

Folio Identifier 6/244030

Certificate of Title Volume 12226 Folio 36

Certificate of Title Volume 9381 Folio 60

Crown Grant Volume 5831 Folio 47

Summary of proprietor(s)
Lot 6 DP 244030

Year	Proprietor
	(Lot 6 DP 244030)
2004 to date	Machiko Pty Ltd
2000 – 2004	Ivan Jelacic Katherina Jelacic
1987 – 2000	Ivan Jelacic Kathy Jelacic
	(Lot 6DP 244030 - CT Vol.12226 36
1986 – 1987	Ivan Jelacic Kathy Jelacic
1975– 1986	Ian Gavin Platt-Hepworth, real estate agent Garry Walter Platt-Hepworth, gardener John Rutherford, developer Tralian Pty Ltd
1973 – 1975	Sparkle Estates Pty Limited
	(Lot 2 DP 500952 – CT Vol 9381 Fol 60)
1971 – 1973	Sparkle Estates Pty Limited
1963 – 1971	Esme Madge Beddows, widow John William Ormsby Martin, farmer
	(part Portion 50 Parish of Beryan County of Gloucester – Crown Grant Vol 5831 Fol 47)
1962 – 1963	Esme Madge Beddows, widow John William Ormsby Martin, farmer
1951 – 1962	Frederick Thomas Beddows, farmer
1951 – 1951	Frederick William Cummins, dairy farmer

1948 – 1951	Rural Bank of New South Wales
1910 – 1948	Crown Land held as Conditional Purchase Lease

****

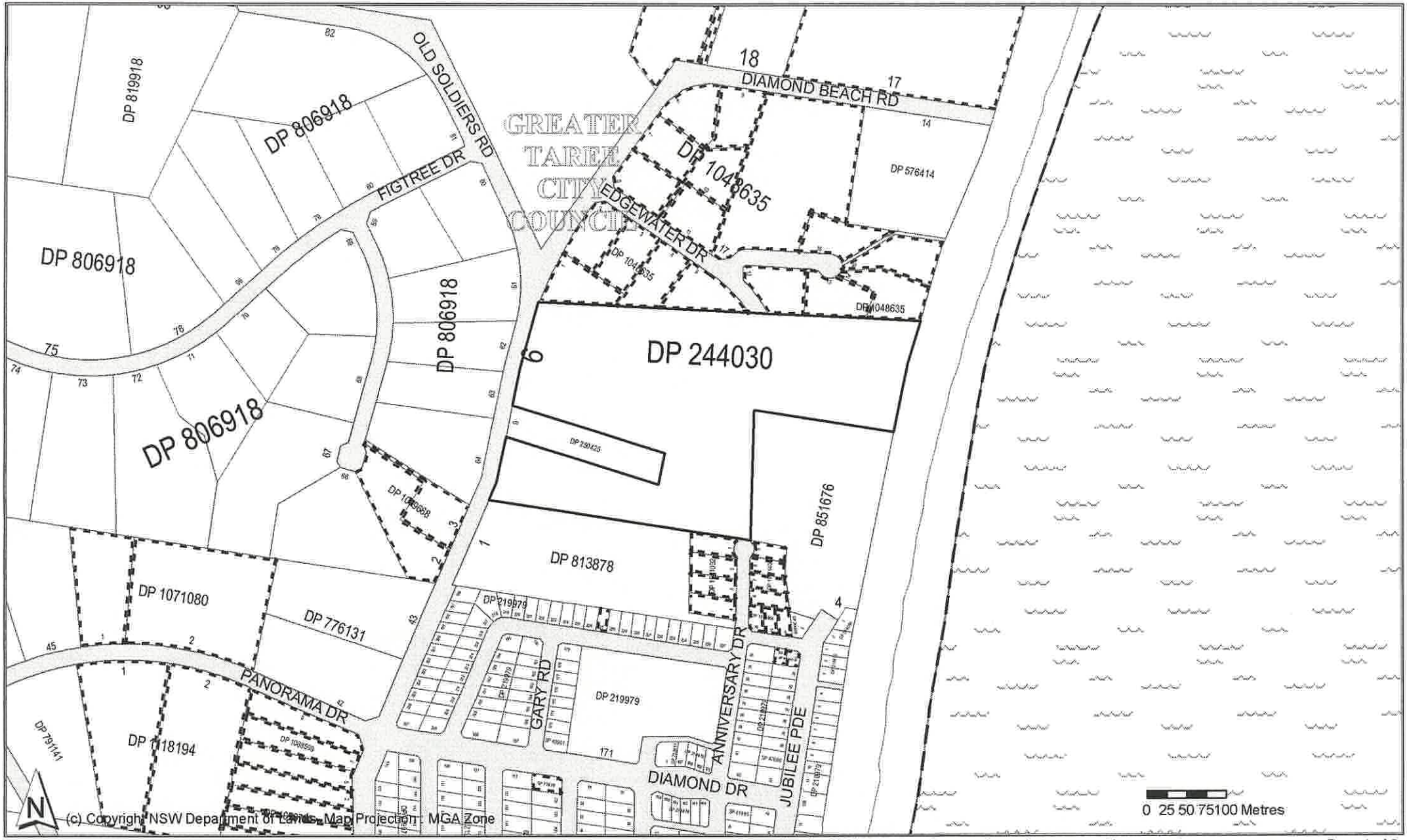
Department of Lands
Reliable from the ground up

Cadastral Records Enquiry Report

Ref : 97 - DIAMOND BEACH

Requested Parcel : Lot 6 DP 244030 **Identified Parcel :** Lot 6 DP 244030

Locality : DIAMOND BEACH **LGA :** GREATER TAREE **Parish :** BERYAN **County :** GLOUCESTER



Report Generated 10:40:59 AM, 26 September, 2008

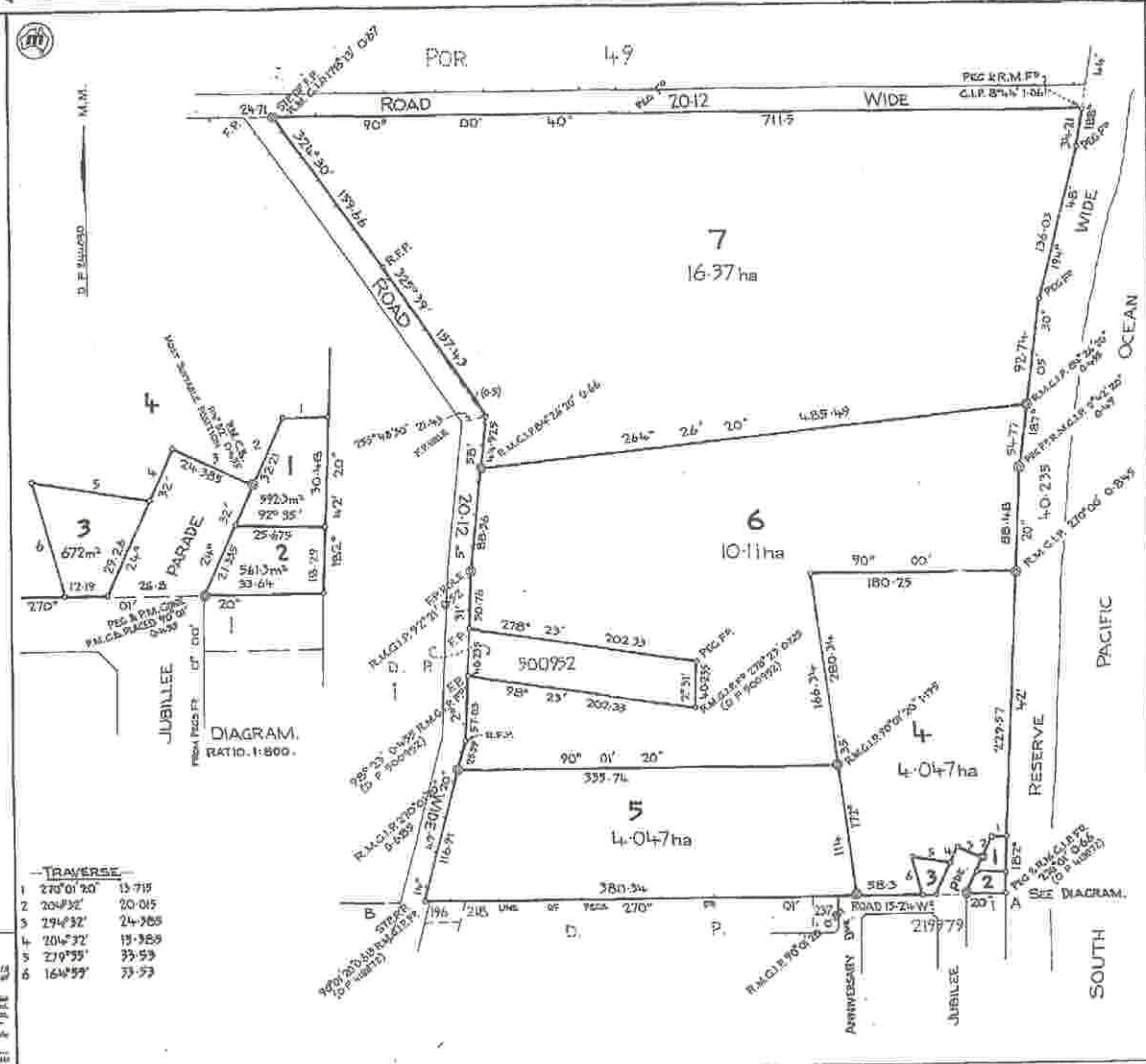
This information is provided as a searching aid only. While every endeavour is made to ensure the current cadastral pattern is accurately reflected, the Registrar General cannot guarantee the information provided. For all ACTIVITY PRIOR to SEPT 2002 you must refer to the RGs Charting and Reference Maps.

PLAN FORM 2

Plan Drawing only to appear in this space

Signatures and seals only.

SPARKLE ESTATES PTY LIMITED Common Seal — DIRECTOR — DIRECTOR



TRAVERSE.

1	270°01'20"	13·715
2	204°32'	20·015
3	294°32'	24·385
4	204°32'	19·385
5	279°55'	33·53
6	164°55'	33·53

Council Clerk's Certificate

I hereby certify that —

(a) the requirements of the Local Government Act, 1919, (other than the requirements for the registration of plans), and

(b) the requirements of section 345 of the Metropolitan Water, Sewerage and Drainage Act, 1924 ... Drainage Act, 1935 are complied with

have been complied with by the applicant in relation to the proposed NEW ROAD - SUBDIVISION

Subdivision No. 2057

Date 23.10.72

(Signature) Council Clerk

*OFFICE USE ONLY

D P 244030

Registered: RG 29·8·1973

C.A.: Nº 2057 OF 23·10·1972

Title System: TORRENS

Purpose: SUBDIVISION

Ref. Map: PARISH

Last Plan: D P 500952

PLAN OF SUBDIVISION OF LOT 2 D. P. 500952 C.T. VOL. 9381 FOL. 60.

Reduction Ratio 1: 2500
Lengths are in metres.

Mun./Shire MANNING

Locality: RED HEAD

Parish: BERYAN

County: GLOUCESTER

William Herbert Stewart McGlashan of Taree a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this plan is accurate and has been made by me in accordance with the Survey Practice Regulations, 1933, and was completed on 9th October 1972

Signature: W McGlashan

Panel for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

IT IS INTENDED TO DEDICATE THE EXTENSION OF JUBILEE PARADE TO THE PUBLIC AS ROADWAY.

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

MPD

I, Bruce Richard Davies, Registrar General for New South Wales, certify that this negative is a photograph made of a permanent record of a document in my custody this 22nd day of August, 1977

1

Historical Search

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
24/9/2008 5:57PM

FOLIO: 6/244030

First Title(s): SEE PRIOR TITLE(S)
Prior Title(s): VOL 12226 FOL 36

Recorded	Number	Type of Instrument	C.T. Issue
5/6/1987		TITLE AUTOMATION PROJECT	LOT RECORDED FOLIO NOT CREATED
15/12/1987		CONVERTED TO COMPUTER FOLIO	FOLIO CREATED CT NOT ISSUED
4/6/1990	Z35981	MORTGAGE	EDITION 1
18/8/1992	E687768	MORTGAGE	EDITION 2
13/1/2000	6485107	DISCHARGE OF MORTGAGE	
13/1/2000	6485108	CHANGE OF NAME	
13/1/2000	6485109	MORTGAGE	EDITION 3
14/2/2004	AA417657	DISCHARGE OF MORTGAGE	
14/2/2004	AA417658	TRANSFER	
14/2/2004	AA417659	MORTGAGE	EDITION 4
19/7/2007	AD281999	DISCHARGE OF MORTGAGE	
19/7/2007	AD282000	MORTGAGE	EDITION 5

*** END OF SEARCH ***

COFFEY - DIAMOND BEACH ALSP PRINTED ON 24/9/2008

CERTIFICATE OF TITLE

NEW SOUTH WALES — REAL PROPERTY ACT, 1900

Vol. 12226 Fol. 36

Crown Grant Vol.5831 Fol.47

Prior Title Vol.9381 Fol.60

Edition issued 3-10-1973.

(Page 1) Vol. 12226 Fol. 36

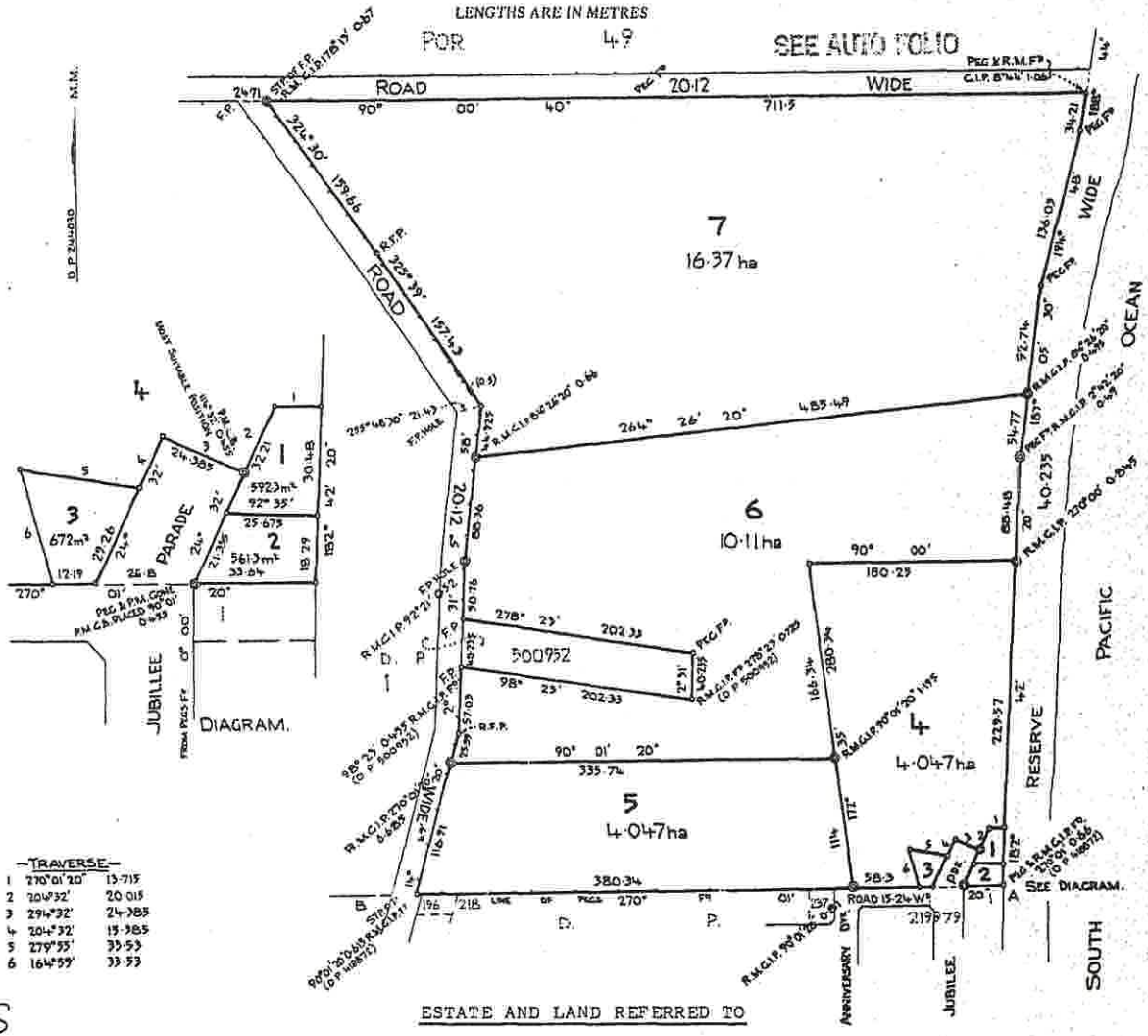
I certify that the person described in the First Schedule is the registered proprietor of the undermentioned estate in the land within described subject nevertheless to such exceptions encumbrances and interests as are shown in the Second Schedule.

Registrar General

CANCELLED

PLAN SHOWING LOCATION OF LAND

LENGTHS ARE IN METRES



ESTATE AND LAND REFERRED TO

Estate in Fee Simple in Lot 6 in Deposited Plan 244030 at Red Head in the Shire of Manning Parish of Beryan and County of Gloucester. EXCEPTING THEREOUT the minerals reserved by the Crown Grant.

FIRST SCHEDULE

~~SPARKLE [illegible] PTY. LIMITED.~~

GRM

SECOND SCHEDULE

1. Reservations and conditions, if any, contained in the Crown Grant above referred to.
2. Attention is directed to Section 8 Land Aggregation Tax Management Act, 1971. See M531064

BA

Registrar General

FIRST SCHEDULE (continued)

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	INSTRUMENT DATE	ENTERED	Signature of Registrar General
~~Ian Gavin Platt-Hepworth, Real Estate Agent, Garry Walter Platt-Hepworth, Gardener, both of Rose Bay, John Rutherford of Neutral Bay, Developer, each as to one undivided one eighth share and Tralian Pty.Ltd. as to the five remaining undivided one eighth shares, AS TENANTS IN COMMON~~	~~Transfer~~	~~P458603~~	~~------~~	~~28-11-1975~~	[signature]
Ivan Jelacic and Kathy Jelacic as joint tenants by Transfer W573664. Registered 23-10-1986					

P458603T
4M
Q660864DM
W573664TE

SECOND SCHEDULE (continued)

NATURE	INSTRUMENT NUMBER	DATE	PARTICULARS	ENTERED	Signature of Registrar General	CANCELLATION		
~~Mortgage~~	~~P458604~~	~~------~~	~~to Paul Francis Connery of Vaucluse, Solicitor, as regards the shares of Ian Gavin Platt-Hepwroth and Garry Walter Platt-Hepworth~~	~~28-11-1975~~	[signature]	Discharged	Q660864	[signature]

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED

CERTIFICATE OF TITLE

...PERTY ACT, 1900, as amended.

Vol. 9381 Fol. 60

CANCELLED

1st Edition issued 26-2-1963

Deposited Plan.)

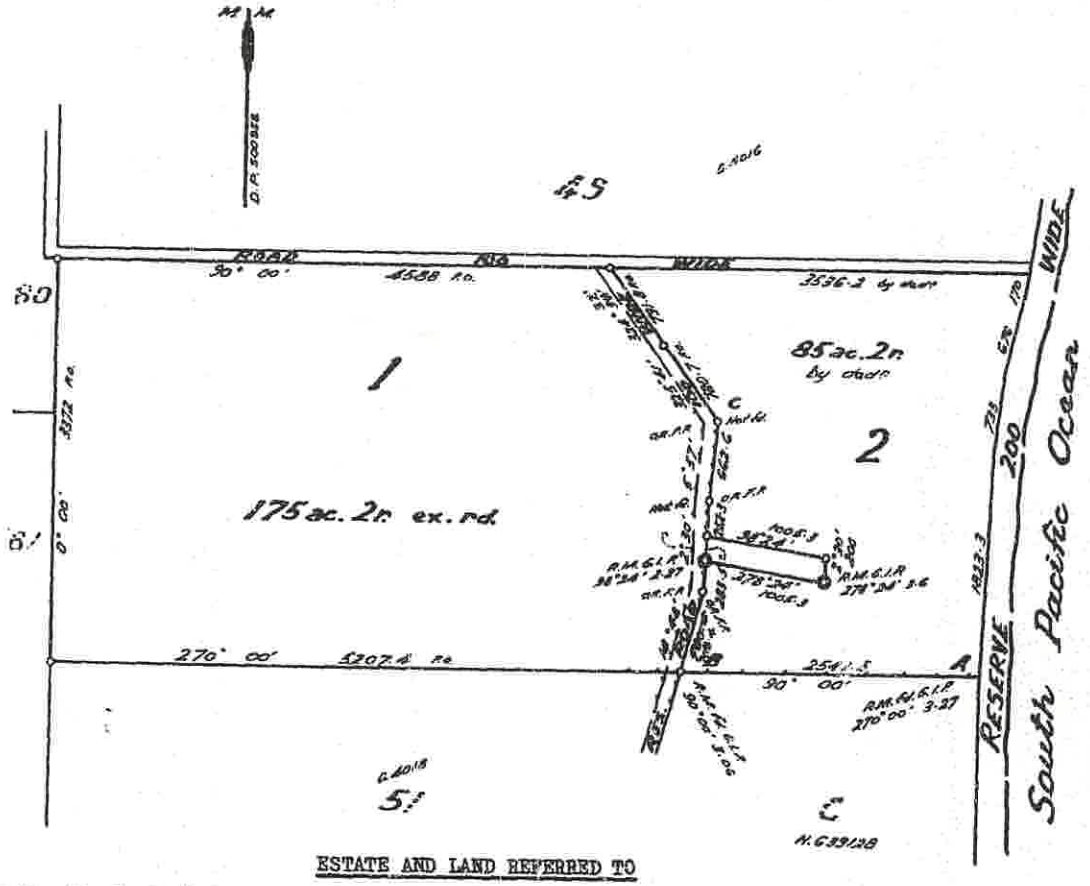
Vol. 9381 Fol. 60 (Page 1)

I certify that the person described in the First Schedule is the registered proprietor of the undermentioned estate in the land within described subject nevertheless to such exceptions encumbrances and interests as are shown in the Second Schedule.

Witness B Bailey

Registrar-General.

PLAN SHOWING LOCATION OF LAND



ESTATE AND LAND REFERRED TO

Estate in Fee Simple in lot 2 in Deposited Plan 500952 at Red Head in the Shire of Manning Parish of Beryan and County of Gloucester excepting thereout the minerals reserved by the Crown Grant.

FIRST SCHEDULE (Continued overleaf)

~~ESMÉ MADGE BEDDOWS of Gentleman, Widow and JOHN WILLIAMS ORMSBY MARTEN of Burrell Creek, Farmer, as Joint Tenants.~~

Registrar General

SECOND SCHEDULE (Continued overleaf)

1. Reservations and conditions, if any, contained in the Crown Grant(s) referred to in the said Deposited Plan.
2. ~~Restrictions on transfer - See Section 47C Crown Lands Consolidation Act, 1913.~~ Cancelled M531064
3. ~~Caveat No. H956827 by the Registrar General entered 3-1-1962.~~ Withdrawn M553356.

Registrar General

BY 1009 V. C. N. BLIGHT, GOVERNMENT PRINTER

FIRST SCHEDULE (continued)

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	INSTRUMENT DATE	ENTERED	Signature of Registrar-General
Sparkle Estates Pty. Limited	Transfer	M553356	10-12-1971	24-1-1972	J.Watson

This deed is cancelled as to whole (ex road)
New Certificates of Title have issued on 3/10/1973
for Deposited Plan No. 244030 as follows:-
Lots 1 to 7 Vol 12226 Fol 31 to 37 respectively

J.Watson
REGISTRAR GENERAL

The residue of land in this folio comprises road in DP 244030

J.Watson
REGISTRAR GENERAL

M53 ... Request ...
M ... 27/...
DP244030
...29/1/73
Progressed DP244030 (whole ex road)

SECOND SCHEDULE (continued)

INSTRUMENT NATURE	INSTRUMENT NUMBER	INSTRUMENT DATE	PARTICULARS	ENTERED	Signature of Registrar-General	CANCELLATION		
REQUEST	M531064		Attention is directed to Section 8, Land Aggregation Tax Management Act, 1971.	21-12-1971	J.Watson			
~~Mortgage~~	~~M553357~~	~~9-12-1971~~	~~to Esme Madge Caddows of ... widow and John Williams ... later, farmer~~	~~24-1-1972~~	J.Watson	Discharged	N431694	J.Watson
			the interests of the Council of the Shire of Manning in the new road shown in DP 244030	29.8.1973	J.Watson			

FORM No. 184A **NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR-GENERAL ARE CANCELLED**

Licence: 10V/0167/95
Edition: 9804

CHANGE OF NA

New South Wales
Real Property Act 1900

6485108S

(A) **TORRENS TITLE** folio Identifier 6/244030

(B) **REGISTERED DEALING** If applicable

(C) **LODGED BY**

LTO Box	Name, Address or DX and Telephone	CODE
	BURKHART & COMPANY PTY LTD BOX 155S TEL: 9231 0122 FAX: 9262 1904 Reference (optional): state/Jelacic	CN

(D) **REGISTERED PROPRIETOR** Whose name is to be changed; show the name as it currently appears on the Torrens Title
Kathy Jelacic.

(E) **NEW NAME** Of the above registered proprietor in full
Katherine Jelacic.

(F) I, the registered proprietor referred to above, apply to have my new name recorded in the Register in respect of the above land/ registered dealing.

(G) **STATUTORY DECLARATION BY THE APPLICANT**

I [new name] Katherine Jelacic solemnly and sincerely declare that-

1. I am identical with the registered proprietor referred to above;
2. on ... at ...
   in the State of ... I married ...;
3. X I AM NOWN AS KATHY JELACIC & KATHERINE JELACIC HOWEVER IN LEGAL DOCUMENTS USUALLY DISCRARED AS KATHERINE JELACIC

I make this solemn declaration conscientiously believing the same to be true and by virtue of the Oaths Act 1900, and I certify this application to be correct for the purposes of the Real Property Act 1900.

X Made and subscribed at SMITHFIELD in the state of NSW
on 10.11.1999 in the presence of -

Signature of witness: [signature] Signature of applicant: [signature]

Name of witness: IVAN JELACIC

Address of witness: 3 BRENTWOOD WAY
CASTLE HILL

Qualification of witness: J.P.

To be witnessed by a JP

May be accepted [signature]

All handwriting must be in block capitals. Page 1 of 1 Checked by (LTO use): gb.

10

PLAN OF PORTION 50

County of Gloucester Parish of Beryan

Land District Taree Land Board District Maitland Eastern Division

~~RESUMED AREA No~~ ~~PASTORAL HOLDING~~

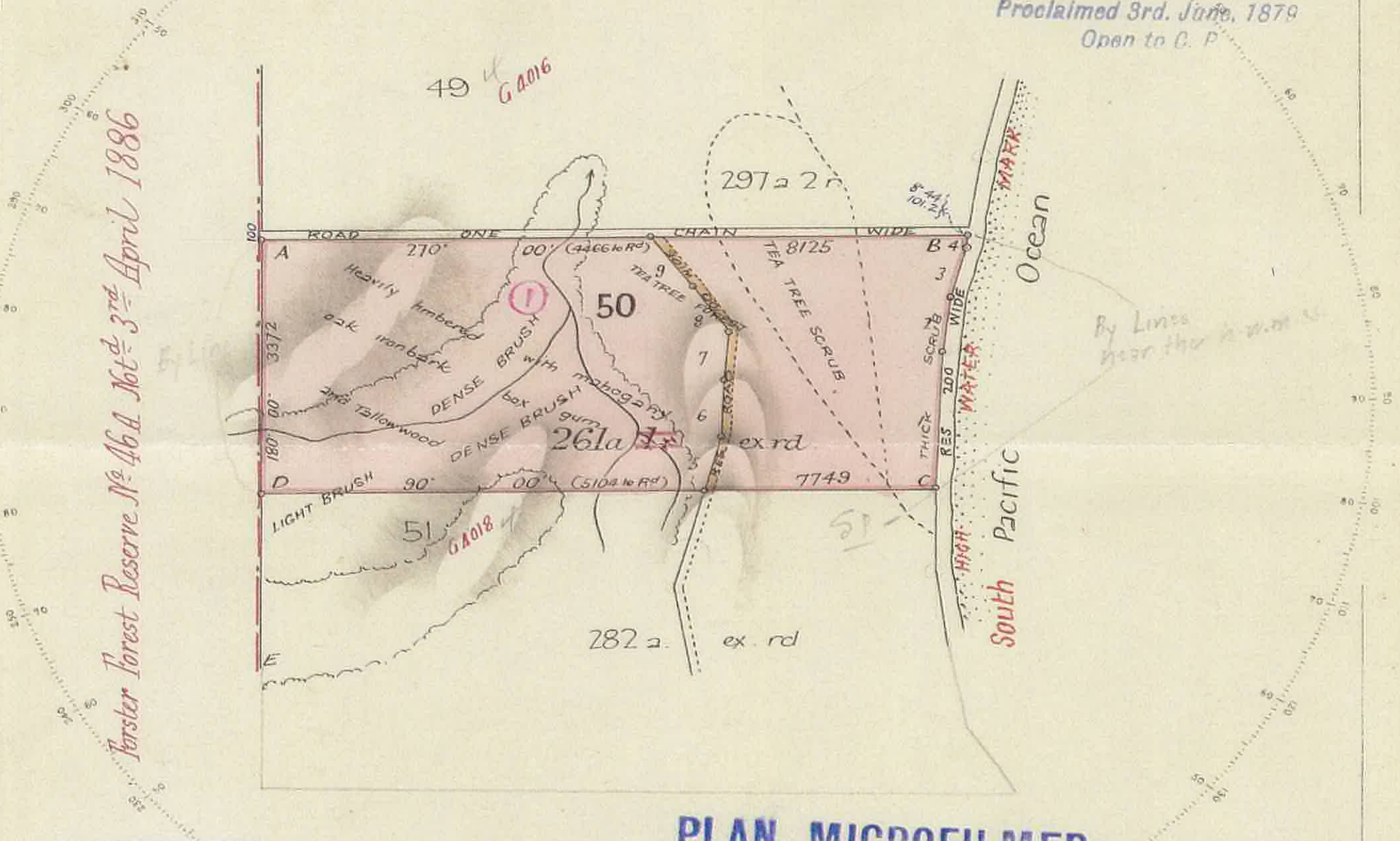
Applied for under the Section of the Crown Lands Act of by

Within Forster Forest Reserve No 46A Notd 3rd April 1886 Revoked 29th Decr 1909

Within R.44669 from Sale generally Notified 29th Decr 1909. Revoked 2nd February 1910.
Within Condl Pur: Lease Area No 227 (Cap: Value £239.5.0. at 1⅛/4 p.a.) notd 2nd February 1910.

(1) Por 50. O.C.P.L. 10.25 Mch. 24th Robert Bennett Now CP 11/45 Mar 29, conversion
now Rural Bank of New South Wales Sale completed Sales 46.11895

Within the Gloucester Gold Field Proclaimed 3rd. June, 1879 Open to C. P.



Azimuth taken from DE

Field Book Vol. 8306 Folio 87, 94 to 97 incl

Reference to Corners

Corner	Bearing	From	Links	No on Tree
A	249° 20'	Blackbutt	18.8	50
B	Numbered Peg (No tree near)			50
C	Numbered Peg (No tree near)			50. 51
D	12° 26'	Mahogany	39.9	50. 51

Reference to Traverse

Line	Bearing	Distance
1	2° 42'	1824
2	7° 05'	733
3	14° 46'	676
4	8° 44'	170
5	14° 48'	724
6	2° 30'	728
7	5° 57'	629
8	325° 41'	745
9	324° 32'	864

I hereby certify that I in person made and on the 14th July 09 completed the survey represented on this plan on which are written the bearings and lengths of the lines measured by me and I declare that the survey has been executed in accordance with the regulations published for the guidance of Licensed Surveyors and the practice of the Department of Lands.

William L. Keil Licensed Surveyor

Transmitted to the District Surveyor with my letter of 16th Aug 1909 No 48

Voucher No 09.55 Passed £16.1.8 R.H.W. 21.10.09

Calculation Book No ~ Folio ~

Checked and Charted W. Wilson 25th Sept 09

Examined

Plan approved 21 October 1909

Draftsman-in-Charge

Improvements

Scale 20 Chains to an Inch.

2 Nov 1909

Cat. No G 4017 1497

Conversion of C.P.L.

No. 1946/1922

Mortgage to 38255

NEW SOUTH WALES
Three pounds
STAMP DUTY
SYDNEY, N.S.W.

State of New South Wales

[LAND GRANT]

CANCELLED

REGISTER BOOK
VOL. 5831 FOL. 47

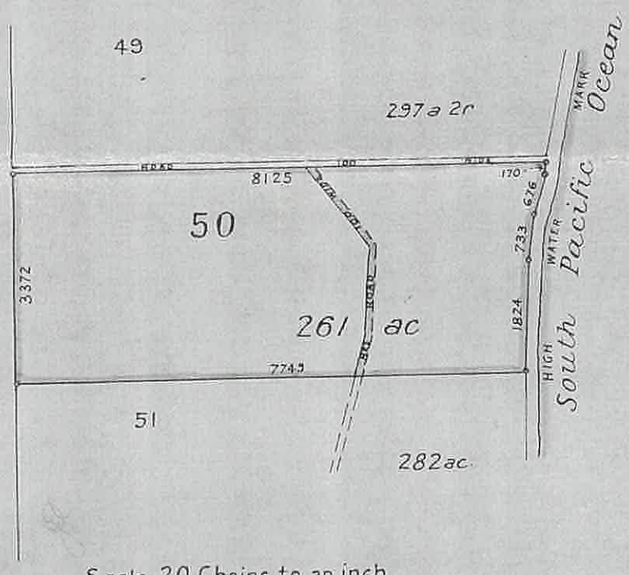
CANCELLED

GRANT OF LAND PURCHASED BY CONDITIONAL SALE.

C.P. 1911/45
Taree

GEORGE VI. by the Grace of God, of Great Britain, Ireland, and the British Dominions beyond the Seas, King, Defender of the Faith, Emperor of India:—
TO ALL to whom these Presents shall come, Greeting:—

Whereas the RURAL BANK OF NEW SOUTH WALES hereinafter called the said BANK ~~in Our State of New South Wales~~ claims to be entitled to the Parcel of Land hereinafter described in virtue of a Conditional Purchase of the same acquired by the conversion of a Conditional Purchase Lease under the provisions of the Crown Lands Amendment Act of 1905 which Conditional Purchase Lease was applied for on the twenty fourth day of March 1910 **And Whereas** a certificate of compliance with the conditions attaching to such purchase has been issued **And** the sum of two hundred and thirty nine pounds five shillings Sterling being the purchase money payable for the said Land has been paid into the Office of the Treasurer of Our said State And all things required by law to be done to entitle the said BANK to a Grant of the fee simple of the said Land subject to the Reservations and Exceptions hereinafter contained have been done and performed **Now Know Ye** That for and in consideration of the said sum for and on Our behalf well and truly paid into the Treasury of Our said State before these Presents are issued and of all and singular the premises WE HAVE GRANTED and for Us Our Heirs and Successors DO HEREBY GRANT unto the said BANK and its ~~Heirs and~~ Assigns Subject to the Reservations and Exceptions hereinafter contained ALL THAT Piece or Parcel of Land in Our said State containing by admeasurement two hundred and sixty one acres be the same more or less situated in the County of Gloucester and Parish of Beryan



Scale 20 Chains to an inch

—— PORTION 50 ——

COMMENCING at the North Eastern corner of portion fifty one of two hundred and eighty two acres and bounded thence on the South by the Northern boundary of portion fifty one bearing West seventy seven chains forty nine links on the West by a line bearing North thirty three chains seventy two links on the North by a road one chain wide dividing this land from portion forty nine of two hundred and ninety seven acres two roods bearing East eighty one chains twenty five links and on the South East and East by lines near the high water mark of the South Pacific Ocean bearing South eight degrees forty four minutes West one chain seventy links South fourteen degrees forty six minutes West six chains seventy six links South seven degrees five minutes West seven chains thirty three links and thence South two degrees forty two minutes West eighteen chains twenty four links to the point of commencement EXCLUSIVELY of a road one chain wide passing through this land in a North Easterly and thence in a North Westerly direction the area of which has been deducted from the total area

As per Plan in the margin hereof With all the Rights and Appurtenances whatsoever thereto belonging To Hold unto the said BANK and its ~~Heirs and~~ Assigns for ever **Provided Nevertheless** AND WE DO HEREBY RESERVE AND EXCEPT unto Us Our Heirs and Successors all minerals which the said Land contains with full power and authority for Us Our Heirs and Successors and such person or persons as shall from time to time be authorised by Us or Them to enter upon the said Land and to search for mine dig and remove the said minerals **And also** all such parts and so much of the said Land as may hereafter be required for public ways viaducts canals railways tramways dams sewers or drains in over and through the same to be set out by Our Governor for the time being of Our said State or some person by him authorised in that respect **And also** all sand clay stone gravel and indigenous timber and all other materials the natural produce of the said Land which may be required at any time hereafter for the construction and repair of any public ways bridges or canals or for naval purposes or railways and tramways or any fences embankments viaducts dams sewers or drains necessary for the same together with the right of taking and removing all such materials by such person or persons as may be authorised in that behalf by Our Governor as aforesaid **Provided Lastly** AND WE DO HEREBY RESERVE for Us Our Heirs and Successors and for Our Governor as aforesaid by such person or persons as shall be by Us Them or him authorised in that behalf full power to make and conduct through in under upon or over the said Land or any portion thereof all public ways viaducts railways tramways canals and all common or public drains and sewers which may be deemed expedient And the right of full and free ingress egress and regress into out of and upon the said Land for the several purposes aforesaid or any of them **In Testimony Whereof** We have caused this Our Grant to be Sealed with the Seal of Our said State the word "seven" at the commencement of the twenty third line hereof having been previously typed over an erasure

Witness Our Trusty and Well-beloved JOHN NORTHCOTT, Esquire, Companion of Our Most Honourable Order of the Bath, Member of Our Royal Victorian Order, Lieutenant-General in Our Australian Military Forces, Governor of Our State of New South Wales and its Dependencies in the Commonwealth of Australia, at Sydney in Our said State, this third day of May in the twelfth year of Our Reign, and in the year of Our Lord one thousand nine hundred and forty eight.

Northcott.

Governor.

RECORDED and ENROLLED in the Registrar General's Office, at Sydney, in New South Wales, this Eighteenth day of May 1948.

J. Wells
Registrar General.

Attention is hereby directed to the provisions of Sec. 272 of the Crown Lands Consolidation Act, 1913, relating to transfer.

No. D&W 6568 CAVEAT dated 7th June, 1948 by the Registrar General.
Regulation 222 A under the Crown Lands Consolidation Act, 1913.
Produced and entered 9th June 1948 at 28 mts pt 3 o'clock in the after noon.

J. Wells
REGISTRAR GENERAL.

The within Caveat No. D&W 568 is hereby withdrawn
Dated 5th April 1951

J. Wells
REGISTRAR GENERAL

No. F403980 TRANSFER dated 9th February 1951 from the said Rural Bank of New South Wales to Frederick William Cummins of Black Head near Gosford, Dairy Farmer of the land within described
Produced 27th February 1951 and entered 5th April 1951 at 12 o'clock in the noon.

J. Wells
REGISTRAR GENERAL

No. F403982 TRANSFER dated 27th February 1951 from the said Frederick William Cummins to Frederick Thomas Beddows of Halliday Point near Forster, Farmer of the land within described
Produced 27th February 1951 and entered 5th April 1951 at 12 o'clock in the noon.

J. Wells
REGISTRAR GENERAL

No. F403982 MORTGAGE dated 9th February 1951 from the said Frederick Thomas Beddows to RURAL BANK OF NEW SOUTH WALES
Produced and entered 27th February 1951 and entered at 12 o'clock in the noon.

J. Wells
REGISTRAR GENERAL.

MORTGAGE No. F403982 has been discharged.
See H956825 Entered 3rd January 1962.

Jan Watson
REGISTRAR GENERAL

Esme Madge Beddows of Mosman, Widow and John Williams Ormsby Martin of Burrell Creek, Farmer, are now the registered proprietors of the land within described.
as joint tenants
See Section 94 Application No. H956826
Entered 3rd January 1962.

Jan Watson
REGISTRAR GENERAL

No. H956827 CAVEAT by the Registrar General
Entered 3rd January 1962.

Jan Watson
REGISTRAR GENERAL

This deed is cancelled as to Whole
New Certificates of Title have issued for Lots 1 & 2 in Deposited Plan No. 500952 as follows:
Lots 1 & 2 Vol. 9381 Fol. 59 & 60 respectively

Jan Watson
REGISTRAR GENERAL

Appendix B

Field Investigation Logs

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 μm to 2.36 mm
	medium	200 μm to 600 μm
	fine	75 μm to 200 μm

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material — Structure and fabric of parent rock visible.

Residual soil — Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil — Deposited by wind.

Alluvial soil — Deposited by streams and rivers.

Colluvial soil — Deposited on slopes (transported downslope by gravity).

Fill — Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.

Lacustrine soil — Deposited by lakes.

Marine soil — Deposited in ocean basins, bays, beaches and estuaries.

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Soil Description Explanation Sheet (2 of 2)

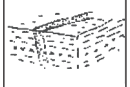
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAIINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms roch substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbrev-iation	Point Load Index, I_S50 (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

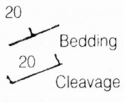
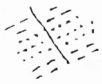
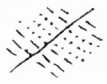
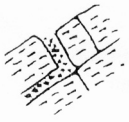
Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

coffey

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

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Engineering Log - Excavation

Excavation No. **TP12**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 5.5

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N						CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, brown, some organics (rootlets), trace Sand, fine grained.	>Wp	St	×	TOPSOIL
				U_{50} Bs	5.0	0.5		CH	**CLAY:** medium to high plasticity, pale grey with red and pale brown mottling, some Sand, fine to medium grained, trace organics (roots) and Silt.		VSt	×	COLLUVIAL
			►		4.5	1.0		CH	**Sandy CLAY:** low to medium plasticity, grey, trace Silt and organics (roots).		St	×	ALLUVIAL
					4.0	1.5		SP	**Clayey SAND:** fine to medium grained, pale brown/yellow, some Silt.	W		×	ALLUVIAL
					3.5	2.0			TP12 terminated due to collapse Test pit TP12 terminated at 1.8m				
					3.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP11**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 23.25

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N	None observed					ML	**TOPSOIL:** SILT, brown, some organics (rootlets) and Sand, fine grained.	<Wp	H		TOPSOIL
				U_{50} and Bs	23.0	0.5		CH	**CLAY:** high plasticity, red, trace Silt and Gravel, fine grained.	>Wp		550	RESIDUAL
					22.5			CH	**Silty CLAY, medium to high plasticity, pale grey with orange/brown mottling, trace Sand, fine grained.**				RESIDUAL (EXTREMELY WEATHERED SILTY SANDSTONE)
						1.0			**Silty SANDSTONE:** coarse grained, orange/brown with grey mottling, slightly weathered, some Clay, low plasticity, and Silt seam.	M	VL	600	RESIDUAL (SLIGHTLY WEATHERED SILTY SANDSTONE) Defect spacing 5-10 mm.
					22.0				TP11 terminated due to refusal. Test pit TP11 terminated at 1.15m				
						1.5							
					21.5								
						2.0							
					21.0								
						2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP10**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 24.25

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N	None observed		24.25	0.0		ML	**TOPSOIL:** SILT, brown, some organics (rootlets), and Sand, fine grained, trace Clay, low plasticity.	<Wp	VSt	×	TOPSOIL/SLOPEWASH
				Bs	24.0			CH	**CLAY:** medium to high plasticity, grey/brown with pale grey and orange/brown mottling, some Sandstone Gravel, subangular and subrounded, trace Silt and organics (roots).	>Wp	H	×	SLOPEWASH/COLLUVIAL
						0.5			**Silty SANDSTONE:** fine grained, orange/brown, some Clay, low plasticity, and Silt seams.	D	VL	600 ×	RESIDUAL SLIGHTLY WEATHERED SANDSTONE Slightly weathered becoming weathered. Defect spacing 5-12 mm.
					23.5	1.0			TP10 terminated due to refusal Test pit TP10 terminated at 0.64m				
					23.0	1.5							
					22.5	2.0							
					22.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP9**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 15.5

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N	None observed					ML	**TOPSOIL:** Silt, brown, some organics (rootlets), Sand, fine grained, and Clay, low plasticity.	<Wp	H		TOPSOIL
				Bs	15.0	0.5		CH	**CLAY:** medium to high plasticity, pale brown with red/orange and yellow mottling, some Sandstone Gravel, fine to medium grained, subrounded and subangular, and Silt.	>Wp		600	SLOPEWASH/COLLUVIAL
									Silty SANDSTONE: medium grained, pale grey with orange/brown and green/blue mottling, some Clay, low plasticity, and Silt seams, trace organics (rootlets).		VSt / VL		RESIDUAL Extremely weathered becoming slightly weathered
					14.5	1.0			TP9 terminated due to refusal Test pit TP9 terminated at 0.9m				
					14.0	1.5							
					13.5	2.0							
					13.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP8**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***23.9.2008***

Principal:

Date completed: ***23.9.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 14.75

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N	None observed		14.5	0.0		CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, dark grey, some organics (rootlets), and Gravel, fine to medium grained, subangular.	>Wp	VSt	×	TOPSOIL
				Bs U_{50}		0.5		CH	**CLAY:** high plasticity, red/brown with pale brown mottling, trace organics (rootlets) and Gravel, fine grained, subangular.			×	RESIDUAL
					14.0			CH	**Gravelly CLAY:** high plasticity, pale grey with orange brown mottling, Gravel, subangular.		H	× 600	RESIDUAL
					13.5	1.0			TP8 terminated due to refusal Test pit TP8 terminated at 0.9m				
					13.0	1.5							
					12.5	2.0							
						2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP7**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 10.5

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
BH		N	None observed					ML	**TOPSOIL:** Clayey SILT, brown, some organics (rootlets), trace Sand, fine grained.	<Wp	H	×	TOPSOIL
				Env Bs	10.0	0.5		CH	**CLAY:** medium to high plasticity, pale brown, trace Gravel, fine grained, subangular, and Silt.	>Wp		×	COLLUVIAL
				U_{50}	9.5	1.0		CH	**CLAY:** high plasticity, pale brown/grey with red mottling, trace Sand, medium grained, and Silt.		VSt	×	RESIDUAL
					9.0	1.5		CL	**Silty CLAY:** low to medium plasticity, orange/brown, some Sand, fine to medium grained, trace Gravel, medium grained, subangular.	<Wp	H	×	RESIDUAL
								SAST	**Silty SANDSTONE:** medium to coarse grained, slightly weathered, some Sandstone Gravel, medium grained, subangular, trace iron staining.	D	VL	600 ×	
					8.5	2.0			TP7 terminated due to refusal. Test pit TP7 terminated at 1.79m				
					8.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration (1 2 3 4)
- no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP6**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***23.9.2008***

Principal:

Date completed: ***23.9.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 8.5

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information					material substance							
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N	None observed					ML	**TOPSOIL:** Clayey SILT, low plasticity, grey/brown, some organics (rootlets), trace Sand, fine grained.	<Wp	H	600	TOPSOIL
				Bs U_{50}	8.0	0.5		CH	**CLAY:** medium to high plasticity, grey with orange/red mottling, some organics (roots), trace Gravel, fine grained, subrounded.	>Wp	H/Fb	600	RESIDUAL
					7.5	1.0						600	
					7.0	1.5		CH	**CLAY:** high plasticity, orange/red with grey mottling, some Gravel, fine to medium grained, subrounded, trace organics (roots) and Silt.		H	600	RESIDUAL
					6.5	2.0			Test pit TP6 terminated at 1.85m				
					6.0	2.5							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP5**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface:

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N			0.0		CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, brown, some organics (rootlets), trace Sand, fine grained.	>Wp	H	×	TOPSOIL
					0.5		CH	**CLAY:** high plasticity, pale brown with grey mottling, trace Sand, fine grained, Silt and organics (roots).		VSt	×	COLLUVIAL
					1.0		CH	**CLAY:** medium to high plasticity, pale grey with red and pale brown mottling, some Sand, fine to medium grained, trace organics (roots), and Silt.			×	COLLUVIAL
			►		1.5		CL	**Sandy CLAY:** low to medium plasticity, grey, trace Silt and organics (roots).			×	ALLUVIAL
					2.0			Test pit TP5 terminated at 2.1m				
					2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **TP4**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 9.25

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
BH		N	None observed		9.0	0.5		CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, brown/grey, some organics (rootlets), trace Sand, fine grained.	<Wp	H	550	TOPSOIL
				Bs	8.5			CH	**CLAY:** medium to high plasticity, pale brown/brown, trace organics (rootlets) and Gravel, fine , subrounded.	Wp			COLLUVIAL
				U_{50}	8.0	1.0		CH	**CLAY:** high plasticity, pale grey with red mottling, trace Sand, coarse grained, and Gravel, fine grained, subangular.	>Wp	VSt		RESIDUAL
					7.5	1.5		CH	**CLAY:** high plasticity, pale grey/brown, with orange/brown mottling, some Gravel, fine to medium grained, subangular, (Sandstone/Siltstone), trace Sand, medium grained and organics (roots).				RESIDUAL (EXTREMELY WEATHERED SILTSTONE/SANDSTONE)
					7.0	2.0			Test pit TP4 terminated at 2.1m				
						2.5							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Excavation

Excavation No. **BH3**

Sheet 1 of 2

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **25.8.2008**

Principal:

Date completed: **25.8.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 6.5

excavation dimensions: m long m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
AST		N	None observed					CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, dark brown, some organics (rootlets), trace Sand, fine grained.	>Wp	F		TOPSOIL
				E				CH	**CLAY:** medium to high plasticity, brown.		St		ALLUVIAL
				E	6.0	0.5		CH	**CLAY:** high plasticity, red/orange with grey mottling.		VSt		RESIDUAL
				E	5.5	1.0		CH	**CLAY:** high plasticity, pale grey with brown mottling, trace Gravel, fine grained.		VSt-H		
				E	5.0	1.5							
				E	4.5	2.0		CH	**CLAY:** high plasticity, blue/grey with aple brown mottling, trace Silt.		VSt		
				E	4.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **BH3**

Sheet 2 of 2

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***25.8.2008***

Principal:

Date completed: ***25.8.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 6.5

excavation dimensions: m long m wide | Northing: m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
AST				E	3.5 / 3.0		CH	**CLAY:** high plasticity, pale blue/grey, some Silt, trace Gravel, fine grained, angular.	>Wp	H		RESIDUAL Note: Moisture Content increasing.
				E	3.0 / 3.5		CH	**CLAY:** high plasticity, pale grey with pale brown mottling, Trace Gravel, fine grained and Silt.		VSt		
					2.5 / 4.0		CH	**CLAY:** high plasticity, pale grey, trace Silt, and Gravel, fine grained.				
				E	2.0 / 4.5		CH	**CLAY:** high plasticity, pale grey with green mottling, trace Silt.				
				E	1.5 / 5.0			Test pit BH3 terminated at 5m				

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **BH2**

Sheet 1 of 2

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***25.8.2008***

Principal:

Date completed: ***25.8.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 5.5

excavation dimensions: m long m wide | Northing: m | datum:

excavation information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
AST		N						CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, dark grey/brown, some organics (rootlets), trace Sand, medium grained.	>Wp	S		TOPSOIL
				E	5.0	0.5		CL	**Silty CLAY:** low to medium plasticity, dark grey/brown, some organics (rootlets).				ALLUVIAL
				E	4.5	1.0		CH	**CLAY:** medium to high plasticity, brown with pale brown/orange mottling, trace Silt.				
				E	4.0	1.5		CH	**Sandy CLAY:** medium to high plasticity, dark grey.		F		
			▶	E	3.5	2.0		SP	**SAND:** fine to medium grained, dark brown, trace organics and shell grit.	W	L		
				E	3.0	2.5							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **BH2**

Sheet 2 of 2

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **25.8.2008**

Principal:

Date completed: **25.8.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 5.5

excavation dimensions: m long m wide | Northing: m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
					2.5 / 3.0			BH2 terminated due to collapse Test pit BH2 terminated at 2.5m				
					2.0 / 3.5							
					1.5 / 4.0							
					1.0 / 4.5							
					0.5 / 5.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **BH1**

Sheet 1 of 2

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***25.8.2008***

Principal:

Date completed: ***25.8.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 5.0

excavation dimensions: m long m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
AST		Nil		E				CH	**Sandy CLAY:**medium to high plasticity, brown/grey, some organics (rootlets).	>Wp	VSt		ALLUVIAL
				E	4.5	0.5		CH	**Sandy CLAY:**medium to high plasticity, pale grey.				
				E	4.0	1.0		SP	**Clayey SAND:**Fine to medium grained, orange/brown.	M	M-MD		
			▶	E	3.5	1.5		SP	**Clayey SAND:**fine to medium grained, pale brown, some Gravel, fine grained, rounded.	W	D		
				E	3.0	2.0		SP	**Clayey SAND:**fine to medium grained, pale brown, trace Gravel, fine grained. Note - interbedded Sand and Clay.		D-MD		
				E	2.5	2.5							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **BH1**

Sheet 2 of 2

Project No: **GEOTTUNC01754AC**

Client: ***OROGEN PTY LTD***

Date started: ***25.8.2008***

Principal:

Date completed: ***25.8.2008***

Project: ***PROPOSED SUBDIVISION, DIAMOND BEACH ROAD***

Logged by: ***PE***

Test pit location: ***Refer to Figure***

Checked by: ***TLM***

equipment type and model: | Pit Orientation: | Easting: m | R.L. Surface: 5.0

excavation dimensions: m long m wide | Northing: m | datum:

excavation information					material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
AST				E	2.0	3.0		CH	**CLAY:** medium to high plasticity, grey/blue, with some Sand, fine to medium grained.	>Wp	VSt		ALLUVIAL
									Test pit BH1 terminated at 3m				
					1.5	3.5							
					1.0	4.0							
					0.5	4.5							
					0.0	5.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP13**

Sheet 1 of 1

Project No: **GEOTTUNC01754AC**

Client: **OROGEN PTY LTD**

Date started: **23.9.2008**

Principal:

Date completed: **23.9.2008**

Project: **PROPOSED SUBDIVISION, DIAMOND BEACH ROAD**

Logged by: **PE**

Test pit location: **Refer to Figure**

Checked by: **TLM**

equipment type and model: Mini Excavator | Pit Orientation: | Easting: m | R.L. Surface: 6.0

excavation dimensions: 2m long 1m wide | Northing: m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N						CL	**TOPSOIL:** Silty CLAY, low to medium plasticity, brown, some organics (rootlets), trace Sand, fine grained.	>Wp	H	×	TOPSOIL
				Bs	5.5	0.5		CH	**CLAY:** high plasticity, pale brown with grey mottling, trace Sand, fine grained, Silt and organics (roots).		VSt	×	COLLUVIAL
					5.0	1.0		CH	**CLAY:** medium to high plasticity, pale grey with red and pale brown mottling, some Sand, fine to medium grained, trace organics (roots) and Silt.			×	ALLUVIAL
					4.5	1.5		CL	**Sandy CLAY:** low to medium plasticity, grey, trace Silt, and organics (roots).			×	
			▶					SP	**Clayey SAND:** fine to medium grained, grey.	M		×	
					4.0	2.0		SP	**SAND:** fine to medium grained, pale brown/grey, some Clay, low plasticity.	W		×	Note: Possible Sand and Clay lense.
					3.5	2.5			Test pit TP13 terminated at 2.1m				

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
V	vane shear (kPa)
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TESTPIT GEOTTUNC01754AC LOGS.GPJ COFFEY.GDT 25.11.08

Form GEO 5.2 Issue 3 Rev.2

Appendix C

Laboratory Testing Results

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 1 of 1)

1 sample supplied by Coffey Tuncurry on 26th September, 2008 - Lab. Job No. A0361

Analysis requested by Paul Edmed. - **Your Job Number: Tunc01754AA Purchase Order Number: 08337**

Sample Site	Depth (m)	EAL lab code	Texture (note 6)	Moisture Content (% moisture)	Lab. Bulk Density tonne DW/m^3	TAA pH_{kcl}	Titratable Actual Acidity (TAA) mole H^+/tonne (to pH 6.5)	Reduced Inorganic Sulfur (% chromium reducible S) (%Scr) (note 2)	Reduced Inorganic Sulfur (Scr) mole H^+/tonne	NET ACIDITY Chromium Suite mole H^+/tonne (based on %Scrs)	LIME CALCULATION Chromium Suite kg $CaCO_3/m^3$ (includes 1.5 safety Factor)
Method No.						*23A*	*23F*	*22B*	*a- 22B*	*note 5*	*note 5*
BH 2	**1.5 - 2.0**	*A0361/1*	Coarse	17.9	1.5	5.17	22	<0.005	0	22	3

NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (Scr - Method 22B)

3 - Methods from Ahern, CR, McElnea AE , Sullivan LA (2004). ***Acid Sulfate Soils Laboratory Methods Guidelines.*** QLD DNRME.

4 - Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5 - **ABA Equation: Net Acidity = Potential Sulfidic Acidity (ie. Scrs or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF (with FF currently defaulted to 1.5)**

6 - The neutralising requirement, lime calculation, includes a 1.5 safety margin for acid neutralisation (an increased safety factor may be required in some cases)

7 - For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays

8 - .. denotes not requested or required

9 - SCREENING, CRS, TAA and ANC are NATA certified but other SPOCAS segments are currently not NATA certification

10- Results at or below detection limits are replaced with '0' for calculation purposes.

11 - Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply (refer to acid sulfate management guidelines).

(Classification of potential acid sulfate material if: coarse Scr≥0.03%S or 19mole H+/t; medium Scr≥0.06%S or 37mole H+/t; fine Scr≥0.1%S or 62mole H+/t)

NATA
WORLD RECOGNISED ACCREDITATION
Lab.Accred.No.:14960
This Document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IES 17025

checked: .....

Department of Lands

Land Administration & Management
Property & Spatial Information

Paul Edmed
Coffey Geotechnics
1 / 4 Douglas Avenue
Tuncurry NSW 2428

Soil Conservation Service
Scone Research Centre
709 Gundy Road
PO Box 283
Scone NSW 2337
Telephone: (02) 6545 1666
Facsimile: (02) 6545 2520
www.lands.nsw.gov.au

14 October 2008

SCO08/393

Dear Paul Edmed

Analysis of two soil samples – Job No: TUNC01754AA

The analysis of two soil samples (Job No: TUNC01754AA) has been completed (Soil test report SCO08/393R1). These samples were analysed for: particle size (clay, silt, very fine sand, coarse fine sand, coarse sand and gravel); dispersion percentage (D%); Emerson aggregate test (EAT); particle size-mechanical dispersion (clay, silt, very fine sand, coarse fine sand, coarse sand and gravel); and organic carbon (OC).

The soil erodibility factor (K factor) has been determined using the particle size analysis-mechanical dispersion (P7C/1) and organic carbon (OC) (as described by Rosewell 1993). The surface soil structure was assumed to be fine or medium granular and the profile permeability was assumed to be moderate or moderate to slow.

Lab No	Sample Id	K factor	Rating
1	TP11 0.2-0.3m	0.068	Very high
2	TP13 0.4-0.5m	0.033	Moderate

This interpretation was based on the sample supplied being representative, and literature guidelines. If you have any queries, please contact me on (02) 6545 1666.

Yours sincerely

SR Young
Laboratory Manager
Scone Research Centre

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No: SCO08/393R1
Client Reference: P Edmed
Coffey Geotechnics
1 / 4 Douglas Avenue
Tuncurry NSW 2428

Lab No	Method	P7B/1 Particle Size Analysis (%)						P8A/2	P9B/2
	Sample Id	clay	silt	vf sand	cf sand	c sand	gravel	D%	EAT
1	TP11 0.2-0.3m	74	12	4	3	5	2	5	6
2	TP13 0.4-0.5m	34	25	10	6	25	<1	33	3(1)

Lab No	Method	P7C/1 Particle Size Analysis- mechanical dispersion (%)						C6A/2
	Sample Id	clay	silt	vf sand	cf sand	c sand	gravel	OC (%)
1	TP11 0.2-0.3m	3	42	26	10	17	2	0.76
2	TP13 0.4-0.5m	30	29	10	7	24	<1	0.53

END OF TEST REPORT

Department of Lands

Land Administration & Management
Property & Spatial Information

Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO08/393R1
REPORT TO:	P Edmed Coffey Geotechnics 1 / 4 Douglas Avenue Tuncurry NSW 2428
REPORT ON:	Two soil samples Job No: TUNC01754AA
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	9 October 2008
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED

G Holman
(Technical Officer)

Scone Research Centre, PO Box 283 Scone 2337, 709 Gundy Road Scone 2337
Ph: 02 6545 1666, Fax: 02 6545 2520

Appendix D

Results of Permeability Testing

CLIENT: Orogen
PROJECT: Proposed Subdivision
LOCATION: Lot 6 Diamond Beach Road, Diamond Beach
SUBJECT: Falling Head Permeability Testing
JOB NO: GEOTTUNC01754AA

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Borehole Number **BH2**

The method of calculation is outlined in BS5930:1999

Borehole/casing diameter	0.05	m
Elevation at borehole location	5.50	m,RL

Depth below top of casing/standpipe to:

bottom of borehole	2.05	m
bottom of casing	2.05	m
height of casing above surface	0.15	m
initial ground water level	0.43	m

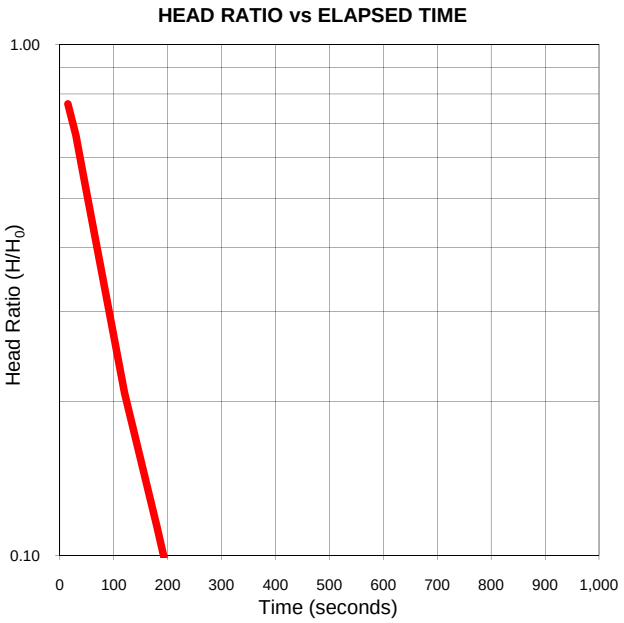
$$k = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

where:
k = permeability of the soil
A = cross-sectional area of borehole or casing (m^2).
F = intake factor (refer to chart)
H_1 = variable head at time t_1
H_2 = variable head at time t_2

Intake Factor Case (b)

No.	Time (mins)	Time (secs)	Depth (m)	Water Level	Head (m)	H/H_0	k (m/s) (from H_0)	k (m/s) (previous)
1	0.0	0	1.92	3.73	-1.49	-3.47		
2	0.3	15	1.57	4.08	-1.14	0.77	2.55E-04	2.55E-04
3	0.5	30	1.42	4.23	-0.99	0.66	1.95E-04	1.34E-04
4	0.8	45	1.24	4.41	-0.81	0.54	1.93E-04	1.91E-04
5	1.0	60	1.10	4.55	-0.67	0.45	1.90E-04	1.81E-04
6	2.0	120	0.74	4.91	-0.31	0.21	1.87E-04	1.83E-04
7	3.0	180	0.60	5.05	-0.17	0.11	1.72E-04	1.43E-04
8	4.0	240	0.52	5.13	-0.09	0.06	1.67E-04	1.51E-04
9	6.0	360	0.47	5.18	-0.04	0.03	1.43E-04	9.65E-05
10	8.0	480	0.46	5.19	-0.03	0.02	1.16E-04	3.42E-05
11	10.0	600	0.45	5.20	-0.02	0.01	1.03E-04	4.83E-05
12	15.0	900	0.43	5.22	0.00	0.00	#DIV/0!	#DIV/0!

Length of open hole (m)	0.00
Depth of soil in casing (m)	1.90
Cross-sectional area (m^2)	1.96E-03
Groundwater level (m)	5.2
Intake Factor	0.1375



Permeability Calculations

Case	Range	k (m/s)
1	1 - 11	1.0E-04
2	1 - 5	1.9E-04
3	5 - 10	1.1E-04
4	6 - 11	8.2E-05

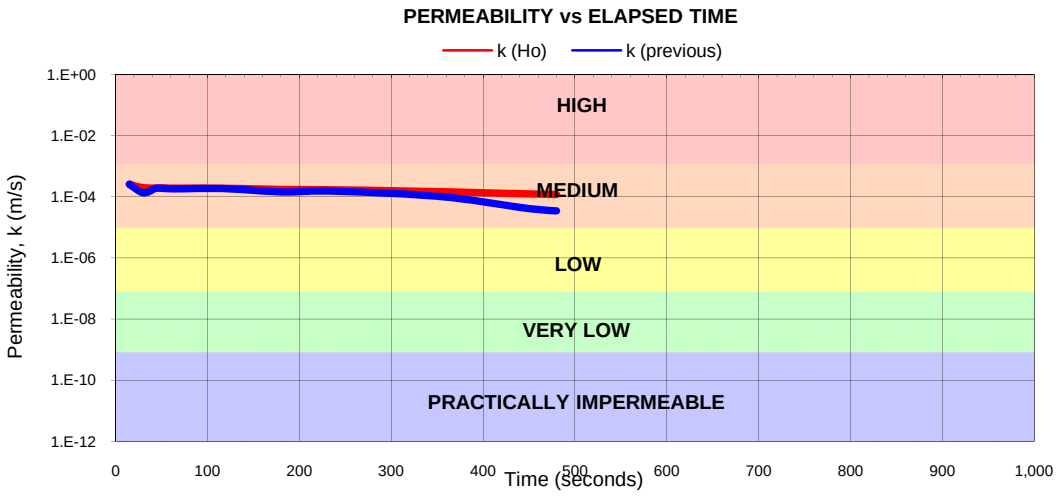


FIGURE 2

CLIENT: Orogen
PROJECT: Proposed Subdivision
LOCATION: Lot 6 Diamond Beach Road, Diamond Beach
SUBJECT: Falling Head Permeability Testing
JOB NO: GEOTTUNC01754AA

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Borehole Number **BH1**

The method of calculation is outlined in BS5930:1999

Borehole/casing diameter	0.05	m
Elevation at borehole location	5.00	m,RL

Depth below top of casing/standpipe to:

bottom of borehole	2.97	m
bottom of casing	2.97	m
height of casing above surface	0.23	m
initial ground water level	0.71	m

$$k = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

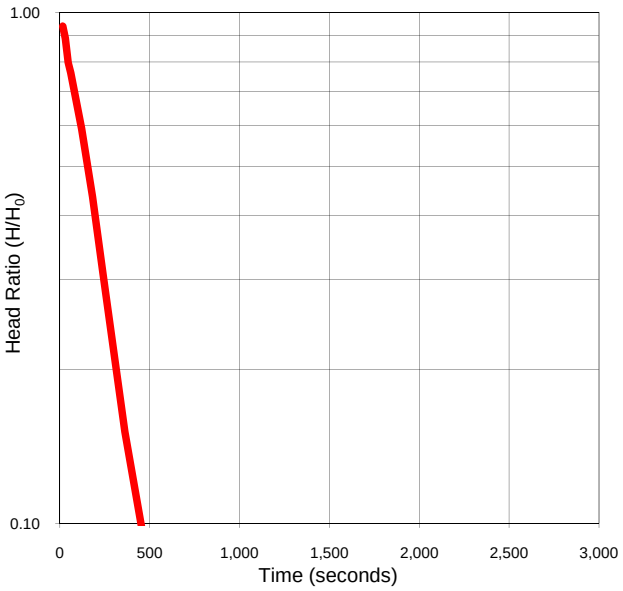
where:
k = permeability of the soil
A = cross-sectional area of borehole or casing (m^2).
F = intake factor (refer to chart)
H_1 = variable head at time t_1
H_2 = variable head at time t_2

Intake Factor Case (b)

No.	Time (mins)	Time (secs)	Depth (m)	Water Level	Head (m)	H/H_0	k (m/s) (from H_0)	k (m/s) (previous)
1	0.0	0	2.89	2.34	-2.18	-3.07		
2	0.3	15	2.76	2.47	-2.05	0.94	5.85E-05	5.85E-05
3	0.5	30	2.65	2.58	-1.94	0.89	5.55E-05	5.25E-05
4	0.8	45	2.45	2.78	-1.74	0.80	7.15E-05	1.04E-04
5	1.0	60	2.37	2.86	-1.66	0.76	6.49E-05	4.48E-05
6	2.0	120	2.00	3.23	-1.29	0.59	6.24E-05	6.00E-05
7	3.0	180	1.66	3.57	-0.95	0.44	6.59E-05	7.28E-05
8	4.0	240	1.38	3.85	-0.67	0.31	7.02E-05	8.31E-05
9	6.0	360	1.04	4.19	-0.33	0.15	7.49E-05	8.43E-05
10	8.0	480	0.90	4.33	-0.19	0.09	7.26E-05	6.57E-05
11	10.0	600	0.78	4.45	-0.07	0.03	8.18E-05	1.19E-04
12	15.0	900	0.76	4.47	-0.05	0.02	5.99E-05	1.60E-05
13	20.0	1200	0.74	4.49	-0.03	0.01	5.10E-05	2.43E-05
14	25.0	1500	0.73	4.50	-0.02	0.01	4.47E-05	1.93E-05
15	30.0	1800	0.72	4.51	-0.01	0.00	4.27E-05	3.30E-05
16	45.0	2700	0.72	4.51	-0.01	0.00	2.85E-05	0.00E+00

Length of open hole (m)	0.00
Depth of soil in casing (m)	2.74
Cross-sectional area (m^2)	1.96E-03
Groundwater level (m)	4.5
Intake Factor	0.1375

HEAD RATIO vs ELAPSED TIME



Permeability Calculations

Case	Range	k (m/s)
1	1 - 16	2.8E-05
2	1 - 5	6.5E-05
3	5 - 10	7.4E-05
4	6 - 12	6.0E-05

PERMEABILITY vs ELAPSED TIME

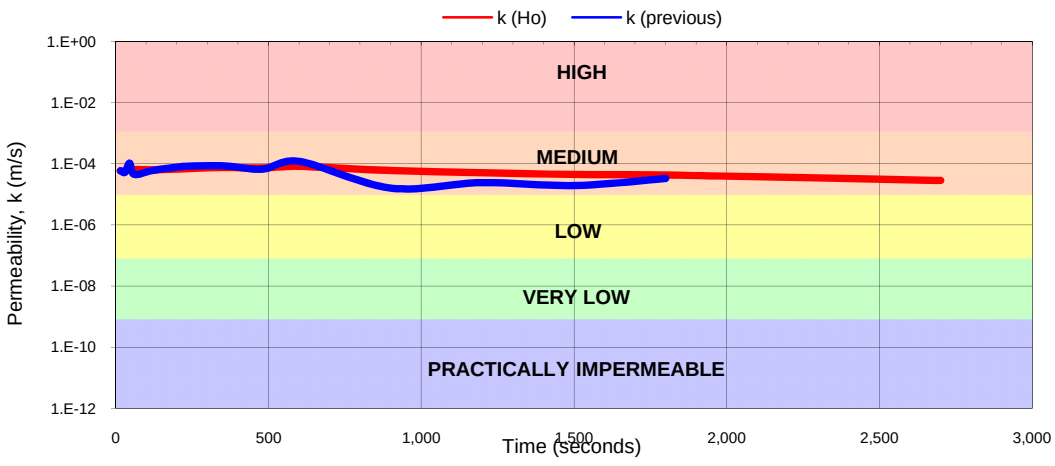


FIGURE 1

CLIENT: Orogen
PROJECT: Proposed Subdivision
LOCATION: Lot 6 Diamond Beach Road, Diamond Beach
SUBJECT: Falling Head Permeability Testing
JOB NO: GEOTTUNC01754AA

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Borehole Number BH3

The method of calculation is outlined in BS5930:1999

Borehole/casing diameter	0.05	m
Elevation at borehole location	6.75	m,RL

$$k = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

where:
k = permeability of the soil
A = cross-sectional area of borehole or casing (m^2).
F = intake factor (refer to chart)
H_1 = variable head at time t_1
H_2 = variable head at time t_2

Depth below top of casing/standpipe to:

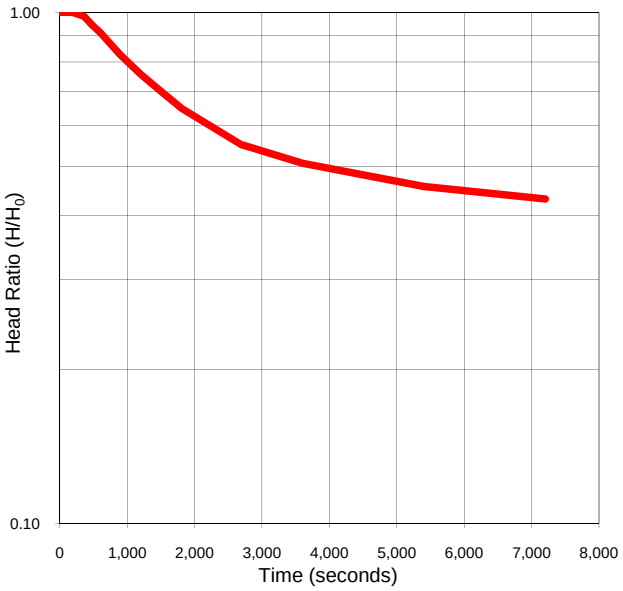
bottom of borehole	2	m
bottom of casing	2	m
height of casing above surface	0.88	m
initial ground water level	1.12	m

Intake Factor Case (b)

No.	Time (mins)	Time (secs)	Depth (m)	Water Level	Head (m)	H/H_0	k (m/s) (from H_0)	k (m/s) (previous)
1	0.0	0	2.72	4.91	-1.60	-1.43		
2	0.3	15	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
3	0.5	30	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
4	0.8	45	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
5	1.0	60	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
6	2.0	120	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
7	3.0	180	2.72	4.91	-1.60	1.00	0.00E+00	0.00E+00
8	4.0	240	2.71	4.92	-1.59	0.99	3.73E-07	1.49E-06
9	6.0	360	2.69	4.94	-1.57	0.98	7.51E-07	1.51E-06
10	8.0	480	2.63	5.00	-1.51	0.94	1.72E-06	4.64E-06
11	10.0	600	2.58	5.05	-1.46	0.91	2.18E-06	4.01E-06
12	15.0	900	2.44	5.19	-1.32	0.83	3.05E-06	4.80E-06
13	20.0	1200	2.33	5.30	-1.21	0.76	3.32E-06	4.14E-06
14	25.0	1500	2.24	5.39	-1.12	0.70	3.40E-06	3.68E-06
15	30.0	1800	2.16	5.47	-1.04	0.65	3.42E-06	3.53E-06
16	45.0	2700	2.00	5.63	-0.88	0.55	3.16E-06	2.65E-06
17	60.0	3600	1.93	5.70	-0.81	0.51	2.70E-06	1.32E-06
18	90.0	5400	1.85	5.78	-0.73	0.46	2.08E-06	8.25E-07
19	120.0	7200	1.81	5.82	-0.69	0.43	1.67E-06	4.47E-07

Length of open hole (m)	0.00
Depth of soil in casing (m)	1.12
Cross-sectional area (m^2)	1.96E-03
Groundwater level (m)	6.5
Intake Factor	0.1375

HEAD RATIO vs ELAPSED TIME



Permeability Calculations

Case	Range	k (m/s)
1	1 - 19	1.7E-06
2	1 - 5	0.0E+00
3	7 - 14	3.9E-06
4	7 - 19	1.7E-06

PERMEABILITY vs ELAPSED TIME