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21st January 2016

Our Ref : JG16959A-r1

Skyblue Developments Pty Ltd
14 Macarthur Street
PARRAMATTA NSW 2150

Attn: Mr Jason Youssef

Dear Sir

Re Geotechnical Assessment Report
Proposed Alterations and Extensions
4 Allen Avenue, Bilgola Beach

1. Introduction

This report presents our comments and assessment on site stability with respect to the proposed alterations and additions to the existing residential dwelling at the above site.

We understand that the proposed development will include construction of an extension at the front of the existing house in order to accommodate a garage and a rumpus room. The proposed garage/rumpus room will be of masonry construction with concrete floor slabs.

2. Site Conditions

The property on the western high side of Bilgola Avenue Bilgola and is roughly rectangular in shape with an approximate 18m frontage to Bilgola Avenue by 50m.

The property is situated at the back of Bilgola Beach at the toe of a sand dune hill. Based on the 1:100,000 geological map of Sydney, the site is underlain by Newport Formation and Garie Formation (Rnn) of the Narrabeen Group. Typical rock units consist of interbedded laminite, shale and quartz to lithic-quartz sandstone and minor red claystone north. Sandstone outcrops were not visible on site however along The Serpentine, some sandstone outcrops were noted and this sandstone appeared highly fractured and generally medium strength.

The property is occupied by a double storey residential dwelling at the rear with a small swimming pool immediately at the front of the dwelling and a car parking area occupying the middle portion of the property. A small lawn area occupies the front portion of the site. The residential dwelling was constructed on the slope and is elevated about 2 to 3m above the car parking area. Ground surface of the car park and front lawn is approximately level.

Based on the survey drawing provided, the building platform is at about Reduced Level (RL) 9.3m Australian Height Datum (AHD) and the car park and front lawn area is at about RL 6.0m AHD. Bilgola Avenue is at Reduced Level (RL) between 5.7m and 24.5m Australian Height Datum (AHD).

The adjoining property to the north consists of a large residential dwelling with a small front yard and a relatively large backyard which rises up about 4m in steps and benches to the rear boundary. To the south, the adjoining property consists of a residential dwelling at the rear with a front lawn and ground surface on this property has relatively gentle slopes of less than 5 degrees.

The neighbouring properties to the rear are situated on a relatively steep slope of between 8 and 14 degrees and these properties are occupied by residential dwellings. Based on our previous investigation on rear neighbouring property, natural Silty Clay overlying siltstone/sandstone bedrock was encountered. Depths of bedrock encountered ranges from about 2m to 5m and the depth of bedrock is expected to increase towards the subject property.

3. Proposed Development and Landslide Risk Assessment

We understand that the proposed development will include construction of a garage and rumpus room at the front of the existing house at RL 6.1m AHD.

Assessment on site classification in accordance to AS2870 "Residential Slabs and Footings' and site stability in accordance with AGS 2007 Landslip Risk Management. The risk of slope instability is affected by three main factors;

- Slope angle
- Strength of the subsurface materials
- Concentration of water

Refer to the attached Risk Matrix outlined in the AGS guidelines for landslip risk assessment.

The consequences of slope instability as a result of downhill slope movements may be considered as MAJOR as it may cause extensive damage to the structure requiring significant stabilisation works. As the subject property is mainly on level ground with gentle slopes of less than 4 degrees dipping to the frontage road and is situated within an established residential area with surface and subsurface water controlled by existing drainage system, the likelihood of a landslip is RARE, therefore the risk of slope instability is assessed to be Low.

Our assessment on the probability of loss of life after development is less than 10^{-6} and this is considered acceptable.

4. Geotechnical Recommendations

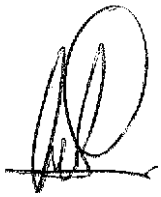
Our general comments and recommendations for the proposed alterations and additions are as follows;

- All excavation and filling required for the proposed extension should be adequately retained by engineered retaining wall to ensure site stability is maintained. Care should be taken to ensure excavation works will not undermine the existing footings of the house, therefore some underpinning works may be required.
- All unretained excavation and filling which are not retained should be adequately battered to not steeper than 1 Vertical to 2 Horizontal.
- All footings for the proposed alterations and additions should be supported on new footings founded on competent foundation material.

- Adequate surface and surface drains should be constructed as part of the proposed development to divert surface runoff away from footings and excavation.
- All design and construction works should be carried out and supervised by a suitably qualified and experienced engineer.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd



Solern Liew CPEng (NPER)
Director

Attachment: Proposed Development Plan
AGS Risk Matrix

D.:\16JOB\959\JG16959A-r1.DOC

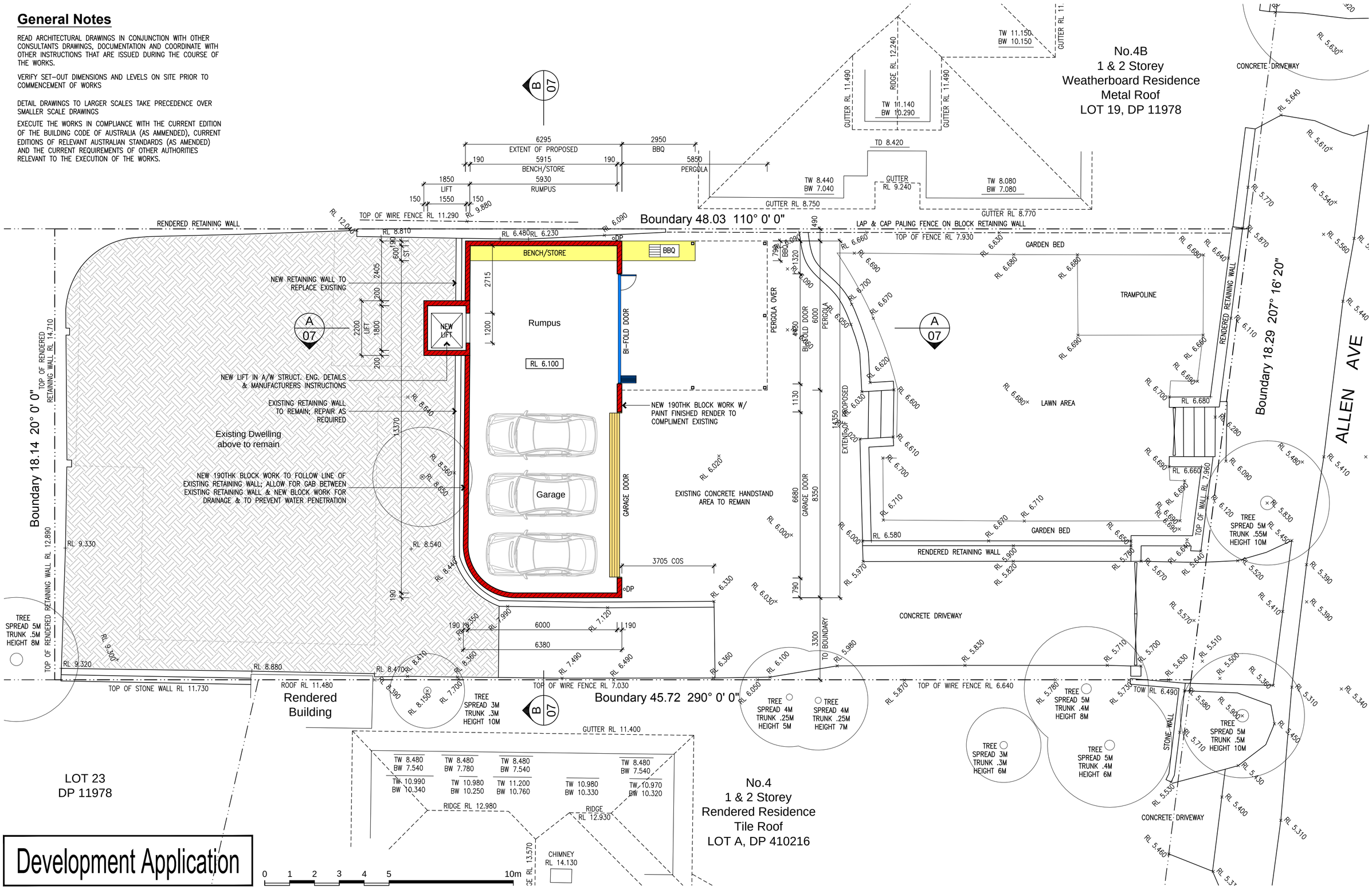
General Notes

READ ARCHITECTURAL DRAWINGS IN CONJUNCTION WITH OTHER CONSULTANTS DRAWINGS, DOCUMENTATION AND COORDINATE WITH OTHER INSTRUCTIONS THAT ARE ISSUED DURING THE COURSE OF THE WORKS.

VERIFY SET–OUT DIMENSIONS AND LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORKS

DETAIL DRAWINGS TO LARGER SCALES TAKE PRECEDENCE OVER SMALLER SCALE DRAWINGS

EXECUTE THE WORKS IN COMPLIANCE WITH THE CURRENT EDITION OF THE BUILDING CODE OF AUSTRALIA (AS AMMENDED), CURRENT EDITIONS OF RELEVANT AUSTRALIAN STANDARDS (AS AMENDED) AND THE CURRENT REQUIREMENTS OF OTHER AUTHORITIES RELEVANT TO THE EXECUTION OF THE WORKS.



This design is not to be used, copied or reproduced without authority.

Do not scale from drawings. Confirm dimensions on site prior to commencement of works. Where a discrepancy arrises seek direction prior to proceeding with the works.

This drawing is only to be used for its designated purpose. Unless otherwise stated this drawing is not to be used for construction.

Amendments

Issue	Description	By	Date
A	DEVELOPMENT APPLICATION ISSUED TO COUNCIL	BH	DEC 2015

BH Designs
Building Design & Drafting Services

ABN: 80 356 936 642
Mob: 0418 218 341
Email: brendan@bhdesigns.com.au

PROJECT TITLE: Alterations & Additions to Existing Dwelling

ADDRESS: No.4 Allen Avenue Bilgola Beach

SCALE: 1:100 @ A2

DATE: December 2015

DRAWN: bh

CHECKED:

CLIENT: Wehbe Residence

DRAWING TITLE: Proposed Lower Ground Floor Plan

DRAWING NO: 1509/DA-03

ISSUE: A

General Notes

READ ARCHITECTURAL DRAWINGS IN CONJUNCTION WITH OTHER CONSULTANTS DRAWINGS, DOCUMENTATION AND COORDINATE WITH OTHER INSTRUCTIONS THAT ARE ISSUED DURING THE COURSE OF THE WORKS.

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Levels

(XXX)????	(RL) RELATIVE LEVEL ???? (SSL) STRUCTURAL SLAB LEVEL ???? (FFL) FINISHED FLOOR LEVEL ???? (GND) FINISHED GROUND LEVEL ????
00.000	EXISTING SITE LEVELS TRANSPOSED FROM SITE SURVEY FOR REFERENCE.
00.000EXT	EXISTING SITE LEVELS EXTRAPOLATED BY BH DESIGN FROM SITE SURVEY INFORMATION. EXTRAPOLATED LEVEL MAY BE LIMITED IN THEIR ACCURACY.

BASIX Compliance

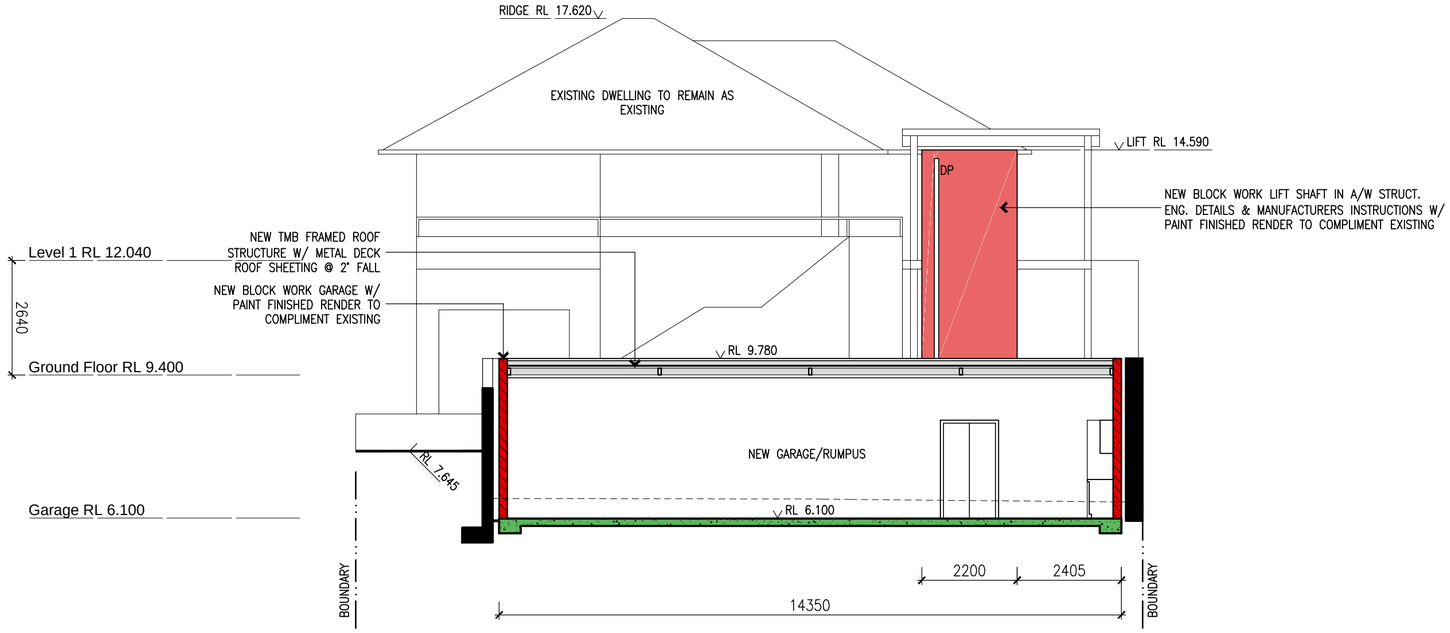
LIGHTING
ENSURE A MIN.40% OF NEW OR ALTERED LIGHT FIXTURES ARE FITTED W/ FLUORESCENT, COMPACT FLUORESCENT, OR LIGHT–EMITTING–DIODE LAMPS.

FIXTURES
INSTALL GAS INSTANTANEOUS HOT WATER SYSTEM.
ENSURE NEW OR ALTERED SHOWERHEADS HAVE A FLOW RATE NO GREATER THAN 9L/MIN OR A 3 STAR WATER RATING.
ENSURE NEW OR ALTERED TOILETS HAVE A FLOW RATE NO GREATER THAN 4L/AVERAGE FLUSH OR A MIN. 3 STAR WATER RATING.
ENSURE NEW OR ALTERED TAPS HAVE A FLOW RATE NO GREATER THAN 9L/MIN OR A MIN. 3 STAR WATER RATING.

INSULATION REQUIREMENTS
FLOOR ABOVE EXISTING DWELLING OR BUILDING – NIL
EXTERNAL WALL: BRICK VENEER – R1.16 (OR R1.70 INCLUDING CONSTRUCTION).
EXTERNAL WALL: FRAMED – R1.30 (OR R1.70 INCLUDING CONSTRUCTION).
FLAT CEILING, PITCHED ROOF – CEILING R2.50 (UP), ROOF: FOIL/SARKING. MEDIUM SOLAR ABSORPTANCE 0.475–0.70.
RAKED CEILING, PITCHED/SKILLION ROOF: FRAMED – CEILING R2.50 (UP), ROOF: FOIL/SARKING. MEDIUM SOLAR ABSORPTANCE 0.475–0.70.

WINDOWS AND GLAZED DOORS
INSTALL ALL WINDOWS, GLAZED DOORS & SHADING DEVICES IN A/W BASIX CERTIFICATE.
FOR PROJECTIONS DESCRIBED IN MM, THE LEADING EDGE OF EACH EAVE, PERGOLA, VERANDAH, BALCONY OR AWNING MUST BE NO MORE THAN 500MM ABOVE THE HEAD OF THE WINDOW OR GLAZED DOOR AND NO MORE THAN 2400MM ABOVE THE SILL.
OVERSHADOWING BUILDINGS OR VEGETATION MUST BE OF THE HEIGHT & DISTANCE FROM THE CENTRE & THE BASE OF THE WINDOW & GLAZED DOOR, AS SPECIFIED IN THE BASIX CERTIFICATE.

GLAZING REQUIREMENTS
EACH SKYLIGHT MAY EITHER MATCH THE DESCRIPTION, OR, HAVE A U–VALUE AND A SHGC NO GREATER THAN THAT LISTED IN THE BASIX CERTIFICATE.
EXTERNAL AWNINGS & LOUVRES MUST FULLY SHADE THE SKYLIGHT ABOVE WHICH THEY ARE SITUATED WHEN FULLY DRAWN OR CLOSED.



Section B-B
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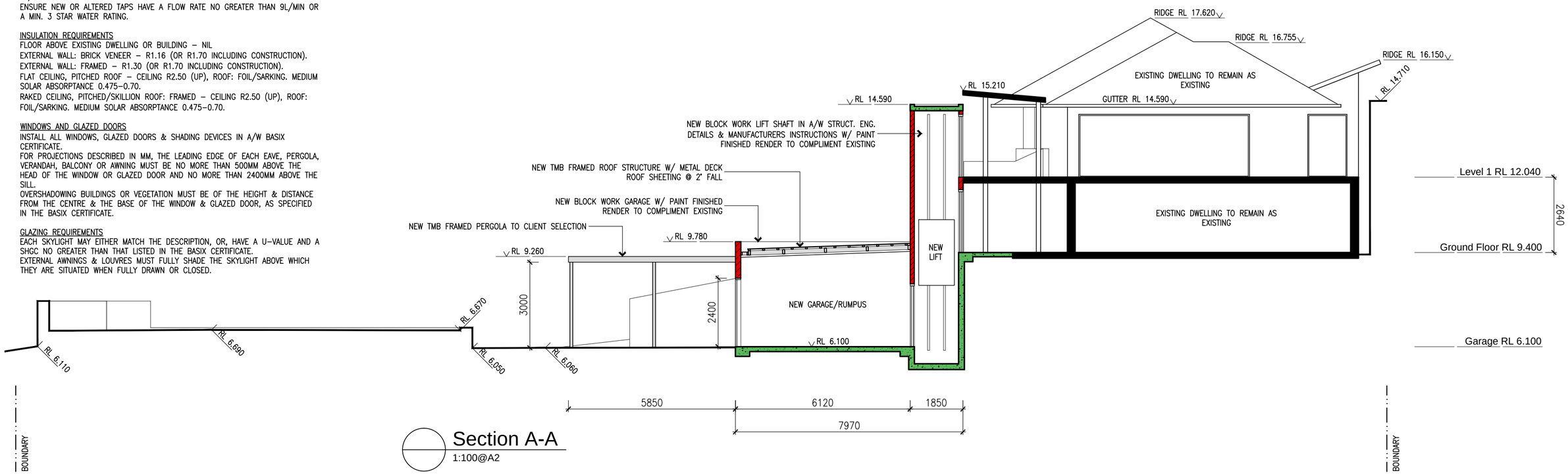


Section A-A
1:100@A2

Development Application

0 1 2 3 4 5 10m

Amendments

Issue	Description	By	Date
A	DEVELOPMENT APPLICATION ISSUED TO COUNCIL	BH	DEC 2015

BH Designs
Building Design & Drafting Services

ABN: 80 356 936 642
Mob: 0418 218 341
Email: brendan@bhdesigns.com.au

PROJECT TITLE: Alterations & Additions to Existing Dwelling

ADDRESS: No.4 Allen Avenue Bilgola Beach

CLIENT: Wehbe Residence

DRAWING TITLE: Proposed Sections

SCALE: 1:100 @ A2

DATE: December 2015

DRAWN: bh

CHECKED:

DRAWING NO: 1509/DA-07

ISSUE: A

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	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		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. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

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

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.

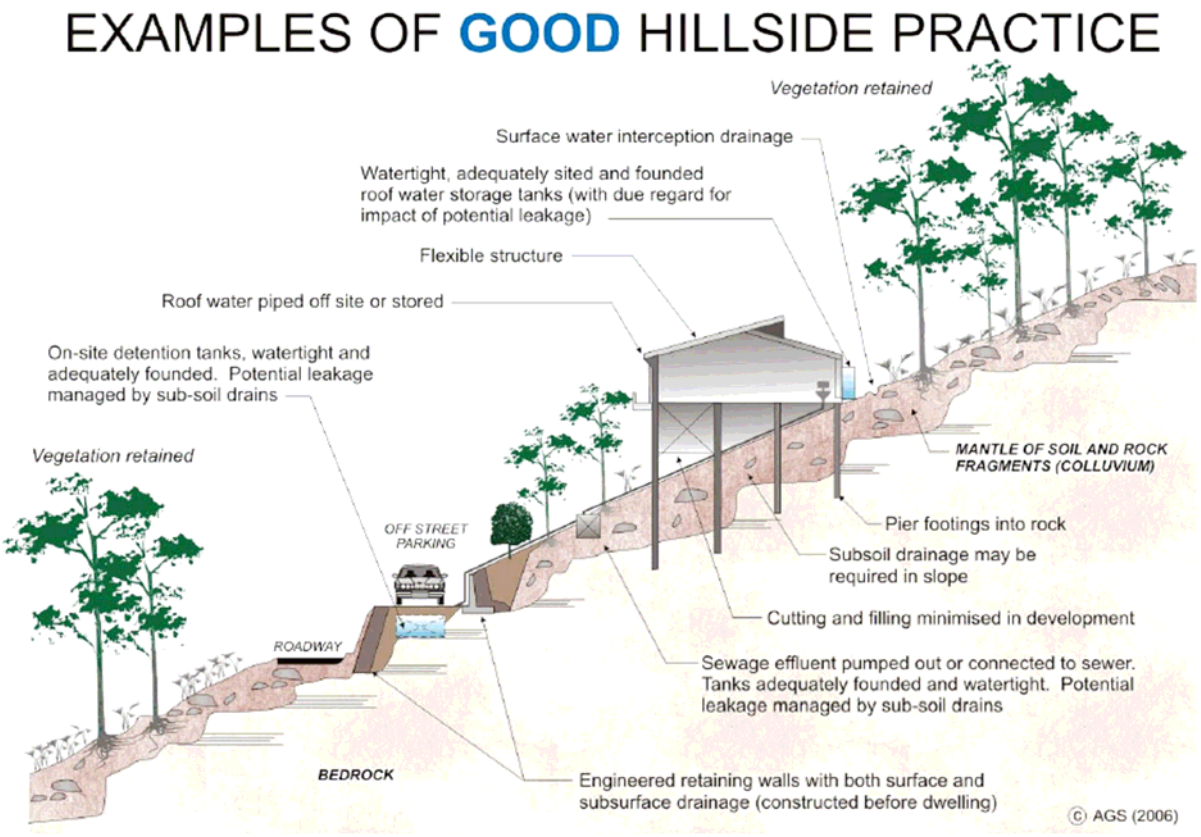
RISK LEVEL IMPLICATIONS

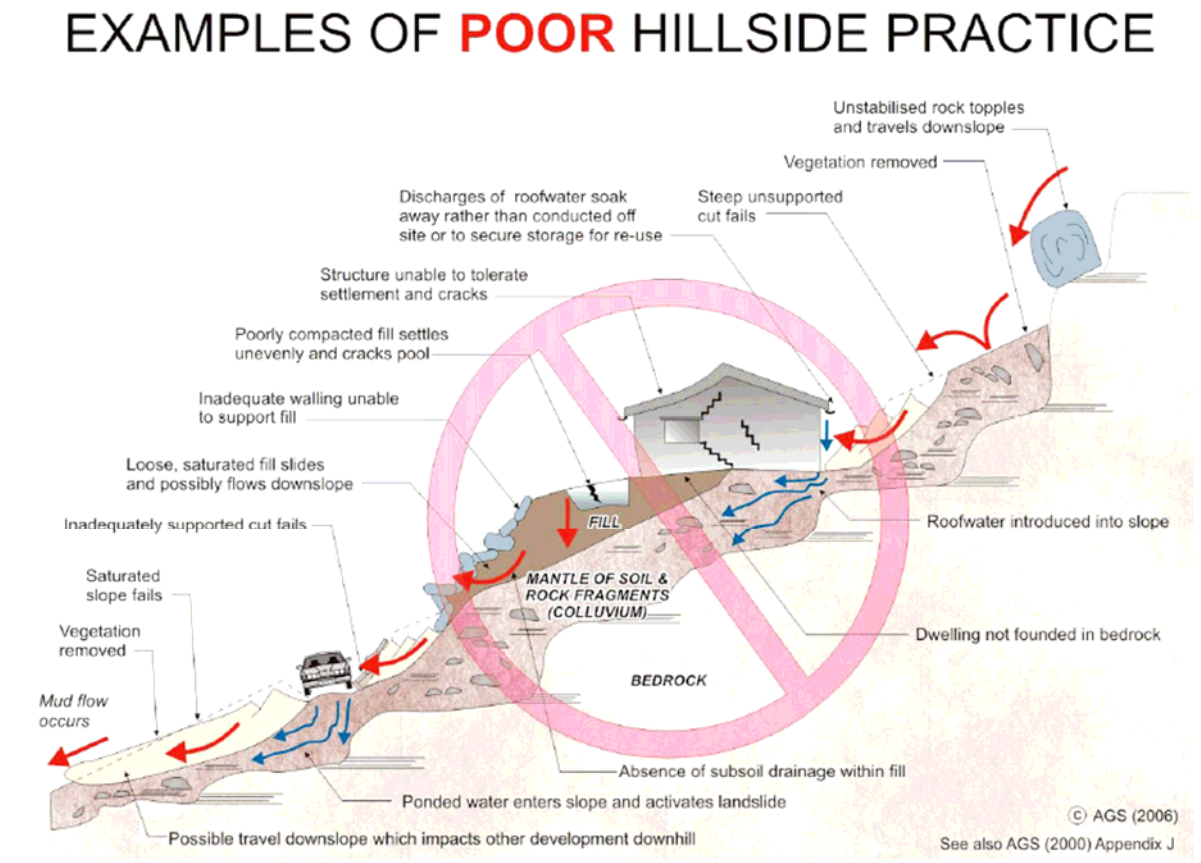
Risk Level		**Example Implications** (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the 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.

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
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
Vegetation retained
Surface water interception drainage
Watertight, adequately sited and founded roof water storage tanks (with due regard for impact of potential leakage)
Flexible structure
Roof water piped off site or stored
On-site detention tanks, watertight and adequately founded. Potential leakage managed by sub-soil drains
Vegetation retained
MANTLE OF SOIL AND ROCK FRAGMENTS (COLLUVIUM)
OFF STREET PARKING
Pier footings into rock
Subsoil drainage may be required in slope
Cutting and filling minimised in development
ROADWAY
Sewage effluent pumped out or connected to sewer. Tanks adequately founded and watertight. Potential leakage managed by sub-soil drains
BEDROCK
Engineered retaining walls with both surface and subsurface drainage (constructed before dwelling)
© AGS (2006)


EXAMPLES OF POOR HILLSIDE PRACTICE
Unstabilised rock topples and travels downslope
Vegetation removed
Discharges of roofwater soak away rather than conducted off site or to secure storage for re-use
Steep unsupported cut fails
Structure unable to tolerate settlement and cracks
Poorly compacted fill settles unevenly and cracks pool
Inadequate walling unable to support fill
Loose, saturated fill slides and possibly flows downslope
Inadequately supported cut fails
FILL
Roofwater introduced into slope
Saturated slope fails
MANTLE OF SOIL & ROCK FRAGMENTS (COLLUVIUM)
Vegetation removed
Dwelling not founded in bedrock
BEDROCK
Mud flow occurs
Absence of subsoil drainage within fill
Ponded water enters slope and activates landslide
Possible travel downslope which impacts other development downhill
© AGS (2006)
See also AGS (2000) Appendix J