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**MORRISON
GEOTECHNIC**
ABN 51 009 878 899
RPEUQ 2241

Shrink Swell Index Report

Client:	STOCKLAND DEVELOPMENT PTY LTD	Report Number:	DE10/162 - 9
Client Address:	P O BOX 10160 ADELAIDE STREET BRISBANE QLD 4000	Report Date:	20/10/2010
Job Number:	DE10/162	Order Number:	
Project:	BROAD GEOTECHNICAL APPRAISAL	Test Method :	AS1289.7.1.1
Location	SITE B, SOUTH DEEBING CREEK ROAD , DEEBING HEIGHTS	Sample Location	
Lab No:	139897	BH31	
Date Sampled:	07/10/2010	Depth 0.30m - 0.55m	
Date Tested:	11/10/2010		
Sampled By:	RJH		
Sample Method:	-		
Material Source:	Insitu		
For Use As:	-	Lot Number:	-
Remarks:	-	Item Number :	-

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Shrinkage Moisture Content (%) :	17.8	Swell MC Before(%) :	14.1
Shrinkage (%) :	2.7	Swell MC After(%) :	19.5
Unit Weight (t/m³) :	2.1	PP Before (kPa) :	330
Swell (%) :	0.8	PP After (kPa) :	320
Shrink Swell Index (Iss %) :	1.7		
Visual Classification :	(CH) Sandy CLAY, high plasticity, very stiff, moist, orange brown.		
Inert Material Estimate(%):	-		
Cracking :	No		
Crumbling :	Yes		



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APPROVED SIGNATORY

Mick Morrison

Mick Morrison (Brisbane)

NATA Accred No:1162 / 1169

FORM NUMBER

RP043-8

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Shrink Swell Index Report

Client:	STOCKLAND DEVELOPMENT PTY LTD	Report Number:	DE10/162 - 10
Client Address:	P O BOX 10160 ADELAIDE STREET BRISBANE QLD 4000	Report Date:	29/10/2010
Job Number:	DE10/162	Order Number:	
Project:	BROAD GEOTECHNICAL APPRAISAL	Test Method :	AS1289.7.1.1
Location	SITE B, SOUTH DEEBING CREEK ROAD , DEEBING HEIGHTS	Sample Location	
Lab No:	139988	BH41	
Date Sampled:	15/10/2010	Depth 0.20m - 0.47m	
Date Tested:	20/10/2010		
Sampled By:	RJH		
Sample Method:	-		
Material Source:	Insitu	Lot Number:	-
For Use As:	-	Item Number :	-
Remarks:	-		

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Shrinkage Moisture Content (%) :	25.18	Swell MC Before(%) :	19.1
Shrinkage (%) :	7.4	Swell MC After(%) :	19.9
Unit Weight (t/m³) :	2.04	PP Before (kPa) :	>600
Swell (%) :	2.9	PP After (kPa) :	230
Shrink Swell Index (Iss %) :	4.9		
Visual Classification :	(CH) Silty Sandy CLAY, fine-medium sand, moist, hard, brown.		
Inert Material Estimate(%) :	-		
Cracking :	Yes		
Crumbling :	No		



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APPENDIX 'D'

**2007 AGS LANDSLIDE RISK MANAGEMENT GUIDELINES AND THE AGS GUIDELINES FOR HILLSIDE
CONSTRUCTION**

MORRISON GEOTECHNIC

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval	Description	Descriptor	Level
Indicative Value	Notional Boundary				
10 ⁻¹	5x10 ⁻²	10 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10 ⁻²		100 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10 ⁻³	5x10 ⁻³	200 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10 ⁻⁴	5x10 ⁻⁴	1000 years			
10 ⁻⁵	5x10 ⁻⁵	10,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10 ⁻⁶	5x10 ⁻⁶	100,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
		1,000,000 years	The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not vice versa.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works.	MEDIUM	3
5%	1%	Could cause at least one adjacent property minor consequence damage.	MINOR	4
0.5%		Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	INSIGNIFICANT	5
		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)		

- Notes:
- (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.
 - (3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.
 - (4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10 ⁻¹	VH	VH	VH	H	M or L (5)
B – LIKELY	10 ⁻²	VH	VH	H	M	L
C – POSSIBLE	10 ⁻³	VH	H	M	M	VL
D – UNLIKELY	10 ⁻⁴	H	M	L	L	VL
E – RARE	10 ⁻⁵	M	L	L	VL	VL
F – BARELY CREDIBLE	10 ⁻⁶	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

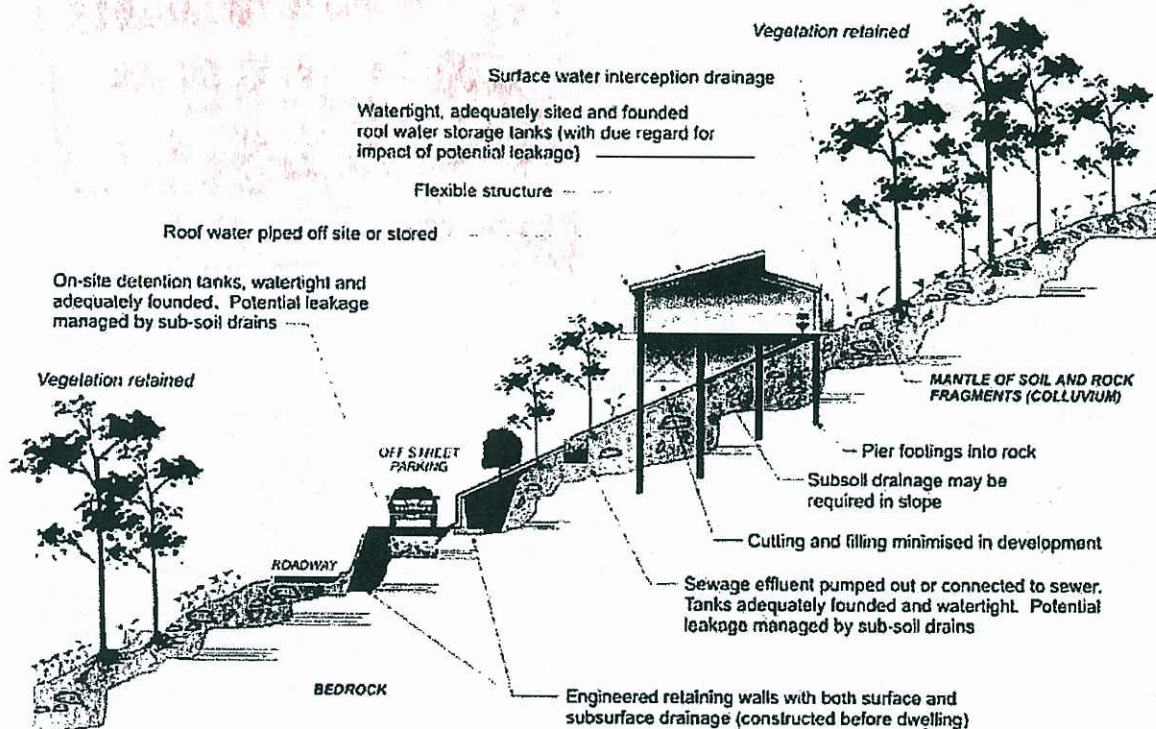
Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

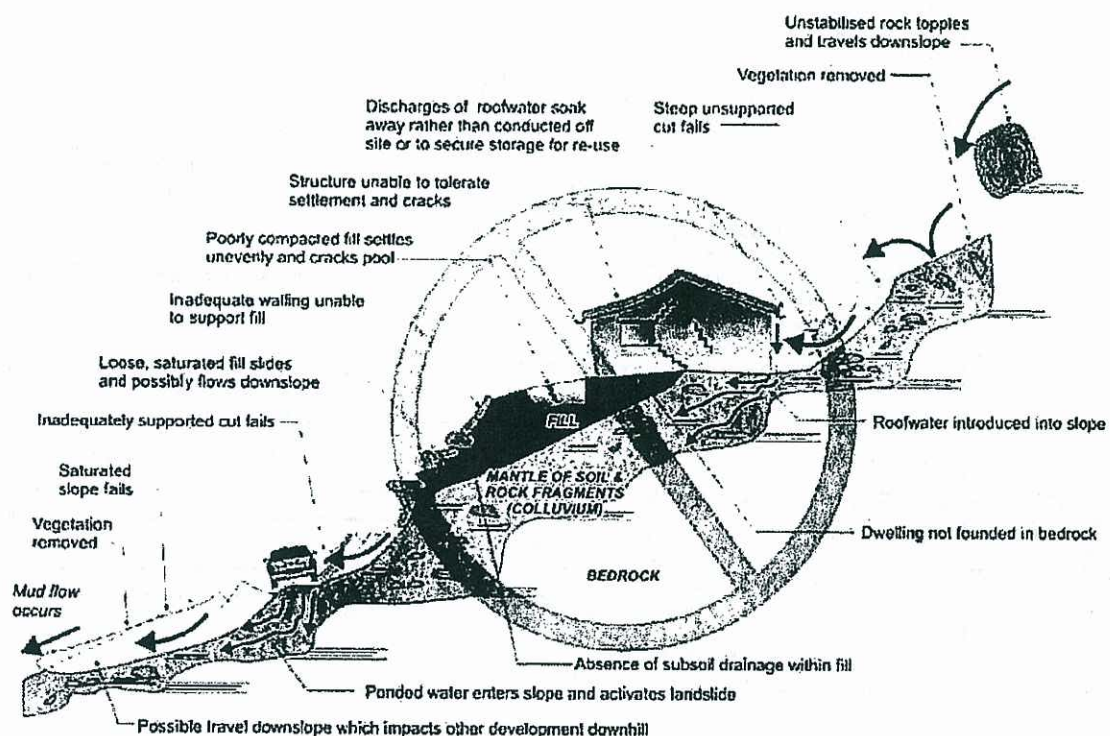
SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

ADVICE		GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
GEOTECHNICAL ASSESSMENT		Obtain advice from a qualified, experienced geotechnical practitioner 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.	Indiscriminatory 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.	

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



This figure is an extract from PRACTICE NOTE GUIDELINES FOR LAND SLIDE RISK MANAGEMENT as presented in Australian Geomechanics Journal and News, Volume 42, No 1, March 2007, which discusses the matter more fully.