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CHARTERED ENGINEERS (AUSTRALIA)

A.B.N. 29 001 266 271

P.O. Box J 159, Coffs Harbour Jetty, 2450
40 Rippingale Road, Korora, 2450

Phone / fax (02) 6653 6457

28th August 2003
(034 135B)

GEOTECHNICAL ASSESSMENT FOR
PROPOSED RESIDENTIAL DEVELOPMENT
AT HEARNS LAKE - WOOLGOOLGA

C O N T E N T S

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INTRODUCTION

The following Report has been prepared at the request of Resource Design Management Pty. Ltd. on behalf of B.B.K. Development Corporation, to accompany the rezoning application for the subject lands, being Lot 4, DP 612977, Lot 21 DP 714858 and Lot 32 DP 1047234, Parish of Woolgoolga, County Fitzroy.

This Report addresses the geotechnical aspects of the land in relation to residential development.

SUMMARY

This investigation concludes that the land is generally suitable for residential development from a geotechnical point of view, provided the indicated constraints are satisfactorily addressed.

The Report indicates constraints under five headings, as :-

1) Drainage
2) Wet and Soft Ground
3) Existing Excavations
4) Low Risk Steep Ground
5) Moderate Risk Steep Ground.

These areas are indicated on the attached Site Plan, as Zone D, W., P, L and M respectively.

Preliminary Geotechnical Assessment
Hearns Lake, Woolgoolga

THE SITE

The site consists of Lots 4, 21 and 32 located on the southern side of the industrial area and extending from the Pacific Highway to the coast. The topography is dominated by a broad ridge line, up to twenty metres high, running from the industrial area through the site to the coast, ending in a steep escarpment. This drops into a back swamp lagoon behind the frontal dune.

There is a broad, low lying, poorly drained valley on the southern side of the ridge line. This valley runs into Hearns Lake which lies to the south of the site. The lower reaches of this valley contain a large farm dam, with a two metre high wall, and low wet swampy terrain.

Apart from these wet areas, the land has been cleared for a long time and is grassed, with scattered timber.

The eastern end has been used for grazing and there was formerly a caravan park adjacent to the Highway. Some access roads and several buildings remain on this site, together with ground slabs from former ablution blocks and relevant underground services.

A number of open drains and levees have been constructed in order to control runoff from the west and to maintain the valley floor as a viable Caravan Park.

The underlying bedrock of this area is a metamorphic greywacke complex from the Coramba Beds. In this area, harder beds form the ridge lines with softer beds being eroded to form the gully lines. The beds have been distorted and fractured by the tectonic upheavals which have given rise to the metamorphous of the original sedimentary rocks.

Because of the fractured nature of the bedrock, high rainfall and humidity, weathering frequently extends deep into the soil profile, so that hard rock is rarely encountered in typical residential development and construction.

Preliminary Geotechnical Assessment
Hearns Lake, Woolgoolga

POSSIBLE CONTAMINATION FROM PREVIOUS LAND USE

Most of the land has been used for grazing purposes, which is not considered to pose any significant risk of contamination to the soil.

The Coffs Harbour City Council mapping of former banana plantations indicates that there have been no banana plantations to the east of the Pacific Highway in this area.

On Lot 4 (the former Caravan park) there are a number of excavations, several of which appear to have been used as repositories for old car bodies, timber, building rubbish and the like, which will have to be cleaned out before reinstatement is undertaken.

In addition, there are three overgrown ponds which were used as polishing ponds for the effluent from the Caravan park treatment works. These will also have to be cleaned out before reinstatement is undertaken.

These areas are identified as Zone 'P' on the attached Plan.

Acid Sulphate Soils

The Soil Conservation Service 1:25000 Moonee Beach Map identifies the back swamp lagoon at the eastern extremity of the site as an estuarine swamp with a high probability of acid sulphate soils occurring within a metre of the surface.

It is understood that this area will be retained as a wetland area, and hence, as undeveloped land, the occurrence of acid sulphate soils is irrelevant.

No other potential area of acid sulphate soil are identified by the mapping. However, it appears possible that such soils may be present in the lower area of Lot 32, adjacent to Hearns Lake Road on the southern boundary.

This area is in Zone 'W' (see attached Plan) which is considered to be unsuitable for development because of the poorly drained, low lying nature of the ground. However a sewer pump station is proposed in this area. When the location of the pump station and sewer mains has been determined, appropriate testing should be carried out to confirm whether or not acid sulphate soils will be encountered.

Preliminary Geotechnical Assessment
Hearns Lake, Woolgoolga

Services

Whilst the location and identification of existing services is not specifically covered in this Report, it is noted that a services corridor exists along the Highway Boundary and several overhead power lines service buildings on the property.

Geotechnical Constraints

Generally the site presents suitable land for residential-type development from the geotechnical point of view. The substrata is typically a silty clay derived from the underlying metasediments which occur at relatively shallow depth on the higher ground. These clays are considered to be moderately reactive and warrant a general Site Classification of Class M (A.S. 2870) for residential building work.

On the lower slopes and valley floor, the accumulation of erosion material results in a silty surface layer which readily takes up water becoming wet and soft after a prolonged wet period. Site Classification of such areas is expected to be modified by the development works, which will improve the drainage in these areas.

Excavation work for typical subdivisional development is expected to be generally in silty clays, firm to stiff, with extremely weathered, very weak and fractured claystone being encountered at one to two metres depth. Such material can generally be excavated by large backhoe or excavator to a depth of three metres. Hard rock, requiring a rock breaker, is unlikely to be encountered in typical residential development.

A number of constraints have been identified which should be considered in the development of this site for residential use. These are identified on the attached Plan, as:-

Zone D	Drainage
Zone W	Wet, soft land
Zone P	Existing excavations
Zone L	Low risk steep land
Zone M	Moderate risk steep land.

Zone D, Drainage

The run-off into this area is concentrated by two culverts under the Pacific Highway. One is located near the northern end and the other at the southern end of the boundary. Generally runoff from the Highway has also required the construction of a drain and levee running parallel to the Highway.

The former Caravan Park has attempted to control the runoff passing through this area with open drains.

It will be necessary for the subdivisional development to replicate these drainage works with an appropriate stormwater system. Subsoil drainage along the 'nick' points (where there is a significant change of grade from the hillslope to the valley floor) will be required to intercept ground water discharging at the bottom of the hillslope during wet periods. Such drainage could be required as a separate system, or incorporated into the stormwater lines if appropriate.

Zone W, Wet, Soft Ground

Further downstream from Zone D, the low lying nature of the ground has developed an area which is usually wet and soft with a high water table. The silty nature of the accumulated erosion material makes for poor foundation conditions under existing conditions.

In order to use this area as residential land it will be necessary to undertake significant earthworks, stripping and filling the area with suitable fill so that it can be graded and drained.

The filling will have to be preceded by the removal of the unsuitable surface layer (up to a metre thick) and the laying of geofabric cloth in particularly wet locations.

The filling will also impede the flow of groundwater from the hillside and hence will cause wet ground along the junction of the fill and the hillslope. Suitable drainage works will have to be installed along the line to collect and drain away such ground water.

Preliminary Geotechnical Assessment
Hearns Lake, Woolgoolga

Zone P, Existing Excavations

These areas, located on Lot 4, are excavations which have been dug out to various depths to create a water storage pond, effluent polishing ponds, rubbish dumps and aborted stormwater lines.

These areas should be identified by survey prior to any construction work commencing.

Appropriate documentation should be recorded so that the location of all filled areas are identified for future reference, and so that owners of the affected Lots are aware of these areas. Appropriate foundation design will be required for building works encroaching into these areas.

Suitable contract documentation and supervision of civil works for the development will be required to ensure that all unsuitable material is removed from the excavations and that suitable thoroughly compacted material is used to restore these excavations.

Zone L – Low Risk Steep Land

A steep escarpment has been formed along the former shoreline at the end of the ridge line. The sea eroding the toe of this ridge has caused collapse of the slope to form the steep escarpment. Subsequently, the shoreline has receded from the ridge with the formation of the back swamp and rounding of the escarpment with time.

Weaker beds in the escarpment have slumped, forming the more unstable area of Zone 'M'.

Zone 'L' represents the area which is considered to have a Low Risk of slope instability, and can be used for residential development, provided the good practices of hillside construction are observed.

The consequences of potential sea level rises should also be considered.

Preliminary Geotechnical Investigation
Hearns Lake, Woolgoolga

The subdivisional layout must recognise the limitations imposed by this topography and the following comments apply :-

1) Significant earthworks must be avoided. It will be preferable not to construct public roads in this area. Any access roads will require suitable engineering design to avoid destabilising the slope.

2) Lot layout should, as closely as possible, provide Lots running up and down the slope, with sufficient width so that a minimum two metre building set back from the boundary can be achieved. This set back should be specified.

3) Since excess groundwater is frequently the catalyst for instability, drainage considerations are important, both in the subdivisional development and for the individual Lot development. Service trenches can act as conduits to allow runoff to have ready access into the soil profile. Ponding of water above and on the slope should be avoided and concentrated runoff should be discharged at the toe of the slope.

The attached Appendices indicate the general good practices of hillside construction.

Zone 'M' - Moderate Risk Steep Land

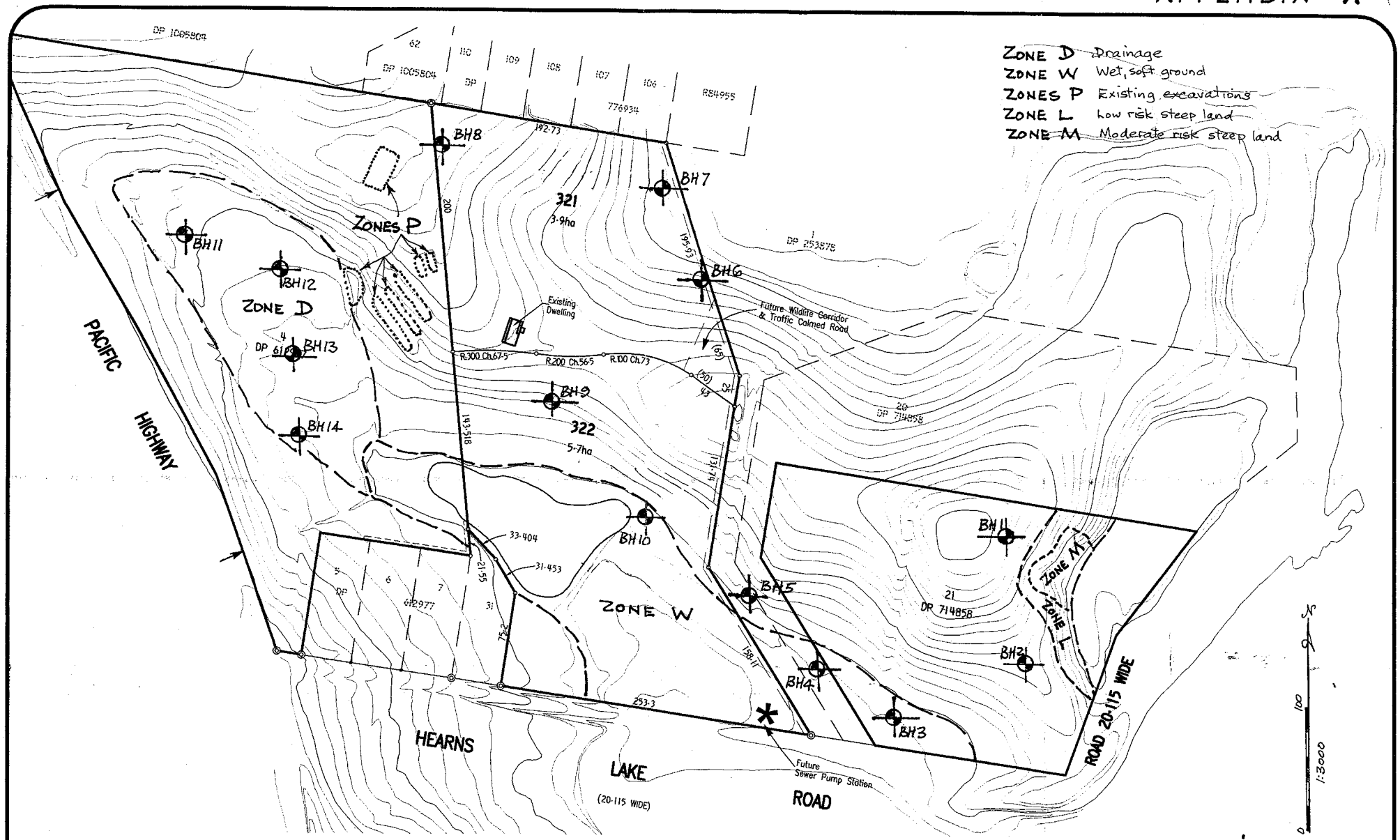
In this area, there is evidence of slumping of the steep slope with the formation of two shallow gully lines in the weaker beds in the rock formation.

This area is considered to have a moderate risk of slope instability and as a result, will require specific investigation of any particular proposed development.

Applying additional loading to the surface mantle must be avoided, and hence it is expected that all structural loads will be supported on deep foundations.

The development of each Lot must be in sympathy with the topography, minimising earthworks and providing appropriate landscaping to stabilise the surface.

W. H. G. Holmes, B.E., FIEAust., CPEng.



RESOURCE DESIGN & MANAGEMENT
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LOCATION OF BOREHOLES AND IDENTIFICATION OF CONSTRAINT ZONES FOR GEOTECHNICAL ASSESSMENT

Aug 03

PROJECT
PROPOSED SUBDIVISION
Lot 32 DP 1047234
Hearns Lake

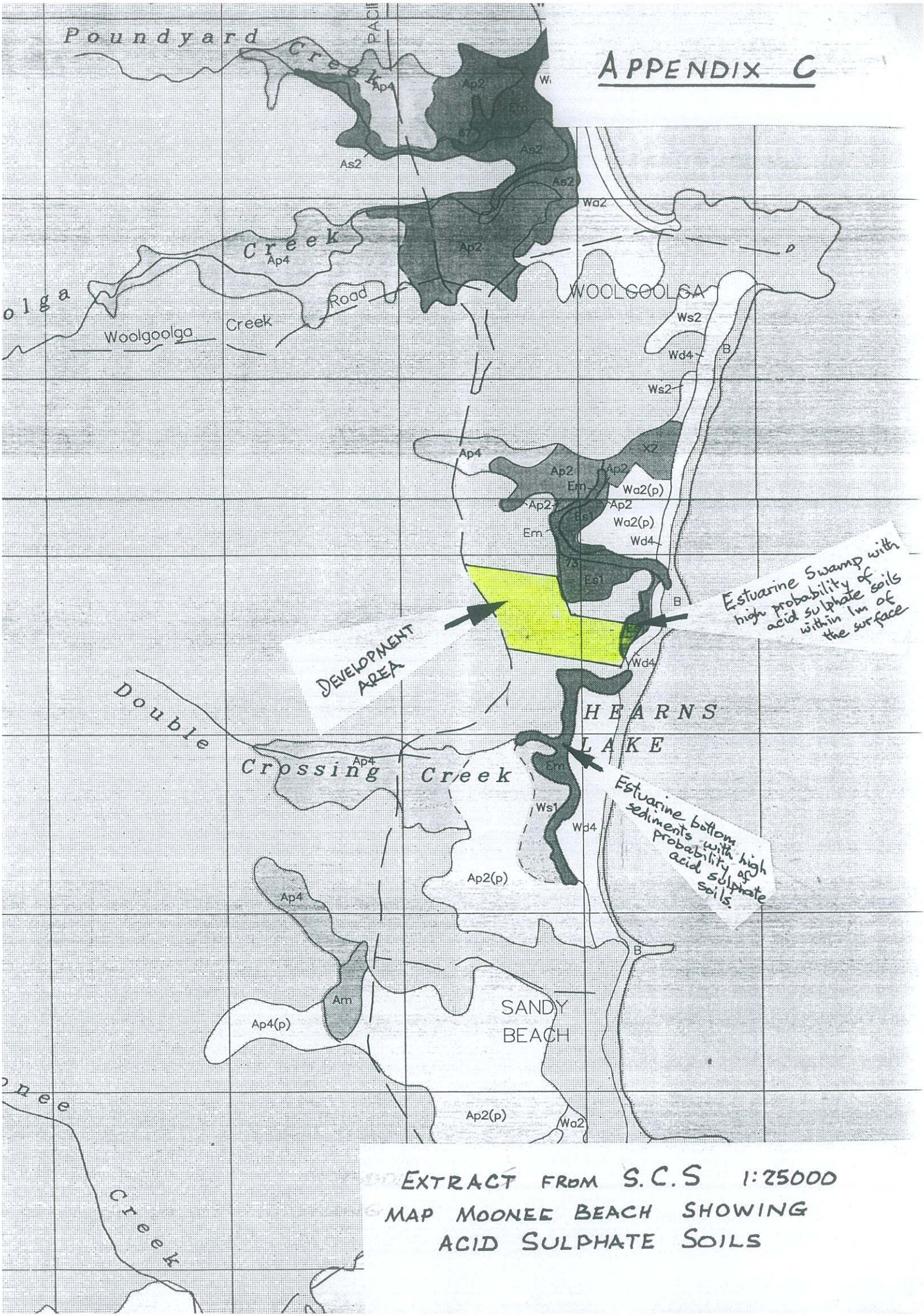
DWG. No. 02031/10 DATE: 19th Feb. 2003
CAD DWG. No. 02031NEW SUBDN

0 20 40 60 80 100metres

APPENDIX B

EXTRACT FROM COFFS HARBOUR COUNCIL'S MAPPING OF FORMER BANANA PLANTATIONS

APPENDIX C



EXTRACT FROM S.C.S 1:25000
MAP MOONEE BEACH SHOWING
ACID SULPHATE SOILS

Looking southwards across Lot 4. Pacific Highway in the rear treeline.

HEARNS LAKE DEVELOPMENT

ZONE D DRAINAGE

View looking westward into the northern end of the Zone slumped slope in centre of photo.

View looking westwards into the southern end of the Zone steep erosion gully with slumping sides

HEARNS LAKE DEVELOPMENT

ZONE M MODERATE RISK STEEP LAND

Water storage pond on main ridge top. Excavation at least 2½ m deep.

Effluent polishing ponds on ridge line

Excavation for material and aborted stormwater line.

View looking southwards in Lot 4.

HEARNS LAKE DEVELOPMENT

ZONE P EXISTING EXCAVATIONS

APPENDIX G

LANDSLIDE RISK ASSESSMENT – EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

Qualitative Measures of Likelihood

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur	$>\approx 10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions	$\approx 10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions	$\approx 10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances	$\approx 10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances.	$\approx 10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful	$<10^{-6}$

Note: "≈" means that the indicative value may vary by say ±1 order of magnitude, or more.

Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

Note: The "Description" may be edited to suit a particular case.

Qualitative Risk Analysis Matrix – Level of Risk to Property

LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1: CATASTROPHIC	2: MAJOR	3: MEDIUM	4: MINOR	5: INSIGNIFICANT
A – ALMOST CERTAIN	VH	VH	H	H	M
B – LIKELY	VH	H	H	M	L-M
C – POSSIBLE	H	H	M	L-M	VL-L
D – UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

Risk Level Implications

Risk Level		Example Implications(1)
VH	VERY HIGH RISK	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical
H	HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels
M	MODERATE RISK	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L	LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.

(2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.

APPENDIX J

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

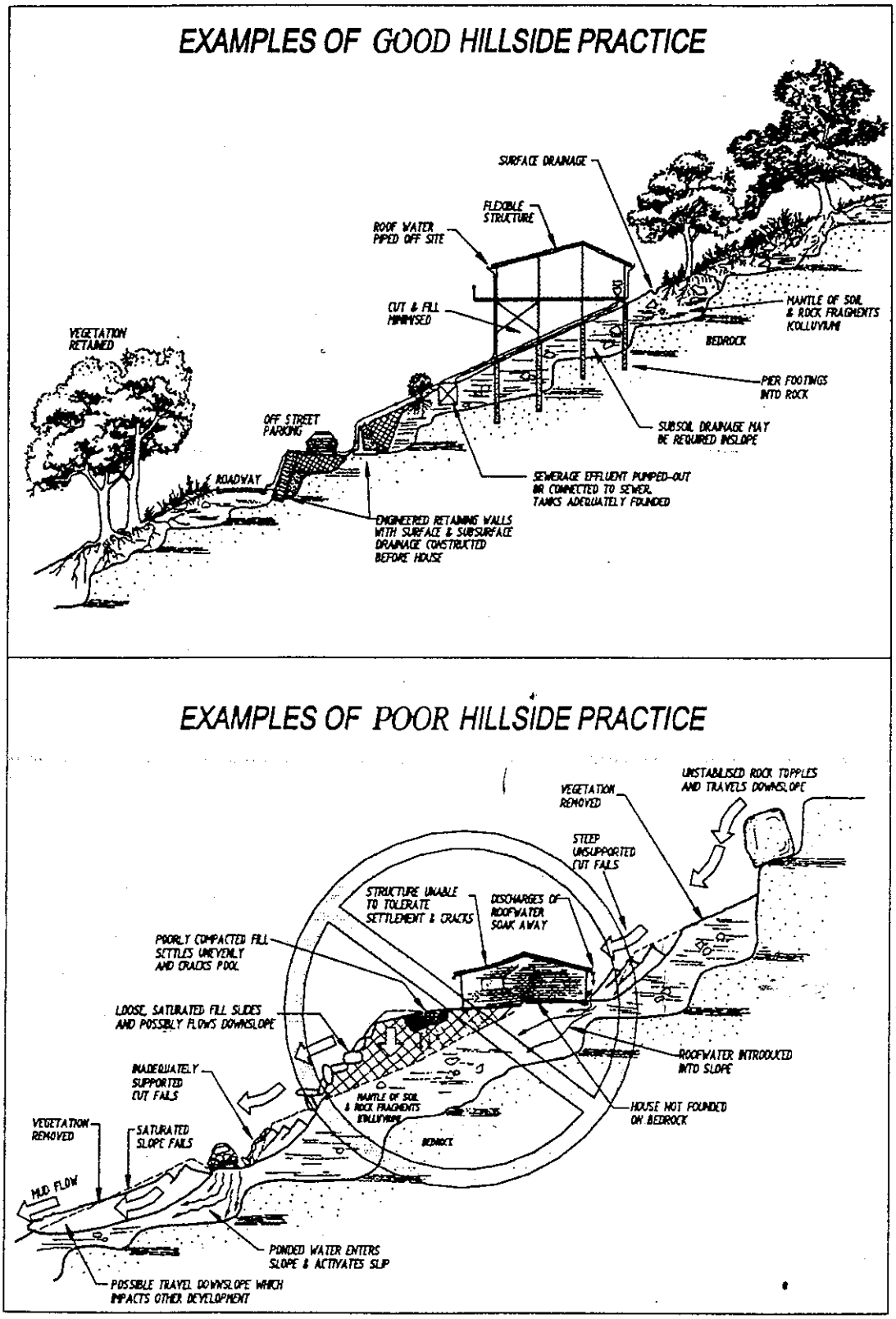


Figure J1 Illustrations of Good and Poor Hillside Practice

RECORD OF BOREHOLE No. 1 & 2

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Aimil P/L Toyota mounted MD200 Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: RL	Description of Strata
BH 1						Topsoil & fill.
						SILTY CLAY moderate plasticity Yellow brown Moist, firm
				1.0		Extremely weathered SILTSTONE dry
						V bit Refusal
				2.0		
BH 2						Clayey Topsoil
						CLAY, high plasticity Red-brown Moist, firm
						CLAY, high plasticity, yellow-brown moist, firm.
				1.0		Extremely weathered, very weak highly fractured CLAYSTONE Dry, stiff
						V bit Refusal
				2.0		

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 3 & 4

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Aimil P/L Toyota mounted MD200

Type of boring: Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: O D Level	Description of Strata
BH 3 4.7.03						CLAYEY SAND, fine grained Grey Wet, soft
				1.0		CLAY, yellow brown, wet, soft
						CLAY, high plasticity Mottled red & grey Moist, firm
				2.0		CLAY, high plasticity Mottled lt. grey, yellow & yellow-br. Moist, stiff
						Extremely weathered, extremely weak, highly fractured CLAYSTONE grey clay with residual rock structure moist, stiff End of Hole
BH 4						Topsoil and hillwash erosion material
						CLAY, Slightly sandy, mod. plasticity Brown, soft, wet
				1.0		CLAY, Slightly sandy, mod. plasticity Lt grey with yellow mottlings Wet, soft
						CLAY, Slightly sandy. mod. plasticity Grey mottled yell. br. moist/wet firm
				2.0		CLAY, high plasticity Mottled lt. grey, yell. & yellow-br. Moist, stiff
						End of Hole

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 5 & 6

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Atmil P/L Toyota mounted MD200 Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: O.D. Level	Description of Strata
BH 5 4.7.03						Clayey Topsoil
						CLAY, mod.pl. yellow-br. moist, firm
						CLAY, high plasticity Mottled lt.grey, brown & yellow moist, firm.
				1.0		Extremely weathered, extremely weak, highly fractured CLAYSTONE dry/moist, stiff
				2.0		V bit Refusal
BH 6						Topsoil
						CLAY, moderate plasticity Brown Soft, moist
				1.0		CLAY, high plasticity Mottled red-br & yellow-brown becoming grey & red Moist, firm
				2.0		CLAY, high plasticity Lt. grey mottled yellow & red brown Moist, firm
						Extremely weathered, extremely weak CLAYSTONE — grey clay with residual rock structure, moist/dry stiff
						End of Hole

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 7 & 8

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Aimil P/L Toyota mounted MD200 Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: RD Level	Description of Strata
BH 7 4.7.03						Clayey Topsoil
						CLAY, moderate plasticity Brown, moist, soft
						CLAY, moderate plasticity Mottled red brown & yellow brown Moist, firm
				1.0		
						CLAY, high plasticity Mottled grey & red Moist, firm
				2.0		
						CLAY, high plasticity Lt. grey with red-br mottlings Moist, firm
						End of Hole
BH 8						Topsoil
						CLAY, mod. plasticity, Brown, moist
						CLAY, high plasticity, Mottled yell.br., grey & red brown Moist, firm
				1.0		
						CLAY, high plasticity, mottled grey & yell. brown, moist/dry, firm
						Extremely weathered, extremely weak CLAYSTONE Plastic grey clay with lt. yellow fragments of claystone. Moist/dry firm becoming stiff.
				2.0		
						End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 9 & 10

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Aimil P/L Toyota mounted MD200 Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: R.L.	Description of Strata
BH 9 4.7.03						Clayey Topsoil
						CLAY, moderate plasticity Brown, Moist, soft
				1.0		CLAY, high plasticity Mottled grey, yell. brown & red-br. Moist, firm
						CLAY, high plasticity Lt. grey with yellow mottlings Moist, firm
				2.0		CLAY and extremely weathered and very weak CLAYSTONE fragments Lt. grey & yellow Dry, stiff.
						V bit Refusal
BH 10						Soft wet Topsoil
						CLAY, moderate plasticity Mottled grey & yellow, wet, soft
				1.0		CLAY, high plasticity Lt. grey with yellow mottlings wet/moist soft becoming firm
				2.0		CLAY and extremely weathered and very weak CLAYSTONE fragments Grey clay with yell. br. fragments Moist/dry, firm
						End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks. (Observations on ground water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 11 & 12

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Aimil P/L Toyota mounted MD200

Type of boring: Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: O.D. Level	Description of Strata
BH 11 4.7.03						Clayey Topsoil
						CLAY, moderate plasticity Brown wet, soft
						CLAY, moderate plasticity Mottled red-br. and yellow-brown moist, soft
				1.0		CLAY, high plasticity Mottled grey and red moist, firm
				2.0		CLAY, high plasticity Grey with red mottlings Moist firm becoming stiff
						End of Hole
BH 12						Clay FILL Moist, soft.
				1.0		CLAY, moderate plasticity. Mottled grey & yellow-brown wet, soft
						CLAY, high plasticity Mottled grey and red Moist, firm
				2.0		CLAY, high plasticity Grey with red mottlings Moist firm becoming stiff
						End of Hole

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test.
No. in brackets gives
No. of blows/300 mm. penetration

Remarks (Observations on ground-water, etc.)

No free groundwater encountered during investigation.

RECORD OF BOREHOLE No. 13 & 14

CLIENT: R.D.M

PROJECT: HEARNS LAKE DEVELOPMENT

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Aimil P/L Toyota mounted MD200 Continuous Solid Flight Auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: O.D. Level	Description of Strata
BH 13 4.7.03						SILTY CLAY moderate plasticity Grey wet, soft
						CLAY moderate plasticity Mottled lt. grey and yellow wet, soft
				1.0		
						CLAY, high plasticity Mottled grey, red and yellowbrown Moist, firm
				2.0		
						End of Hole
BH 14						Gravel & clay FILL (hardstand)
						SILTY CLAY, Yellow br., wet, soft
						CLAY, moderate plasticity Mottled red br. and yell. br. wet, soft
				1.0		CLAY, high plasticity Mottled grey and red Moist, firm
				2.0		CLAY, high plasticity Grey with red br. mottlings Moist, firm/stiff
						End of Hole

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

No free groundwater encountered during investigation.