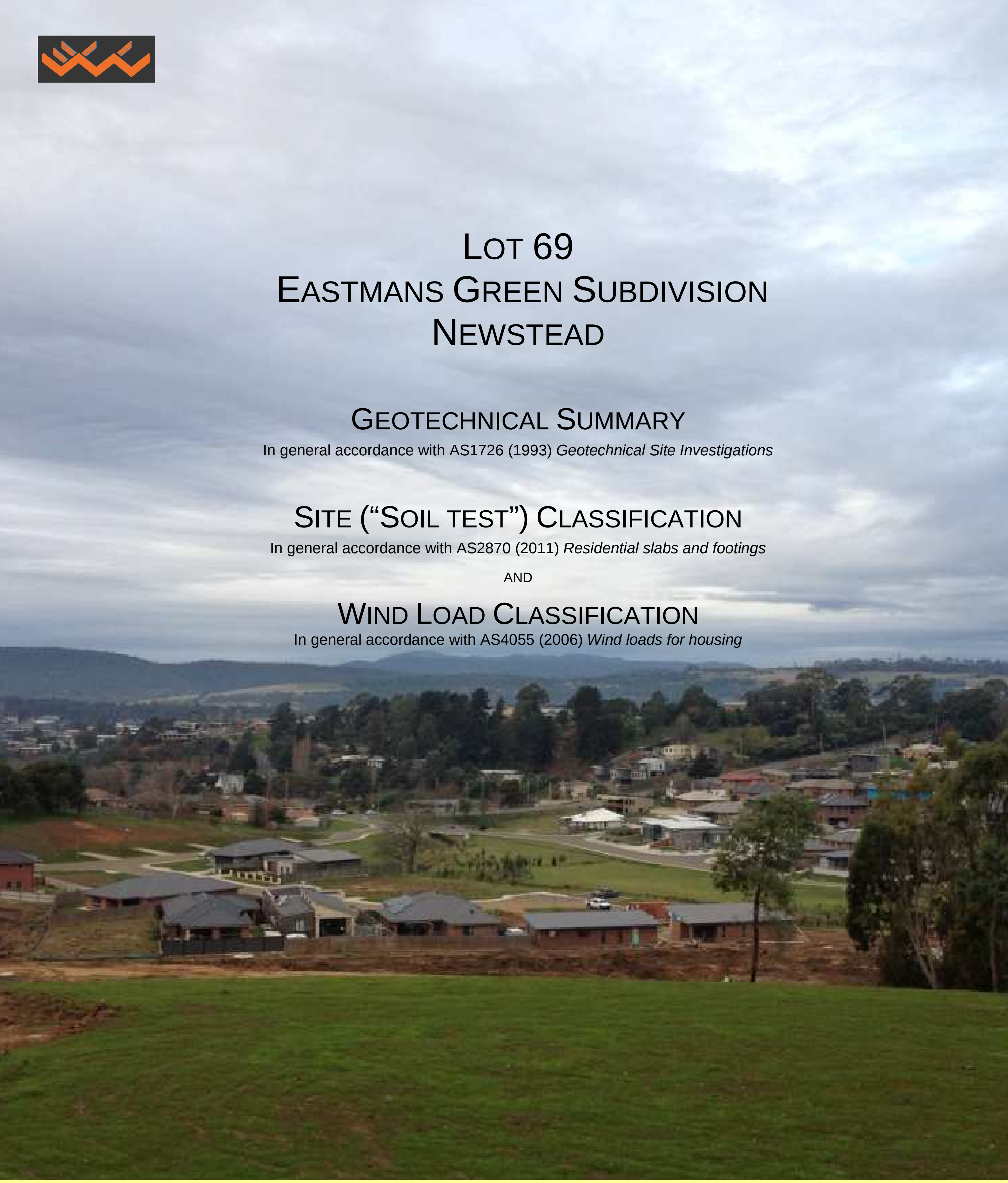


LOT 69
EASTMANS GREEN SUBDIVISION
NEWSTEAD

GEOTECHNICAL SUMMARY

In general accordance with AS1726 (1993) *Geotechnical Site Investigations*

SITE (“SOIL TEST”) CLASSIFICATION

In general accordance with AS2870 (2011) *Residential slabs and footings*

AND

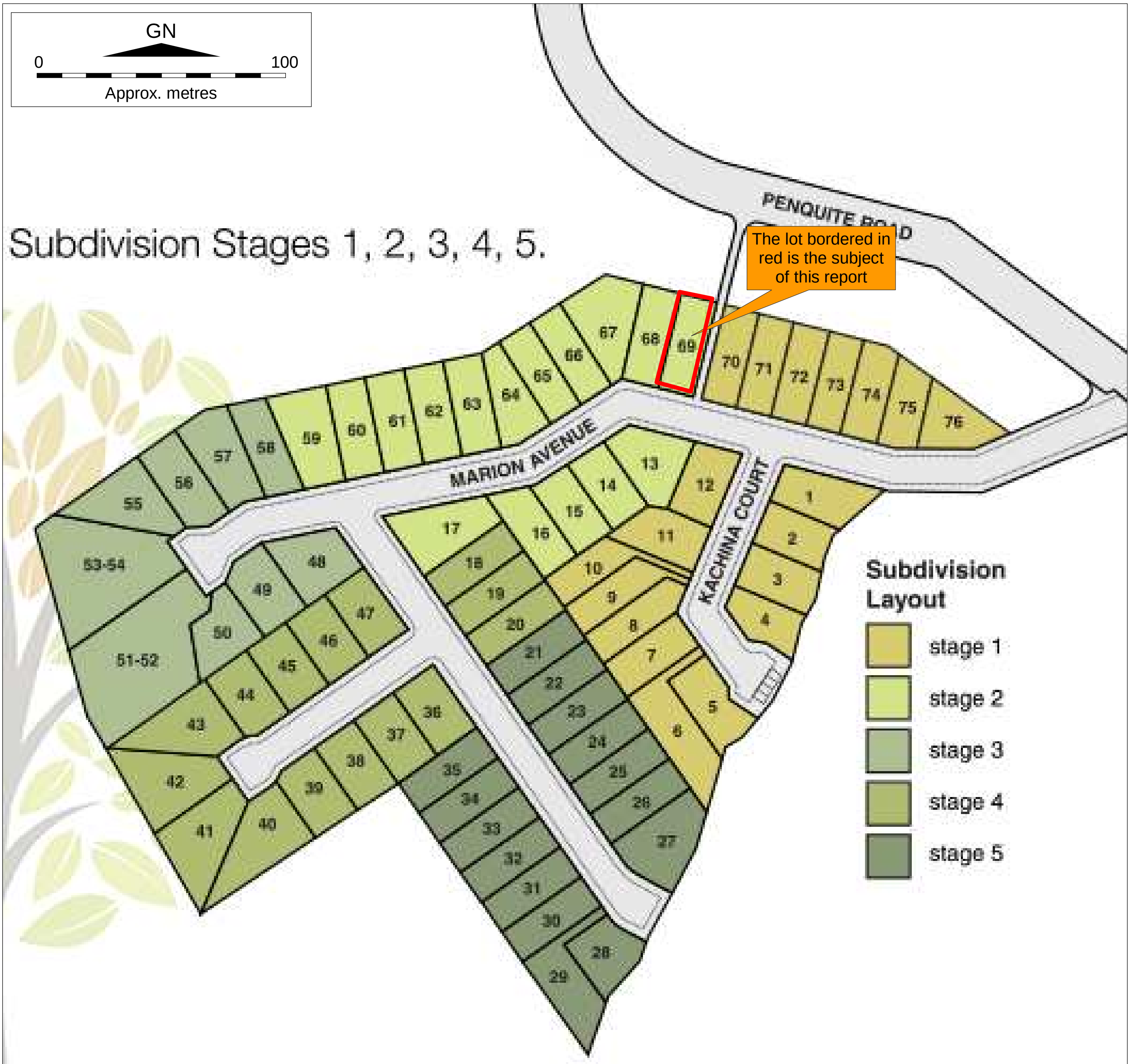
WIND LOAD CLASSIFICATION

In general accordance with AS4055 (2006) *Wind loads for housing*

eastmans green
take the first step

Newstead, Tasmania

The Eastmans Green Subdivision and its 5 stages



Source: http://www.eastmansgreen.com.au/layout-and-pricing/stage-1/

Geotechnical summary

Risks associated with a variety of geotechnical issues on and near Lot 69 Eastmans Green Subdivision, Newstead range from Very Low to High. This is a normal situation for many undeveloped hillsides in Launceston. Provided the recommendations in Attachment 1, and in the Table on the next page, are followed, the risks will be reduced to, and will remain mostly in, the Very Low – Low range during and after residential development.

AS2870 Site Classification

In accordance with Australian Standard 2870 (2011) *Residential slabs and footings*, the area **abcd** shown on the accompanying site plan of Lot 69 Eastmans Green Subdivision, Newstead is classified as **Class P**.

Class P sites require footings designed by engineering principles.

AS4055 Wind Classification

In accordance with Australian Standard 4055 (2006) *Wind loads for housing*, the following wind load classification is made for a house site on Lot 69 Eastmans Green Subdivision, Newstead:

Wind Region	**A**
Terrain Category classification	**TC3**
Topographic classification	**T1**
Shielding classification	**PS**
Wind classification	**N1**
Max. Design Gust Wind Speed	**26m/s** [Serviceability limit state ($V_{h,\ s}$)] **34m/s** [Ultimate limit state ($V_{h,\ u}$)]

W. C. Cromer

Principal
22 August 2014

PART 1 of this AS2870 assessment is this report accompanied by the following Attachments:

Attachment 1.	Summary of geotechnical issues, consequences and risks to house site, before and after management of the risks
Attachment 2.	Title plan
Attachment 3.	Excavation logs of test pits
Attachment 4.	Site and test pit photographs
Attachment 5.	Good and poor hillside construction practices
Attachment 6.	Important notes about this report

PART 2 of this AS2870 assessment contains important additional geotechnical information in a separate report entitled *Geotechnical Notes to accompany AS2870 ("soil test") reports for individual lots, Eastmans Green Subdivision, Newstead.* It is freely available on-line at http://eastmansgreen.com.au/ and http://www.williamccromer.com/ and hard copies are available on request free of charge.

Stakeholders shall consider both Part 1 and Part 2 for the development of this lot.

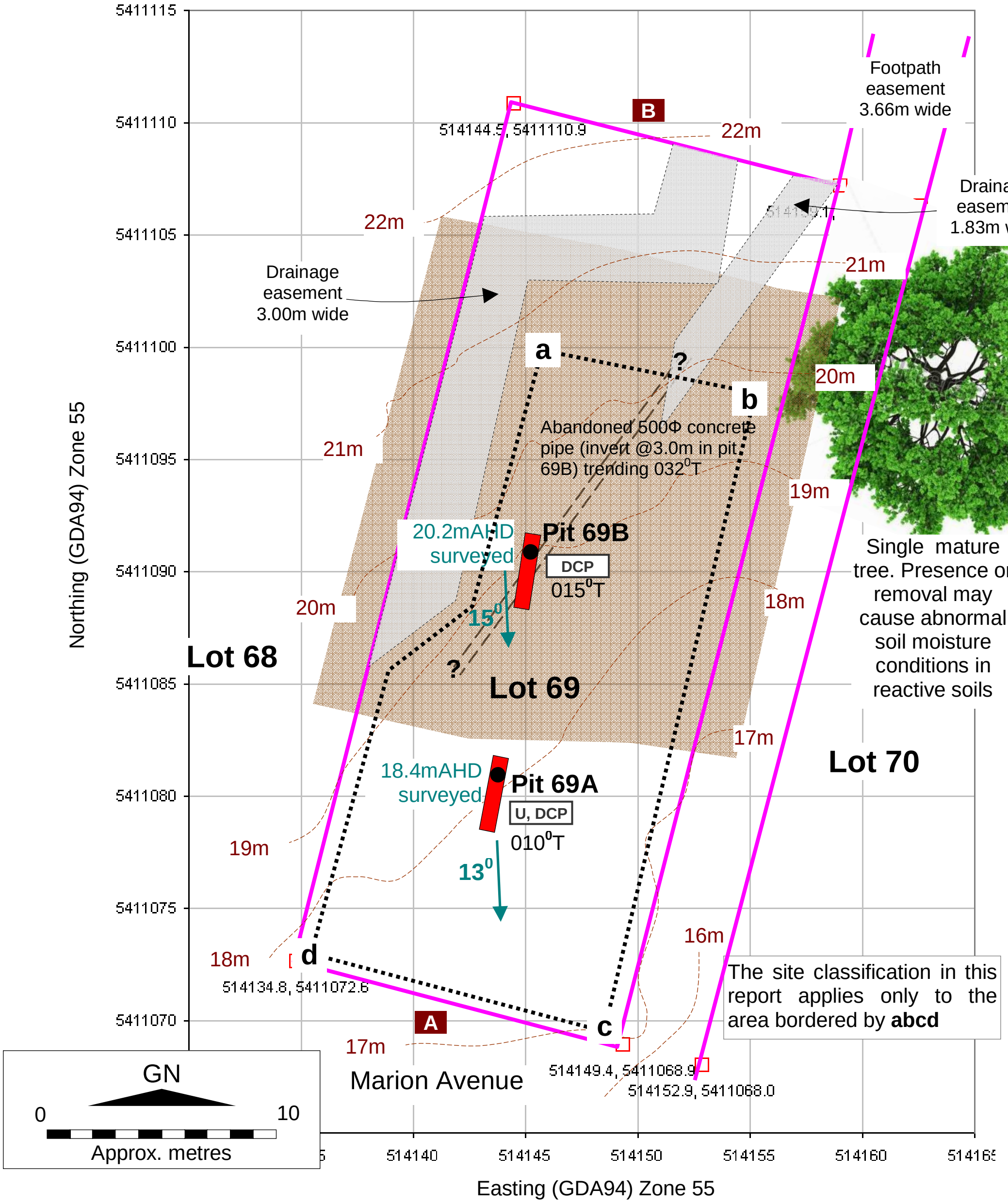
Summary of geotechnical information for this Lot

Test pits dug	69A, 69B
Photographs	Of each pit and excavated materials
Dumpy levelling	Pits relative to each other and to lot boundary pegs
DCP profiles	2; range 1 to 22 blows/100mm
Shear vane readings	8; range 44 to 228kPa
Shrink-swell tests	2. Iss = 5.0% @0.6 - 0.9m, and 2.8%@ 1.1 - 1.4m, both in pit 69A
Est. ground surface movement	60mm in pit 69A, 40mm in pit 69B, based on Iss and soil profile
AS2870 site classification	Class H2 based on test pit profiles, inside area abcd on site plan
Dispersion tests	1; Emerson Class #3 (dispersive when remoulded)
Fill	0.1m in pit 69A, thickening upslope to about 1.1m in pit 69B; note, however, presence of drainage easement (sewer pipe is about 5m deep across the lot; expect variable thickness across upper parts of lot
Soils	0.7m thick in pit 69A; absent in pit 69B
Geology	Weakly cemented sandstone; claystone
Groundwater	None encountered
Subsurface conditions	Clay and claystone in pit 69A; disturbed ground in pit 69B on extremely weathered sandstone
	Reactive clays present in area abcd, but depth and thickness expected to be variable
	Bearing capacities variable; adequate below 1m or so; strength increases with depth
	Risk of settlement low based on in-situ strength testing. See test pit logs
	Risk of slope instability low conditional on Recommendations below and in Attachment 1.

Recommendations

General	Adopt good hillside construction practices (Attachment 5). Keep records/photographs of all construction stages (Attachment 6).
General	Avoid loading the slope unnecessarily, at all scales. Consider building with flexible, light-weight materials.
Test pits	Locate backfilled test pits; design footings to avoid them
Footings	Piers through fill to materials of adequate bearing capacity.
Footing target and depth	Recommended target is claystone at >1.5m near pit 69A; weathered sandstone may be present below 2m closer to pit 69B
Footings inspection	Engineering inspection desirable
Excavations	Avoid excavations or minimise height and number. Support all excavations higher than about 0.8m with engineered, drained retaining walls. Construct upslope cut-off drains. All drains to discharge to stormwater system.
Use of fill	Avoid using fill as a weight bearing material, unless its placement is controlled. Batter angles to be gentler than 1 vertical:2 horizontal
Access drives	Where the grades of access drives exceed about 15% (8.5^0), the access should be constructed with asphalt or concrete surfaces.
Services	All water and sewer services should be in flexible pipework, laid in trenches aligned up and down the slope as far as possible. All trenches to be backfilled with clayey materials (not screened gravel). Where stormwater or sewer pipes are constructed on grades greater than 15% (8.5^0), they should be constructed with anchors to prevent movement down the slope.
Revegetating	Do not plant large trees closer to the house than the height of the mature tree
Subsurface issues	Contact Bill Cromer (0408 122 127; billcromer@bigpond.com) if unexpected site or subsurface conditions are found. Take photographs of the conditions.

Site plan and cross section



Abandoned 500Φ concrete pipe (invert @3.0m in pit 69B) trending 032⁰T

Single mature tree. Presence or removal may cause abnormal soil moisture conditions in reactive soils

The site classification in this report applies only to the area bordered by **abcd**

WARNINGS

The contour lines shown in this site plan have been obtained from 2008 1m LiDAR, and have since probably been altered by cut and fill.

An indication of the depth of fill (if fill is present) can be obtained from the test pit logs in this report, and by comparing the 1m contour map generated from the 2008 1m LiDAR with detailed surveys of the current land surface.

Purchasers of lots are advised to commission a survey check of lot dimensions and a detail survey.

Fill depth may be extremely variable across a lot, and across a single house footprint. The distribution of fill may be different from that indicated in test pit logs, or on this site plan.

Excavated backfill in test pits is uncontrolled, low strength and prone to settlement. Designers and builders must take account of test pit locations in footing design and placement.

☐ Surveyed peg with grid coordinates. XY data file (to 3 decimal places, but rounded to one) supplied by D. J. McCulloch & Associates, Surveyors, Riverside. Grid and all other features added by William C Cromer Pty Ltd. is the section line on the next page.

18m <u>Pre-subdivision</u> contours (mASL) at 1m intervals, from LiDAR coverage based on the 2008 Climate Futures. Prospective or actual land purchasers are strongly advised to do a detail survey of the lot <u>prior to building design</u> to (a) establish that survey pegs as shown are accurately located, and (b) compare the pre-subdivision contours shown here with present-day contours to estimate the extent and depth of ground disturbance (cut or fill) to assist in footing and house design.

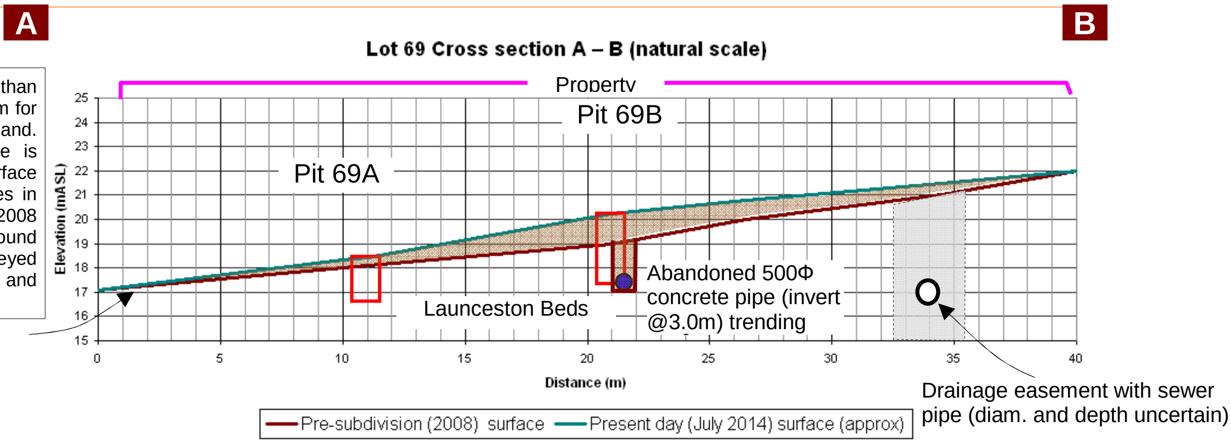
▨ Areas inferred to comprise controlled fill other than sand and deeper than 0.4m, and/or uncontrolled fill deeper than 0.8m for sand and 0.4m for material other than sand,

Pit 69A 040⁰T 50.0m Numbered excavator test pit, approximately drawn to scale. Black dot is deepest part of pit. The alignment of the long axis of the pit is shown as degrees true (⁰T). Distances from deepest part of pit (black dot) to pegs or other indicated features are accurate to 0.3m. [It will be important to relocate the backfilled test pit(s), <u>and</u> their deepest points, so that the ground disturbance they caused can be accounted for in footing design and location.]

The green figure (where present) is an arbitrary elevation of 50.0m for the ground surface at (one of) the test pit(s). (No surveyed elevations are available). Other green figures are dumpy-levelled elevations relative to the test pit. Assume elevations are accurate to about 0.1m.

U, DCP D = Disturbed sample collected; U = Undisturbed sample collected; DCP = Dynamic cone penetrometer profile done

Lot 69 Cross section A – B (natural scale)

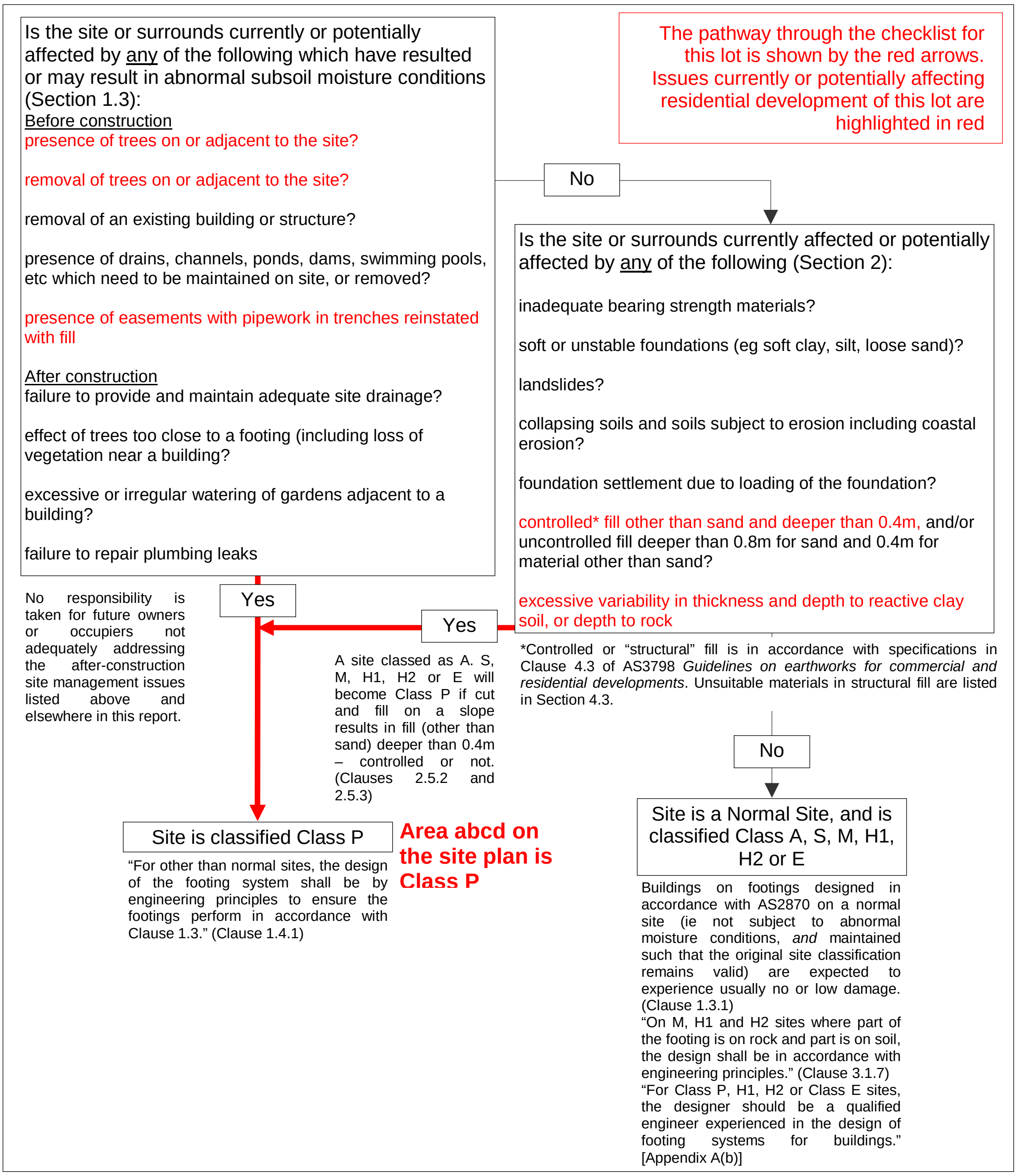


Inferred fill deeper than 0.8m for sand and 0.4m for material other than sand. Thickness shown here is based on site surface observation, exposures in test pits, and the 1m 2008 LiDAR contours. Ground surface was not surveyed other than at pits 69A and 69B.

Drainage easement with sewer pipe (diam. and depth uncertain)

Checklist for AS2870 site classification

In accordance with AS2870:2011 *Residential slabs and footings*



The pathway through the checklist for this lot is shown by the red arrows. Issues currently or potentially affecting residential development of this lot are highlighted in red

Is the site or surrounds currently or potentially affected by <u>any</u> of the following which have resulted or may result in abnormal subsoil moisture conditions (Section 1.3):

<u>Before construction</u>

presence of trees on or adjacent to the site?

removal of trees on or adjacent to the site?

removal of an existing building or structure?

presence of drains, channels, ponds, dams, swimming pools, etc which need to be maintained on site, or removed?

presence of easements with pipework in trenches reinstated with fill

<u>After construction</u>

failure to provide and maintain adequate site drainage?

effect of trees too close to a footing (including loss of vegetation near a building?

excessive or irregular watering of gardens adjacent to a building?

failure to repair plumbing leaks

No

Is the site or surrounds currently affected or potentially affected by <u>any</u> of the following (Section 2):

inadequate bearing strength materials?

soft or unstable foundations (eg soft clay, silt, loose sand)?

landslides?

collapsing soils and soils subject to erosion including coastal erosion?

foundation settlement due to loading of the foundation?

controlled* fill other than sand and deeper than 0.4m, and/or uncontrolled fill deeper than 0.8m for sand and 0.4m for material other than sand?

excessive variability in thickness and depth to reactive clay soil, or depth to rock

*Controlled or "structural" fill is in accordance with specifications in Clause 4.3 of AS3798 *Guidelines on earthworks for commercial and residential developments*. Unsuitable materials in structural fill are listed in Section 4.3.

No responsibility is taken for future owners or occupiers not adequately addressing the after-construction site management issues listed above and elsewhere in this report.

Yes

Yes

A site classed as A. S, M, H1, H2 or E will become Class P if cut and fill on a slope results in fill (other than sand) deeper than 0.4m – controlled or not. (Clauses 2.5.2 and 2.5.3)

No

Site is classified Class P

"For other than normal sites, the design of the footing system shall be by engineering principles to ensure the footings perform in accordance with Clause 1.3." (Clause 1.4.1)

Area abcd on the site plan is Class P

Site is a Normal Site, and is classified Class A, S, M, H1, H2 or E

Buildings on footings designed in accordance with AS2870 on a normal site (ie not subject to abnormal moisture conditions, *and* maintained such that the original site classification remains valid) are expected to experience usually no or low damage. (Clause 1.3.1)
"On M, H1 and H2 sites where part of the footing is on rock and part is on soil, the design shall be in accordance with engineering principles." (Clause 3.1.7)
"For Class P, H1, H2 or Class E sites, the designer should be a qualified engineer experienced in the design of footing systems for buildings." [Appendix A(b)]

Attachment 1

Summary of geotechnical issues, consequences and risks to house site on Lot 69, before and after management of the risks

			Before treatment				After treatment		
	Issue #	Issue	Likelihood of occurrence	Consequences to property	Level of risk to property	Recommended risk treatment	Likelihood of occurrence	Consequences to property	Level of risk to property
Landslide/slope instability	1	Rotational or translational deep seated earth or debris slide. Refer to Attachment 4 in PART 2.	Barely Credible	Minor to Major	Very Low to Low	None	Barely Credible	Minor to Major	Very Low to Low
	2	Rotational or translational shallow earth or debris slide. Refer to Attachment 4 in PART 2.	Possible to Unlikely	Minor to Medium	Low to Moderate	Control stormwater discharge. Incorporate good hillside construction practices. Avoid or minimise excavations. Support excavations with engineered, drained retaining walls designed to resist lateral movement. Ensure fill placement is controlled. See Attachment 5.	Unlikely	Minor	Low
	3	Translational earth or debris slide, fall or topple: Very small scale; on steep, unsupported (artificial) excavations. Refer to Attachment 4 in PART 2.	Likely to Almost Certain	Minor	Moderate to High	As for Issue 2	Unlikely	Minor	Low
	4	Rotational or translational earth or debris slide: Very small to small scale; shallow, in fill (eg beneath or next to houses; on the outside of access drives). Refer to Attachment 4 in PART 2.	Possible to Likely	Medium	Moderate to High	As for Issue 2	Unlikely	Insignificant to Minor	Very Low to Low
	5	Earth or debris flow: Very small to small scale; shallow; in soil and/or uncontrolled fill. Refer to Attachment 4 in PART 2.	Unlikely	Minor	Low	As for Issue 2	Unlikely	Minor	Low
	6	Soil creep. Refer to Attachment 4 in PART 2.	Barely Credible	Minor	Very low	As for Issue 2	Barely Credible	Minor	Very low

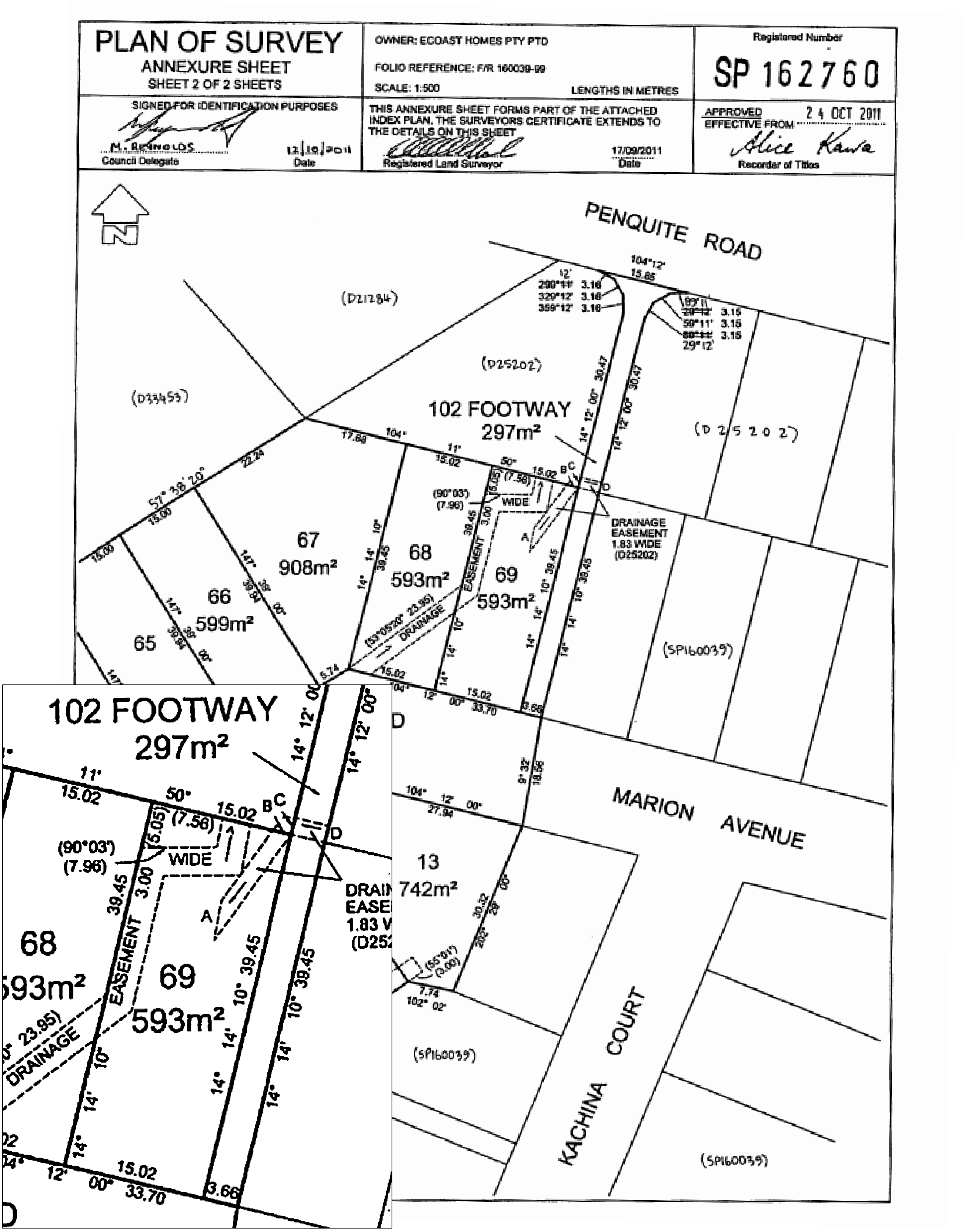
Summary of geotechnical issues (continued)

		Before treatment				After treatment		
7	Surface soil erosion	Possible	Minor	Moderate	As for Issue 2. Revegetate (but no large trees close to house (see below)	Unlikely	Minor	Low
8	Tunnel erosion (dispersive soils)	Unlikely	Medium	Low	As for Issue 2. Revegetate (but no large trees close to house (see below)	Unlikely	Minor	Low
9	Foundation movement (eg settlement) due to low strength materials (eg uncontrolled fill, soft soils)	Possible	Medium	Moderate	Pier all footings for house through any fill identified during construction. Refer to accompanying site plan.	Unlikely	Minor	Low
10	Foundation movement due to reactive or unstable soils	Likely	Medium	High	As for Issue 9 and 11. Control drainage. Avoid ponding of water against buildings. Avoid gardens adjacent to building; Do not overwater. Repair plumbing leaks promptly.	Unlikely	Minor	Low
11	Foundation movement due to tree removal or planting	Possible	Minor to Major	Moderate to High	Restrict tree planting to (and tree removal from) a distance from the house of 1.5x, 1x and 0.75x mature tree height for Class P, (H1, H2) and M sites respectively	Unlikely	Minor	Low
12	Surface drainage	Possible	Minor	Moderate	Divert surface drainage away from buildings to reticulated system	Possible	Insignificant	Very Low
13	Flooding or waterlogging	Unlikely	Medium	Low	As for Issues 10 and 12			
14	Shallow groundwater seepages	Unlikely	Medium	Low	Divert seepages with cut-off drains behind retaining walls, or in herring bone alignment diagonally down slope, away from buildings	Unlikely	Minor	Low
15	Site contamination from previous activities	Unlikely	Minor to Medium	Low	Visual examination during construction. Removal or testing of suspect materials. May require outside advice.	Unlikely	Minor to Medium	Low
16	Earthquake risk	Almost certain (magnitude <5); Likely (magnitude> 5)	Insignificant to Medium	Low to Moderate	Accept risk. Risk applies to all Tasmanian houses to varying degrees depending on earthquake intensity, geology and house construction	Almost certain (magnitude <5); Likely (magnitude> 5)	Insignificant to Medium	Low to Moderate

1. The assessments are unavoidably subjective to varying degrees.
2. Further reading: AGS (2007c). Practice Notes Guidelines for Landslide Risk Management. Australian Geomechanics Vol 42 No 1 March 2007

Attachment 2

Title plan



PLAN OF SURVEY
ANNEXURE SHEET
SHEET 2 OF 2 SHEETS

OWNER: ECOAST HOMES PTY PTD
FOLIO REFERENCE: F/R 160039-99
SCALE: 1:500
LENGTHS IN METRES

Registered Number
SP 162760

SIGNED FOR IDENTIFICATION PURPOSES
M. REYNOLDS
Council Delegate
12/10/2011
Date

THIS ANNEXURE SHEET FORMS PART OF THE ATTACHED INDEX PLAN. THE SURVEYORS CERTIFICATE EXTENDS TO THE DETAILS ON THIS SHEET
Registered Land Surveyor
17/09/2011
Date

APPROVED
EFFECTIVE FROM 24 OCT 2011
Alice Kawa
Recorder of Titles

Attachment 3

Excavation logs of test pits

William C. Cromer Pty. Ltd. Environmental, engineering and groundwater geologists
http://www.williamccromer.com/

Excavation log

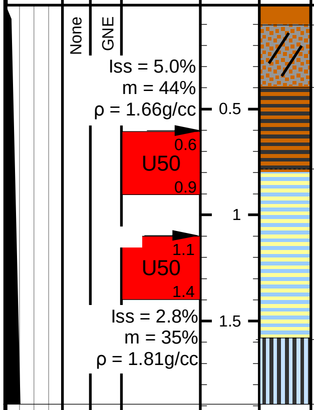
EG69A
Sheet 1 of 1

Project – Eastmans Green Subdivision, Newstead

Location – Lot 69

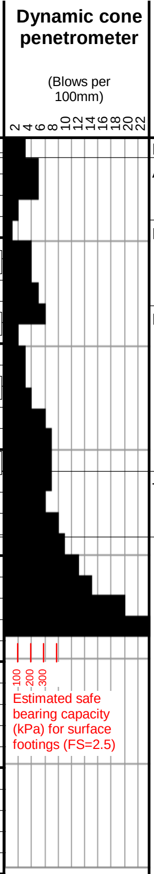
Coordinates	514144mE 5411081mN	**Exposure type**	Excavator test pit	**Date dug**	12 June 2014
Datum	GDA94			**Date logged**	12 June 2014
RL	18.4m (Surveyed)	**Equipment**	12t Caterpillar with 0.6m GP bucket with 3 teeth	**Logged by**	W. C. Cromer
Dimensions (m)	Depth 1..9 Length 2.5 Width 0.7	**Operator**	Harry Bracey	**Checked by**	W. C. Cromer

Support: None
Water: GNE



Notes (Samples and tests)	USCS	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency Density index	Shear Vane (kPa)	Structure, geology and interpretation
	SP, CL	SAND, silty CLAY: brown	M	MD		Fill
Iss = 5.0% m = 44% ρ = 1.66g/cc	SP	Silty SAND: brownish grey; some gravel; gradational base; (40mm abandoned poly pipe)	M	MD		A soil horizon
U50 0.6–0.9	CH	CLAY: mottled orange and grey; high plasticity; gradational base	M>PL M<>PL	St VSt	128kPa@0.6m	B soil horizon
U50 1.1–1.4	CH	CLAY: mottled light blue and light yellow; high plasticity; gradational base			180kPa@0.9m 172kPa@1.2m 180kPa@1.6m	EW claystone
Iss = 2.8% m = 35% ρ = 1.81g/cc	CH	CLAYSTONE: light blue; laminated	M<PL	Fb-VSt		Tertiary claystone
		Hole terminated at required depth of 1.9m in Tertiary claystone				

Strength: Hand penetrometer (kPa) 25 50 100 200 400



1m / 1m V and H scale

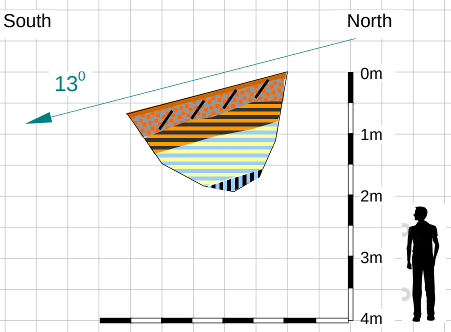
Moisture and density
D = Dry M = Moist W = Wet
m=31% = lab-measured moisture content of U50 sample
ρ = 1.86g/cc = lab-measured density of U50 sample

Samples
D = disturbed; U50 = undisturbed; 50mm diameter drive tube (top & bottom depths shown)

Water
Water level
Water inflow
Water outflow
GNE = Groundwater not encountered

Penetration
1 2 3 4
No resistance
Refusal

Test pit is aligned 010⁰True



60mm (Class H2) = ground surface movement estimated from test pit log and Iss results

Graphic log key

☰	CLAY (CH, CL)
▦	SAND (SP)
▨	SILT (SM)
▩	GRAVEL (GP, GW)
⬠	COBBLES (63-200mm) BOULDERS (>200mm)
@	SHELLS SHELL FRAGMENTS
	ROOTS
	FRACTURES

Consistency (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25-50kPa; easily penetrated by fist); F = Firm (50-100kPa; easily penetrated by thumb); St = Stiff (100-200kPa; indented by thumb, penetrated with difficulty); VSt= Very Stiff (200-400kPa; easily penetrated by thumbnail); H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail)
Relative density (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense (picking); VD = Very dense (hard picking)

William C. Cromer Pty. Ltd. Environmental, engineering and groundwater geologists
http://www.williamccromer.com/

Excavation log

EG69B
Sheet 1 of 1

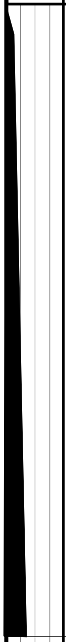
Project – Eastmans Green Subdivision, Newstead

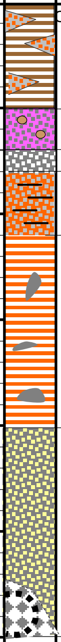
Location – Lot 69

Coordinates	514145mE 5411091mN	**Exposure type**	Excavator test pit
Datum	GDA94	**Equipment**	12t Caterpillar with 0.6m GP bucket with 3 teeth
RL	20.2m (Surveyed)	**Operator**	Harry Bracey
Dimensions (m)	Depth 3.0 Length 2.5 Width 0.7		

Date dug	12 June 2014
Date logged	12 June 2014
Logged by	W. C. Cromer
Checked by	W. C. Cromer

Penetration 1 2 3 | **Support** None | **Water** GNE | **Notes** Samples and tests





Depth (metres)	USCS	Materials (Soil type, colour, plasticity or particle characteristics, secondary and minor components)	Moisture condition	Consistency / Density index	Structure, geology and interpretation
0 – 0.5	CH, SC	Variable texture: CLAY, SAND: orange, grey; low to mod plasticity	M<>PL	St	Fill
0.5 – 0.7	SP	Gravelly SAND: purple	D	VD	
0.7 – 0.8	SP	SAND: grey		Fb-D	
0.8 – 1.1	SC	Clayey SAND: orange and grey	M<PL	VSt	A soil horizon
1.1 – 2.0	CH	Sandy CLAY: orange with grey patches	M<PL	VSt	B soil horizon
2.0 – 3.0	SC	Clayey SAND: light yellowish grey Abandoned 500Φ concrete pipe in gravel ; invert at 3.0m	M	Fb-D	Extremely weathered Tertia sandstone
3.0		Hole terminated at required depth of 3.0m in Tertiary sandstone			

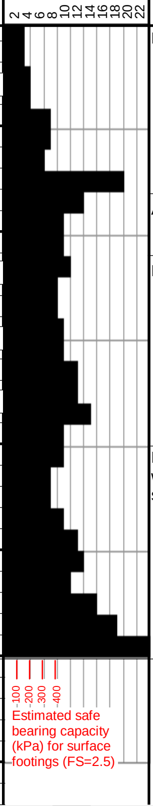
Fill down one corner of test pit to 3.0m (pip invert)

Strength

Hand penetrometer (kPa) 25 50 100 200 400

Shear Vane (kPa)
44kPa@0.3m
Too hard
170kPa@1.2m
228kPa@1.5m
170kPa@1.8m

Dynamic cone penetrometer (Blows per 100mm)



1m
1m
V and H scale

Moisture and density

D = Dry M = Moist W = Wet
m=31% = lab-measured moisture content of U50 sample
ρ = 1.86g/cc = lab-measured density of U50 sample

Samples

D = disturbed; U50 = undisturbed; 50mm diameter drive tube (top & bottom depths shown)

Water

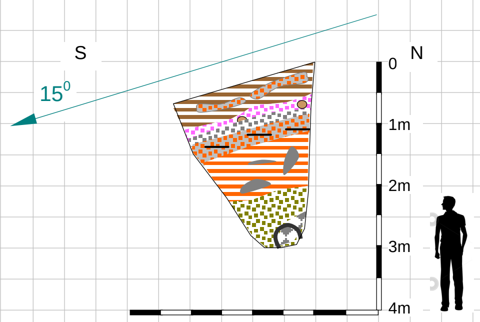
- Water level
- Water inflow
- Water outflow

GNE = Groundwater not encountered

Penetration

1 2 3 4
No resistance
Refusal

Test pit is aligned 015°True



40mm (Class H1) = ground surface movement estimated from test pit log and Iss results in pit 69A

Graphic log key

- CLAY (CH, CL)
- SAND (SP)
- SILT (SM)
- GRAVEL (GP, GW)
- COBBLES (63-200mm)
- BOULDERS (>200mm)
- SHELLS SHELL FRAGMENTS
- ROOTS
- FRACTURES

Consistency (silt, clay, sandy clay, silty clay) VS = Very soft (<25kPa; exudes in fingers when squeezed); S = Soft (25-50kPa; easily penetrated by fist); F = Firm (50-100kPa; easily penetrated by thumb); St = Stiff (100-200kPa; indented by thumb, penetrated with difficulty); VSt= Very Stiff (200-400kPa; easily penetrated by thumbnail); H = Hard (>400kPa; indented by thumbnail with difficulty); Fb = Friable (crumbles or powders when scraped by thumbnail)
Relative density (sand and gravel) VL = Very loose (ravelling); L = Loose (easy shovelling); MD = Medium dense (hard shovelling); D = Dense (picking); VD = Very dense (hard picking)

Attachment 4

Site and test pit photographs

The staff in these photographs is graduated in yellow and white sections each one metre long.
The numbers on the staff are decimetres (tenths of a metre).

The main photograph depicts the soil profile in the test pit.
Smaller photos (if present) show the materials excavated from the pit, the location of the pit in relation to roads, etc, and other aspects of interest as indicated.


12 JUNE 14
PIT
69A
Clay
Claystone
EASTMANS
GREEN
NEWSTEAD
12 JUNE 14
PIT
69A

Fill

Abandoned 500Φ diam concrete pipe

EW sandstone

Attachment 5

(4 pages)

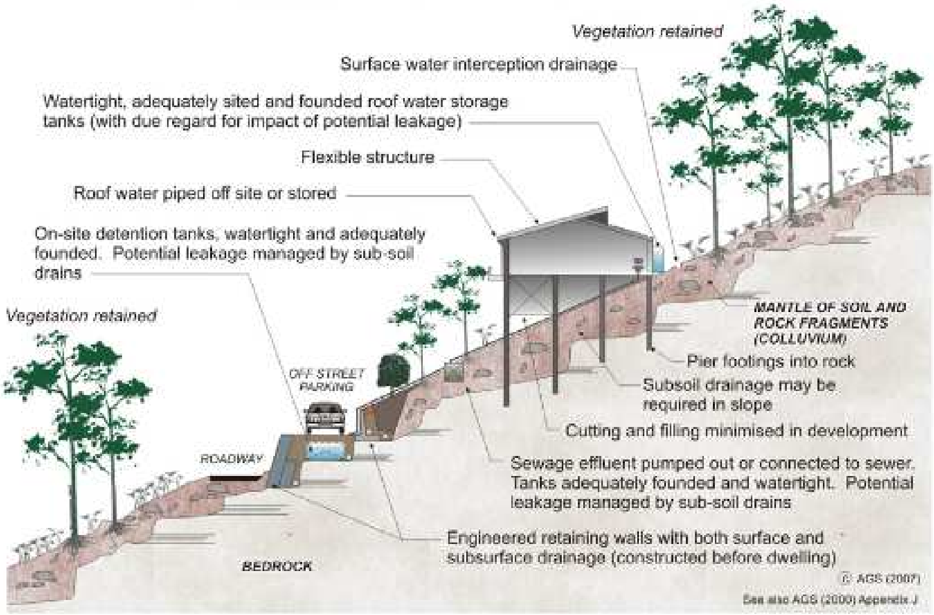
Good and poor hillside construction practices

AGS Geoguide LR8 (Construction Practice)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.

EXAMPLES OF GOOD HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a light weight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

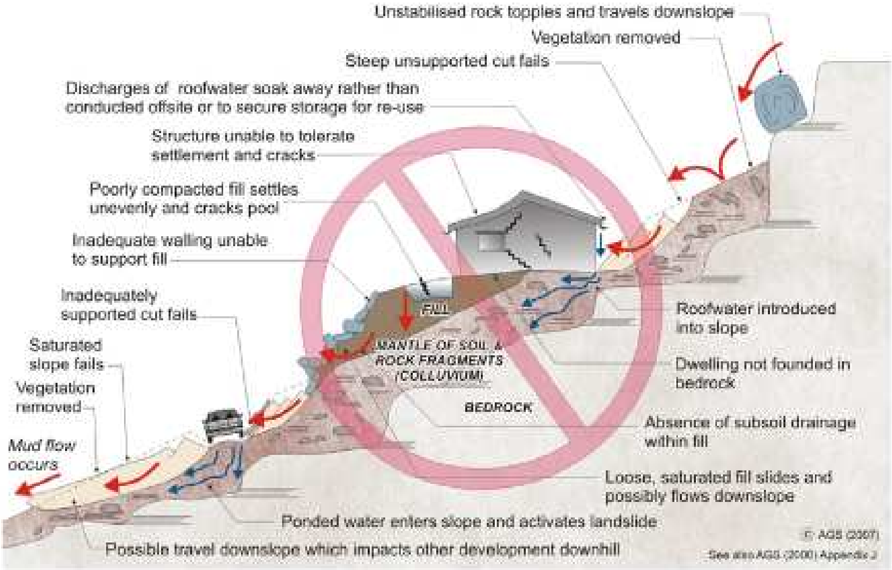
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

EXAMPLES OF POOR HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flowpaths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

More information relevant to your particular situation may be found in other Australian GeoGuides:

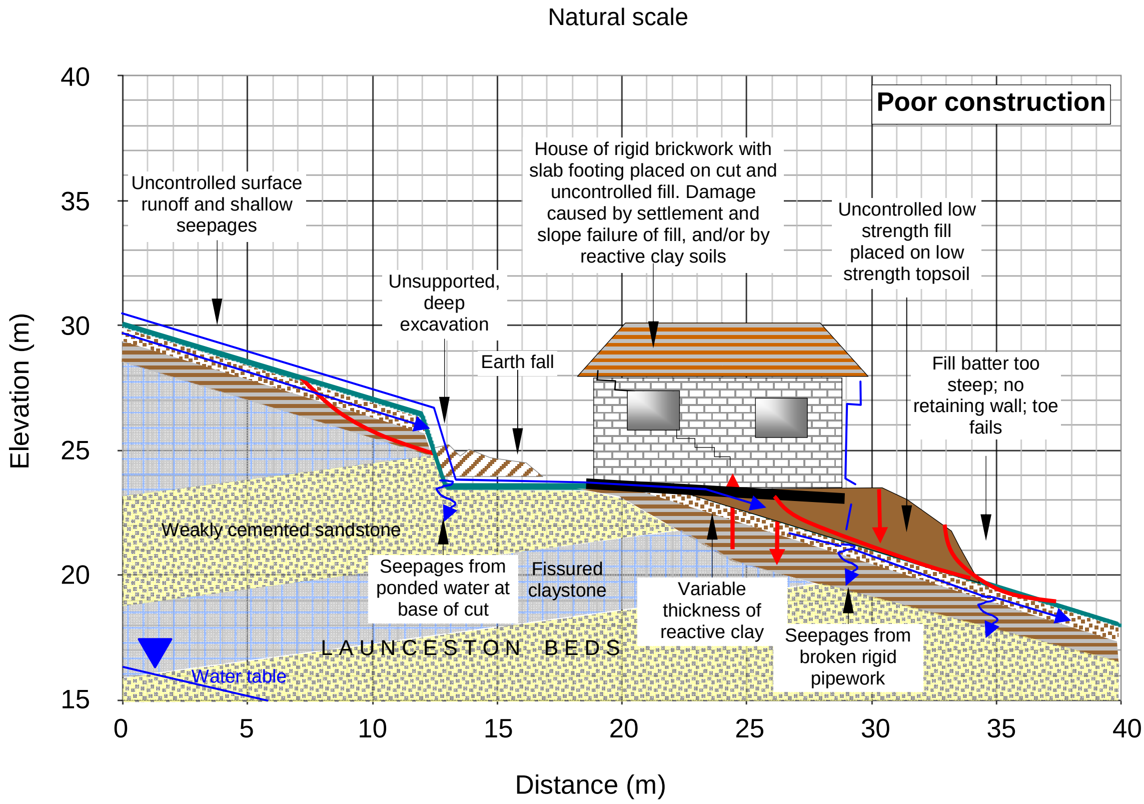
- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal

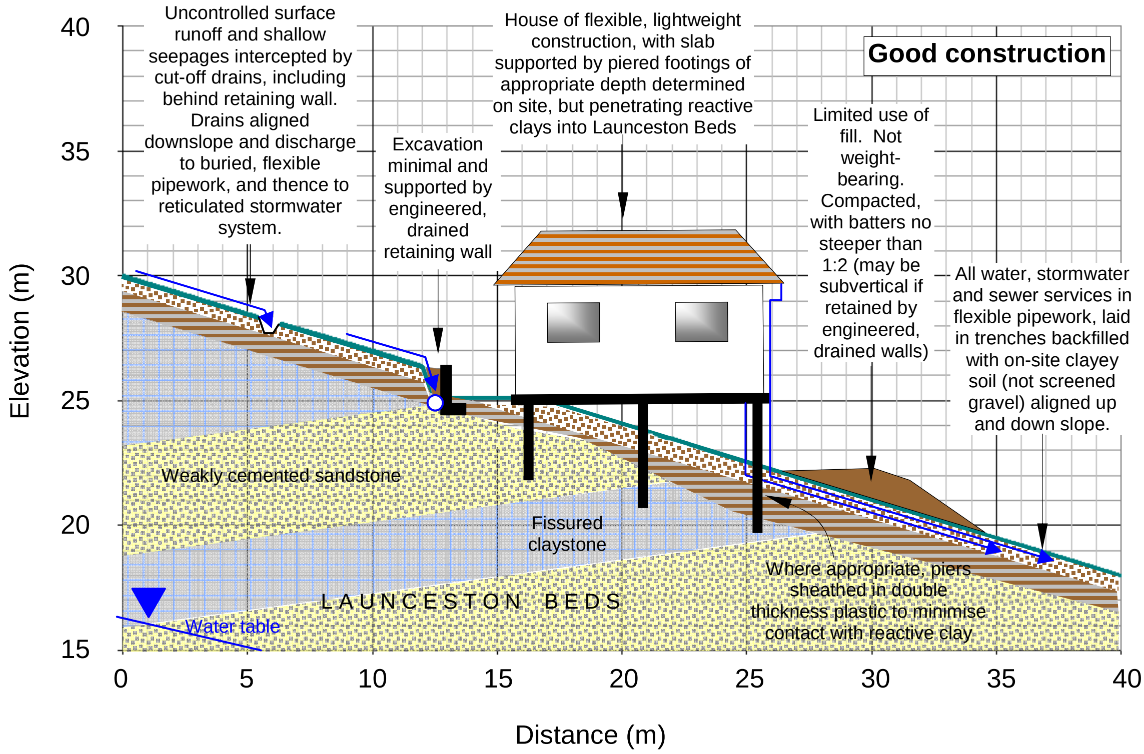
GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

Generalised good and poor construction practices for hillsides in Launceston

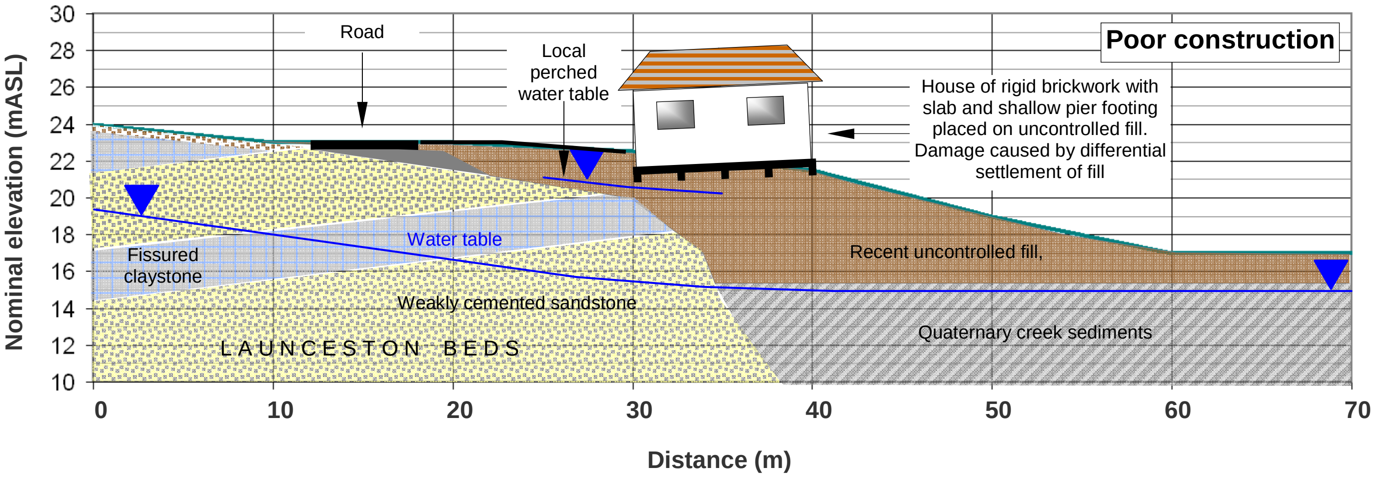
These schematic cross sections apply to houses on hillsides on geologic materials called the Launceston Beds. See Attachment 3 of Part 2 of this report.

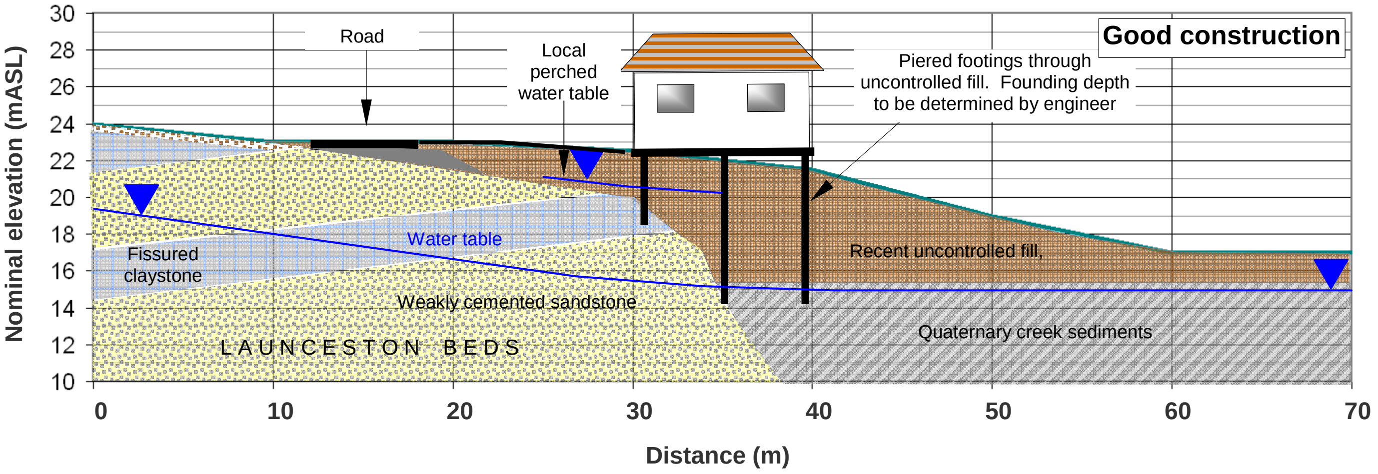




Generalised good and poor hillside construction practices on fill

Natural scale





Attachment 6

(2 pages)

Important notes about this report

Background information

William C Cromer Pty Ltd has been engaged by Ecoast Homes Pty Ltd to prepare site classification ("soil test") reports for about 50 lots in the Eastmans Green Subdivision.

The assessments are being done in accordance with Australian Standard 2870:2011 *Residential slabs and footings*, and draft Tasmanian guidelines[1] relating to the draft Tasmanian Landslide Code.

This individual AS2870 soil test report contains geotechnical information specific to the lot in question, and is freely available at http://eastmansgreen.com.au/ It is PART 1 of the AS2870 site assessment for the lot.

Important geotechnical information is common to all lots in the subdivision. Rather than repeat this information in each individual report, it was thought preferable to provide it as a separate document (PART 2), freely available at http://eastmansgreen.com.au/ and http://www.williamccromer.com/

PART 1 and PART 2 together constitute the AS2870 site classification for this lot.

Design of footing systems for this site

Recommendations for a footing system in this report do not preclude the use of alternative footing systems based on sound engineering principles sensitive to the site.

Implications for AS2870 reports from the draft Tasmanian Landslide Code and guidelines

There are Tasmania-wide implications for AS2870 site classifications if the draft Tasmanian Landslide Code[2] is adopted in its current form:

- All residential lots in the Medium landslide hazard band[3] will automatically be classified as Class P unless otherwise classified by a suitably qualified practitioner. Footings for Class P sites require certification by a suitably experienced engineer.

- In the Medium landslide hazard band, new buildings (or new extensions to an existing building) which result in a total final floor area greater than 200m^2 will require a Landslide Risk Management (LRM) report.

Most of the Eastmans Green Subdivision is in the Medium landslide hazard band (see Attachment 1 of PART 2). A general LRM has been completed for the subdivision as Attachment 4 in PART 2. Where appropriate, automatic Class P classifications for lots in the Medium landslide band in this subdivision have been amended.

Refer to this report as:

Cromer, W. C. (2014). *Geotechnical summary, site classification and wind classification, Lot 69 Eastmans Green Subdivision, Newstead.* Unpublished report for Ecoast Homes Pty Ltd by William C. Cromer Pty. Ltd., 22 August 2014.

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[1] Cromer, W. C. (2014). *Building for landslide: Geotechnical guidance for regulators and practitioners using the Tasmanian Landslide Code*. Report for the Tasmanian Department of Premier and Cabinet by William C. Cromer Pty. Ltd., June 2014).

[2] Available at http://www.planning.tas.gov.au/__data/assets/pdf_file/0009/168948/Draft_Planning_Directive_-_Statewide_Codes.pdf

[3] See Attachment 1 of *Geotechnical Notes to accompany AS2870 ("soil test") reports for individual lots, Eastmans Green Subdivision, Newstead*

Dissemination of information is important

New geotechnical information is contained in this report. The information may be useful to regulators and other geotechnical practitioners. Dissemination of such knowledge is important.

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William C Cromer Pty Ltd may submit hard or electronic copies of this report to Mineral Resources Tasmania to enhance the geotechnical database of Tasmania.

This report is freely available at http://eastmansgreen.com.au/ and http://www.williamccromer.com/

Other reports on this subdivision

William C Cromer Pty Ltd produced detailed geotechnical reports (including landslide risk management, LRM) for Ecoast Homes Pty Ltd for the original Eastmans Green subdivision:

- Cromer, W. C. (2009). *Geotechnical assessment, 76 – lot subdivision, Penquite Road, Newstead.* (Unpublished report for ECoast Homes Pty Ltd by William C. Cromer Pty. Ltd., 7 April 2009; 137 pages), and

- Cromer, W. C. (2011). *Geotechnical Assessment Addendum Report, Eastman's Green subdivision, Penquite Road, Newstead.* (Unpublished report for ECoast Homes Pty Ltd by William C. Cromer Pty. Ltd., 22 May 2011; 33 pages)

Both are available at http://eastmansgreen.com.au/ and http://www.williamccromer.com/

Notes about how Tasmanian practitioners should prepare AS2870 soil test reports for houses are available at http://www.williamccromer.com/soil-testing-for-houses/

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