Central Coast Council

Local Planning Panel Meeting

ATTACHMENTS PROVIDED UNDER SEPARATE COVER

Thursday 23 September 2021

Central Coast Council

ATTACHMENTS PROVIDED UNDER SEPARATE COVER to the

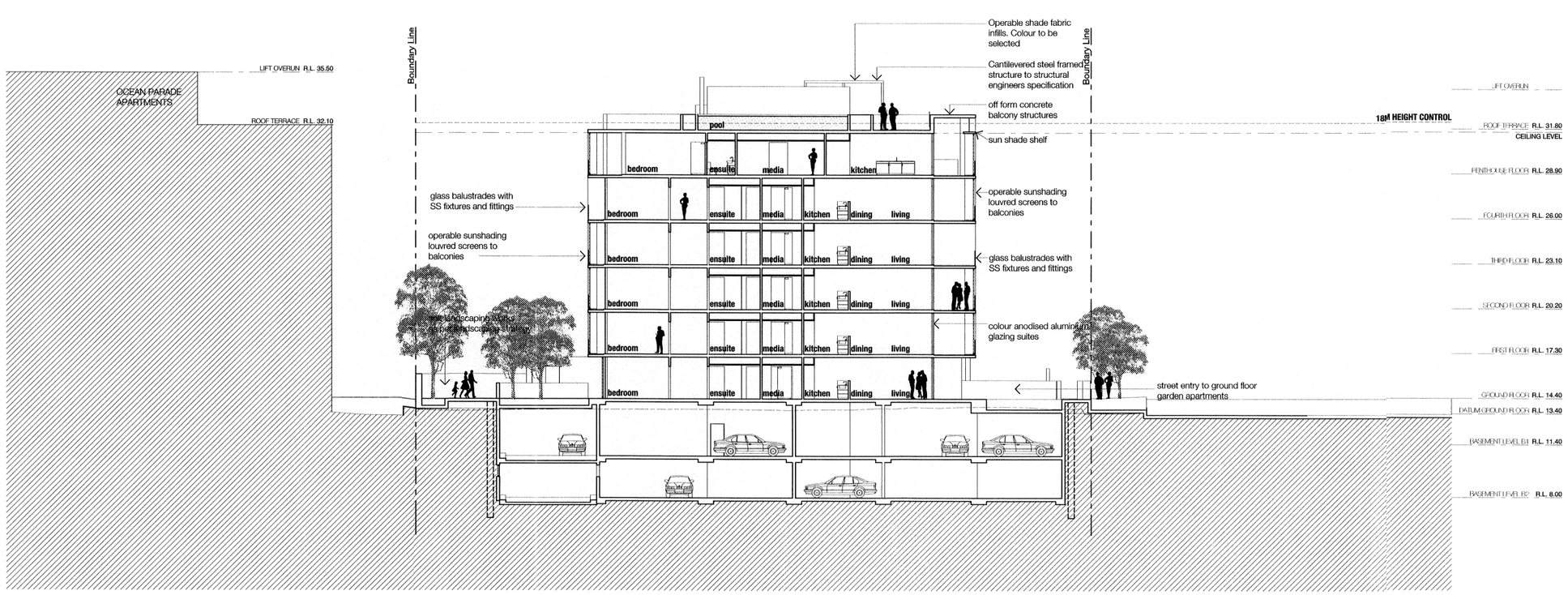
Local Planning Panel Meeting

To be held Remotely - Online,
on Thursday 23 September 2021
Commencing at 2:00pm

INDEX

PLANNING REPORTS

PLANNING REPORTS - OUTSIDE OF PUBLIC MEETING



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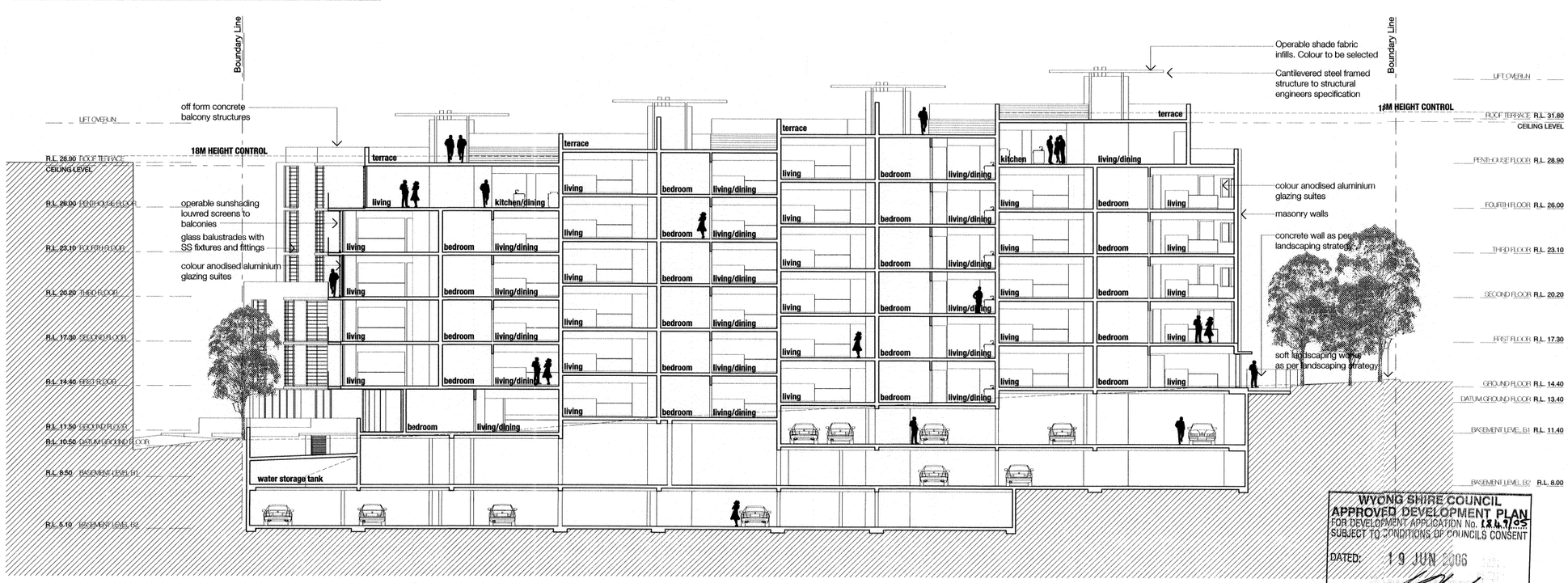

EAST - WEST SECTION 1 : 200

issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford, NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
SECTIONS

drawing scale	
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1601 issue B

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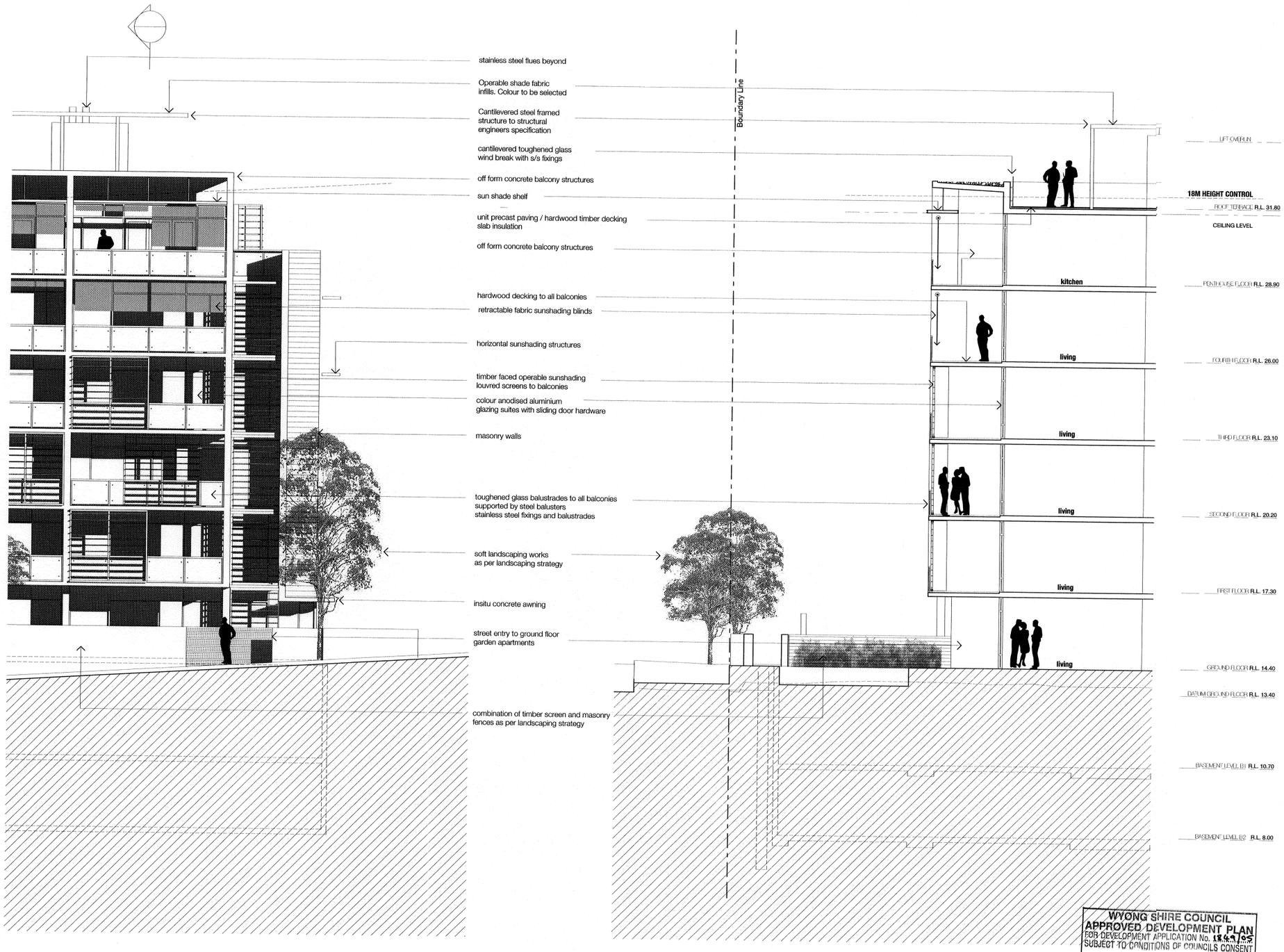

issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
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Cnr Ocean Parade & Fairport Avenue
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drawing title
FACADE DETAILS NORTH

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1602 issue C

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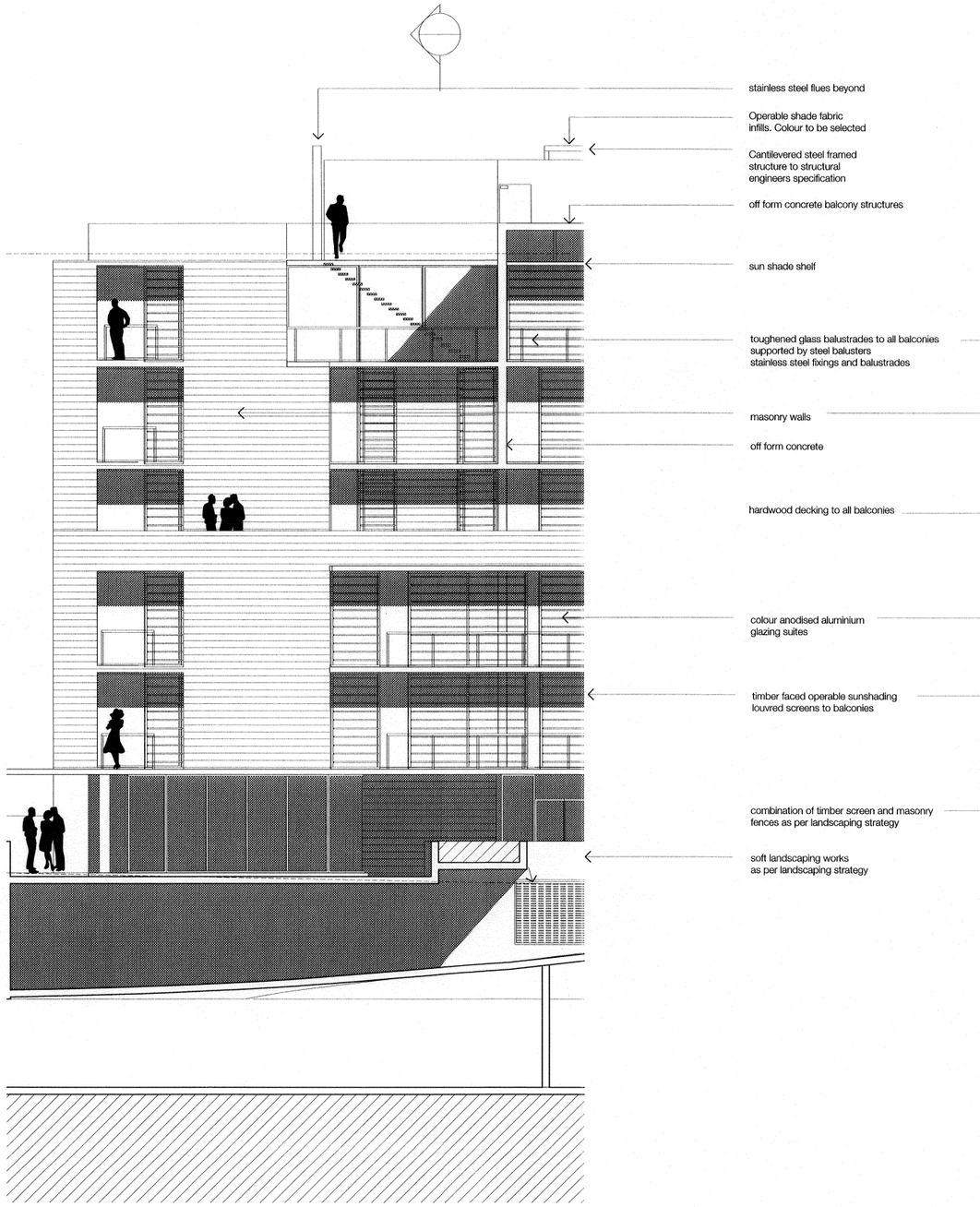


stainless steel flues beyond

Operable shade fabric infills. Colour to be selected

Cantilevered steel framed structure to structural engineers specification

off form concrete balcony structures

sun shade shelf

toughened glass balustrades to all balconies supported by steel balusters stainless steel fixings and balustrades

masonry walls

off form concrete

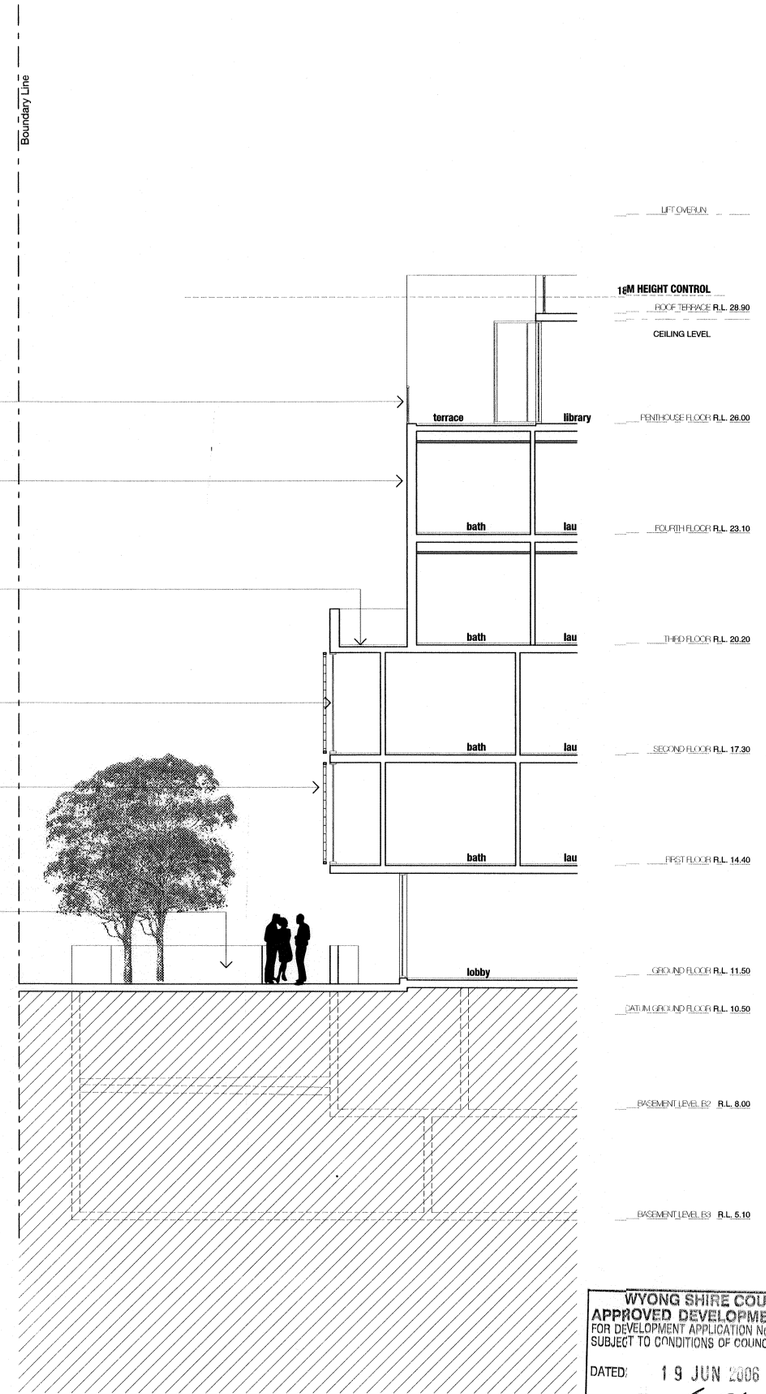
hardwood decking to all balconies

colour anodised aluminium glazing suites

timber faced operable sunshading louvred screens to balconies

combination of timber screen and masonry fences as per landscaping strategy

soft landscaping works as per landscaping strategy



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A	RE-ISSUE FOR DA	15.12.05

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford, NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

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drawing title
FACADE DETAILS EAST

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1603 issue A

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stainless steel flues beyond

Operable shade fabric
infills. Colour to be selected

Cantilevered steel framed
structure to structural
engineers specification

toughened glass balustrades to all balconies
supported by steel balusters
stainless steel fixings and balustrades

hardwood decking to all balconies

toughened glass balustrades to all balconies
supported by steel balusters
stainless steel fixings and balustrades

timber faced operable sunshading
louvred screens to balconies

off form concrete balcony structures

masonry walls

colour anodised aluminium glazing suites

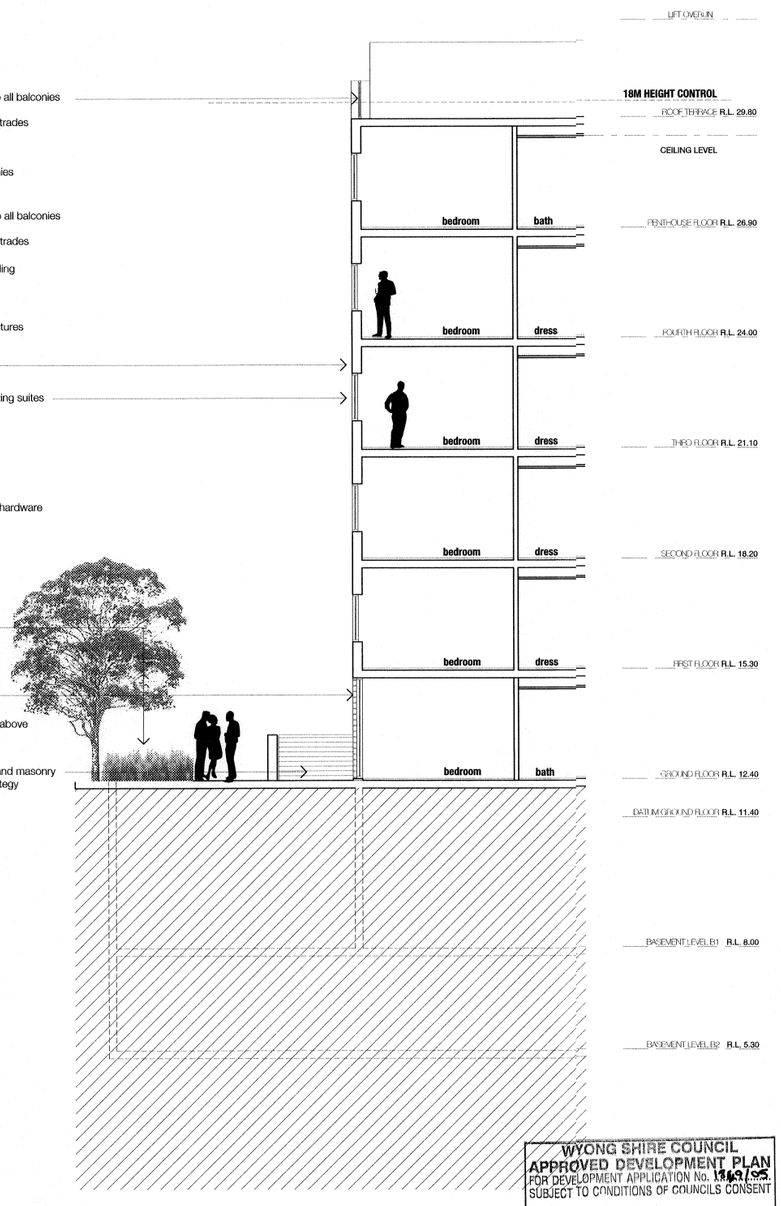
colour anodised aluminium
glazing suites with sliding door hardware

soft landscaping works
as per landscaping strategy

adjustable screens for privacy
inconjunction with landscape
and seperation

entry to lobby and apartments above

combination of timber screen and masonry
fences as per landscaping strategy



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landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

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THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
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drawing title
FACADE DETAILS SOUTH

WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05B
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1604 issue A

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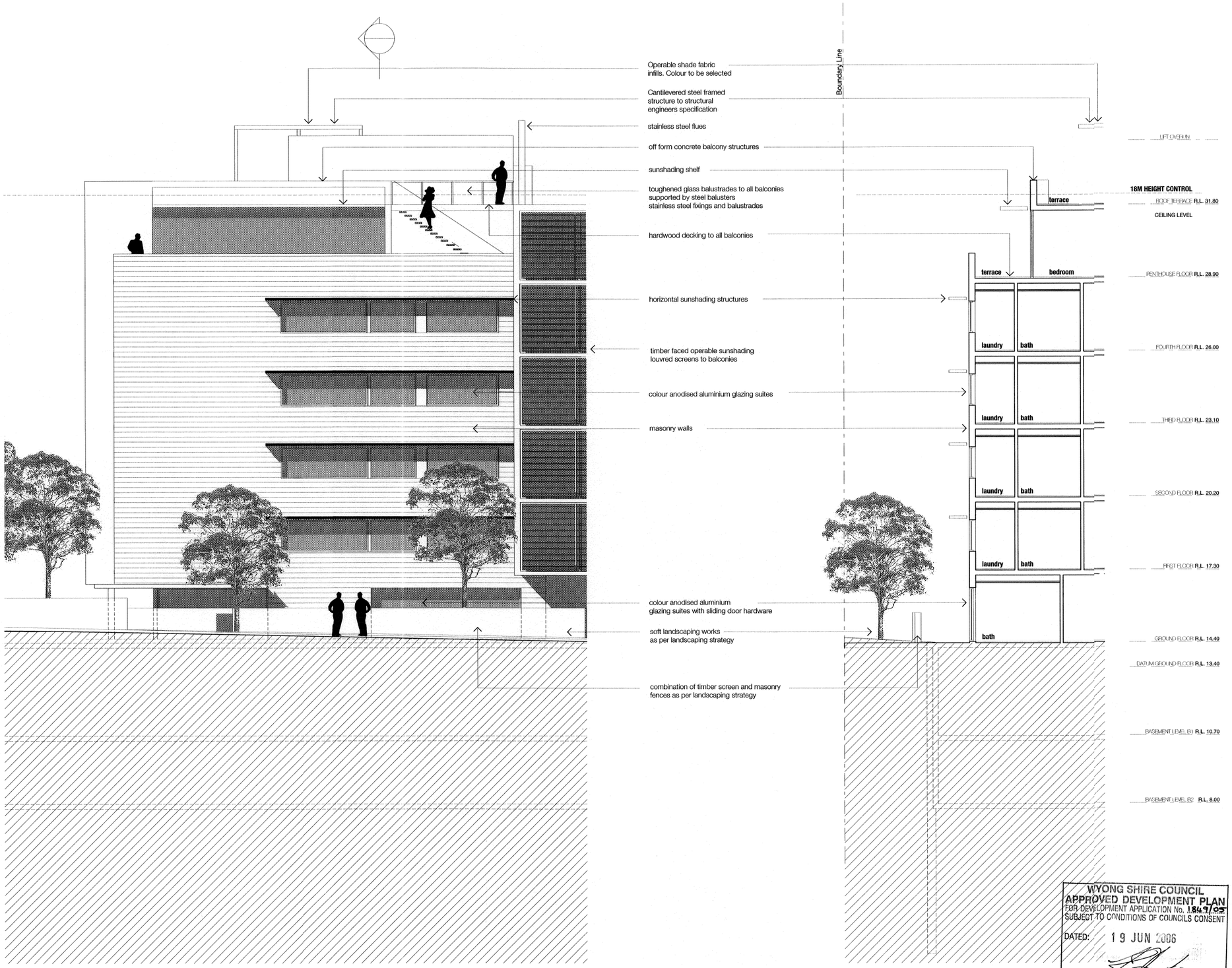

issue	description	date
A	RE-ISSUE FOR DA	15.12.05
B	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
FACADE DETAILS WEST

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1605 issue B

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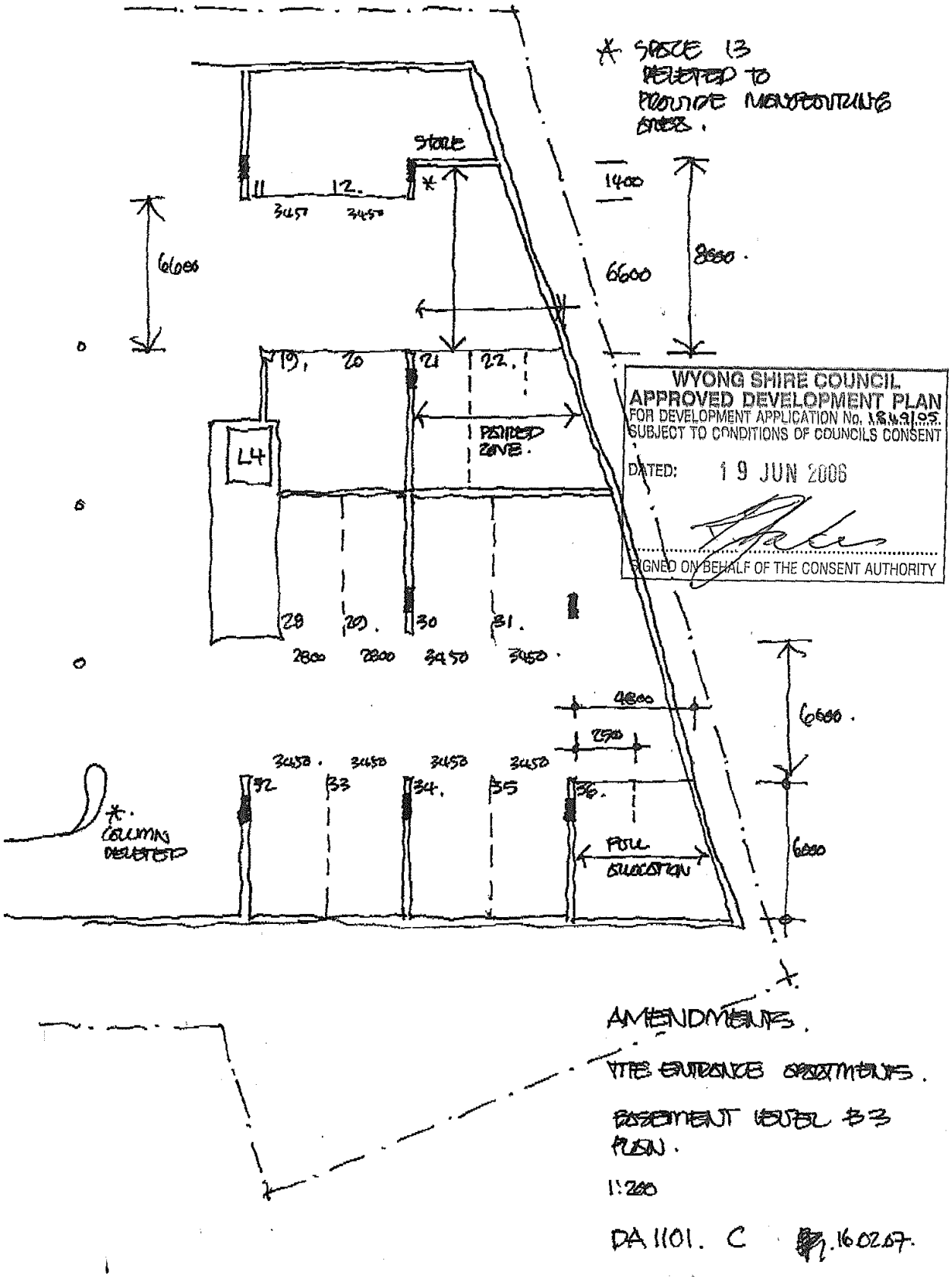

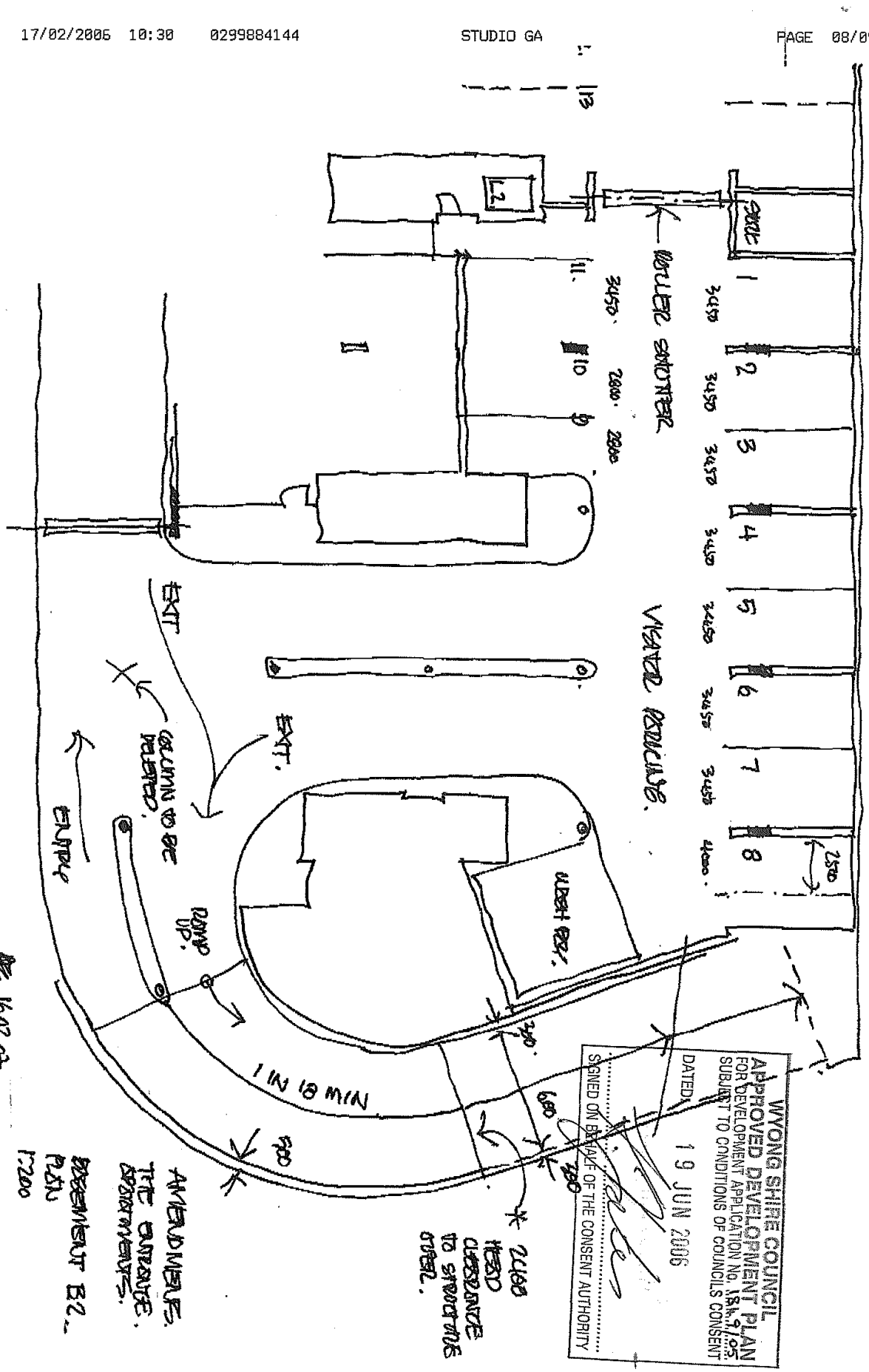
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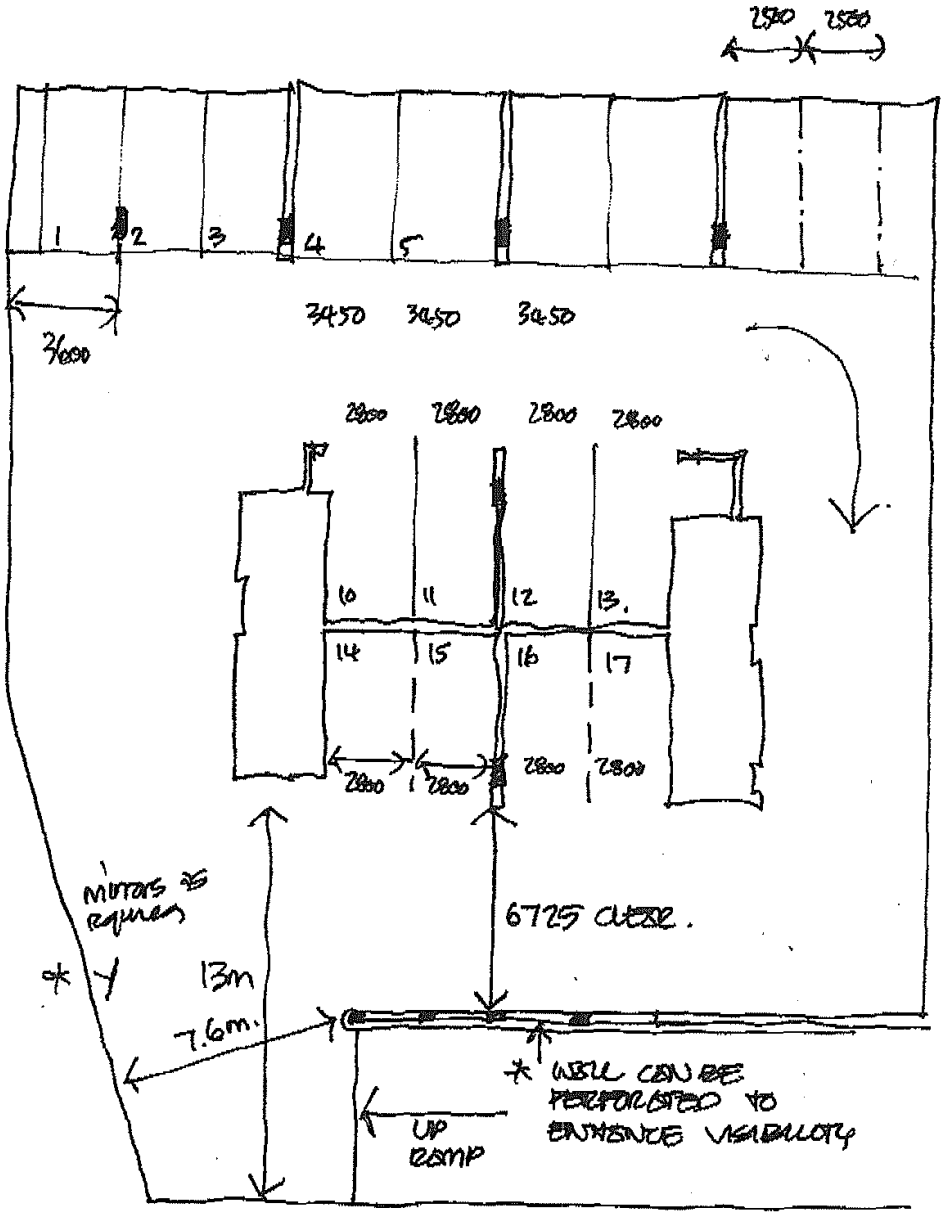
WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/2005
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY
EXIT
EXIT.
ENTRY
RAMP UP.
1 IN 18 MIN
VISITOR PARKING.
WASH BAY.
2400 HEAD CLEARANCE TO STRUCTURE OVER.
AMENDMENTS. THE ENTRANCE ARRANGEMENTS.
BASEMENT B2 - PLAN
1:200
DA 1102 C
16.02.06



WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

AMENDMENTS.
THE ENTRANCE GAS.
DEVELOPMENT 81.
PLAN
1:200
DA 1201. D REV 16.02.06

legend

- in-situ concrete
- paving strips
- concrete slabs
- gravel 1
- gravel 2
- paving
- timber deck
- stone seating wall (min. 0.4 m to 1.6 m depending on terrain)
- rendered feature wall (2.0 m high)
- stone retaining wall to boundaries (1.6 m high)
- concrete planter/retaining wall (1.0 m high, depending on terrain)
- semitransparent screening wall (1.6 m high)
- screening fence (1.6 m high)
- pool fence (1.2 m high)
- pool
- turf
- 'forest' screen/feature planting to sheltered locations
- 'seaside' planting to exposed locations
- 'wetland' planting to overland flow path
- higher roof top planting (deeper soil depth)
- lower roof top planting
- hedge
- tree to be planted

- O 14.32 existing level
- +64.50 proposed level
- −64.50 level of slab under

NOTES

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DATE	REV	AMENDMENTS	APP
22.09.05	C	DA	
12.09.05	B	Consultant Review	
22.08.05	A	Consultant Review	

REFERENCES

CONSULTANT	DRAWING ID	DATE OF ISSUE
studio GA	psb zip	16.06.05
studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept

Landscape Concept

The Fairport Apartments

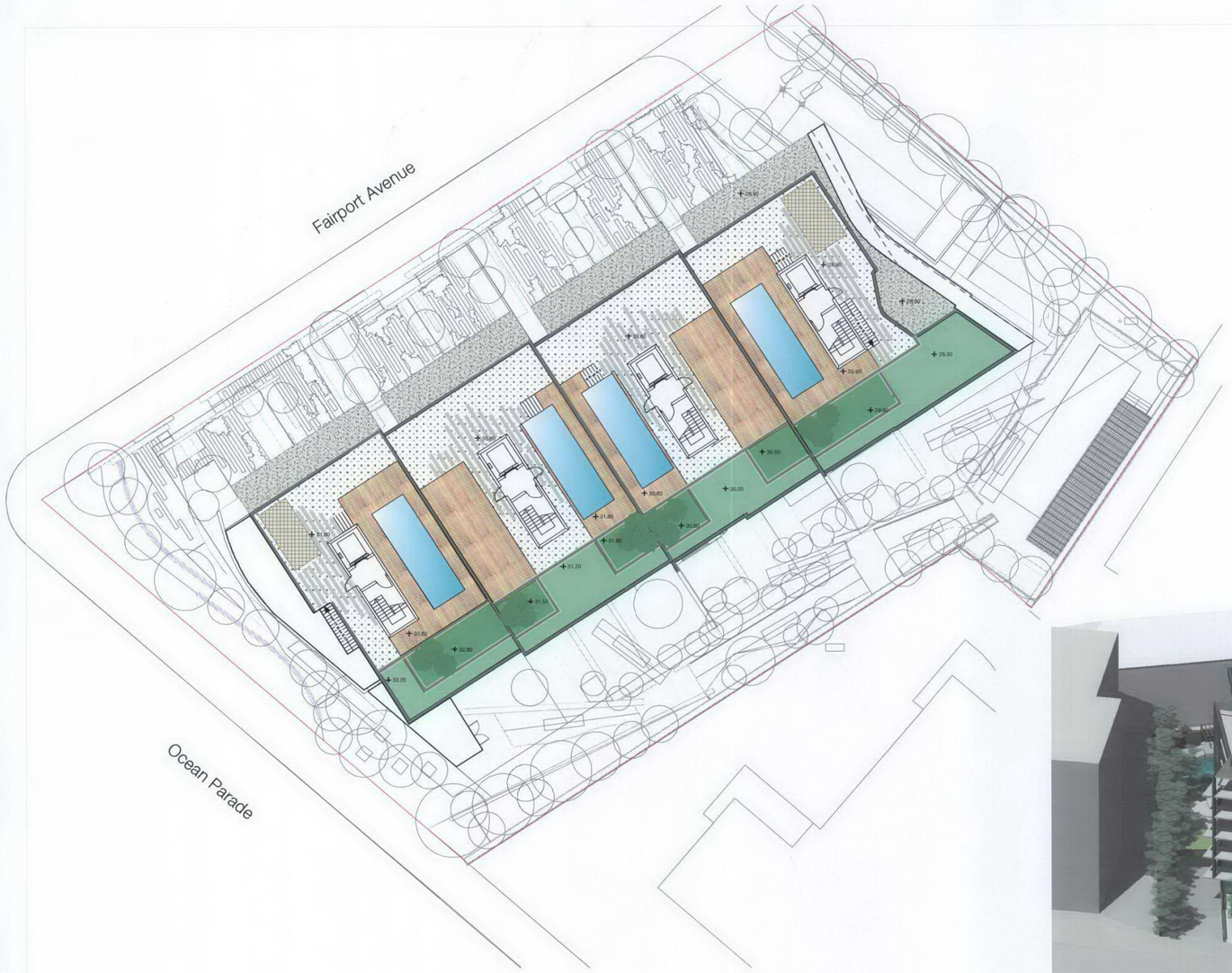
Beachview Pty Ltd c/- Studio GA Pty Ltd.

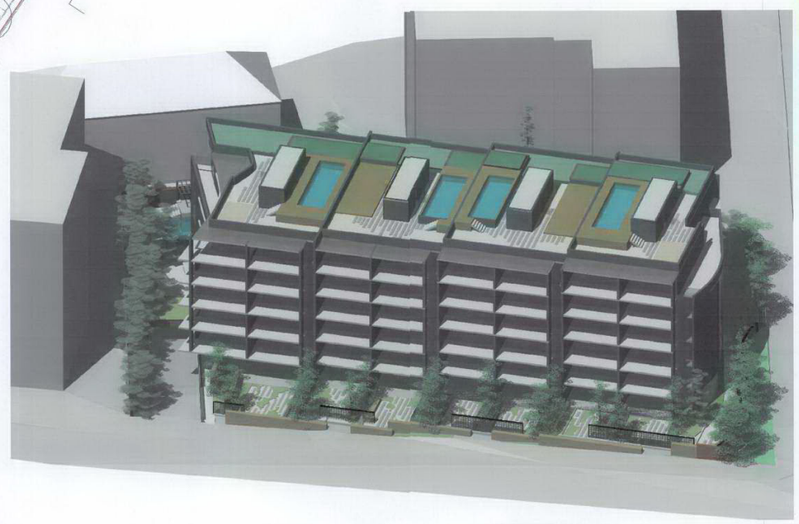
0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au W www.psb.com.au

Scale	1:200@A1
	05062
	01.07.05

DA01C





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studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept - Rooftop Planting

Landscape Concept - Rooftop Planting

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au | W www.psb.com.au

Scale	1:200@A1
	05062
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DA02C

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studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept hardworks

Landscape Concept - Hardworks

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au | W www.psb.com.au

Scale	1:200@A1
	05062
	01.07.05

DA03C

Trees and specimen shrubs

Botanical name	Common Name	Height	Spread
Angophora costata	Sydney Red Gum	12.0 m	7.0 m
Acmena smithii	Lilly Pilly	8.0 m	5.0 m
Syzygium paniculatum	Magenta Lilly Pilly	5.0 m	5.0 m
Howea belmoreana	Kentia	6.0 m	3.0 m
Ceratopetalum gummiferum	NSW Xmas Bush	6.0 m	2.0 m
Elaeocarpus reticulatus	Blueberry Ash	10.0 m	5.0 m
Corymba gummifera	Red Bloodwood	16.0 m	7.0 m
Nyssa sylvatica	Tupelo	15.0 m	10.0 m

Shrubs and Hedges

Botanical name	Common Name	Height	Spread
Banksia spinulosa var. spinulo	Hairpin Banksia	2.0 m	2.0 m
Callandra tweedii	Red Tassle-flower	2.0 m	3.0 m
Camelia sasanqua	Camelia	1.5 m	1.0 m
Doryanthes revoluta	Doryanthes	1.5 m	1.5 m
Fatsia japonica	Aralia	2.0 m	1.0 m
Gardenia augusta 'Florida'	Gardenia	1.0 m	1.0 m
Hebe 'Inspiration'	Veronica	1.0 m	1.0 m
Lavandula angustifolia	Dwarf Lavender	1.0 m	1.0 m
Melaleuca thymifolia	Thyme Honey Myrtle	1.0 m	1.0 m
Philodendron 'Xanadu'	Dwarf Philodendron	1.0 m	0.8 m
Pittosporum 'Miss Mauffett'	Pittosporum	1.0 m	1.0 m
Raphiolepis indica	India Hawthorn	1.8 m	1.5 m
Rhaphis excelsa	Little Lady Palm	2.0 m	1.0 m
Rosmarinus officinalis	Rosemary	1.2 m	1.2 m
Schefflera aboricola	Dwarf Umbrella	2.0 m	1.5 m
Strelitzia reginae	Birds Nest Flower	1.0 m	2.0 m
Syzygium 'Cascade'	Lilly Pilly	2.0 m	2.0 m
Viburnum odoratissimum	Viburnum	3.0 m	2.0 m

Groundcovers

Botanical name	Common Name	Height	Spread
Agapanthus x orientalis	Dwarf African Lily	0.5 m	0.5 m
Brachycome 'White'	Rock Daisy	0.3 m	0.4 m
Clivia miniata	Clivia	0.5 m	0.6 m
Crinum asiaticum		0.6 m	0.6 m
Hardenbergia violaceae	False Sarsparilla	2.0 m spread	
Hemerocallis fulva	Orange Day Lily	0.4 m	0.6 m
Hibbertia scandens	Snake Vine	1.5 m spread	
Liriope muscari 'Evergreen Gia	Giant Turf Lily	0.6 m	0.5 m
Myoporum parvifolium	Creeping Boobialla	0.4 m	1.0 m
Phormium 'Bronze Baby'	Bronze Baby Flax	0.6 m	0.6 m
Scaevola aemula 'Mauve Mist'	Fan Flower	0.3 m	0.5 m
Trachelospermum jasminoides	Star Jasmine	2.0 m spread	
Viola hederaceae	Native Violet	0.3 m	0.5 m

Grass and Fern Mix

Adiantum aethopicum	Maidenhair Fern	0.5 m	0.5 m
Asplenium nidus	Mother Fern	1.0 m	1.0 m
Cyathea cooperii	Cooper's Tree Fern	6.0 m	5.0 m
Cycas revoluta	Sago Palm	2.0 m	2.0 m
Dianella caerulea var. caerulea	Blue Flax Lily	0.5 m	0.5 m
Dianella revoluta	Mauve Flax Lily	0.5 m	0.5 m
Festuca glauca	Blue Fescue	0.3 m	0.4 m
Pteridium esculentum	Bracken Fern	0.8 m	0.7 m

ROOFTOP PLANT SCHEDULE

Botanical name	Common Name	Height	Spread
Agapanthus x orientalis	Dwarf African Lily	0.5 m	0.5 m
Banksia spinulosa var. spinulosa	Hairpin Banksia	2.0 m	2.0 m
Brachicome "White"	Rock Daisy	0.3 m	0.4 m
Carpobrotus glaucescens	Pigface	0.5 m	2.0 m
Dianella caerulea var. caerulea	Blue Flax Lily	0.5 m	0.5 m
Festuca glauca	Blue Fescue	0.3 m	0.4 m
Grevillea sericea	Pink Spider Flower	1.0 m	1.0 m
Lavandula angustifolia	Dwarf Lavender	1.0 m	1.0 m
Phormium 'Bronze Baby'	Bronze Baby Flax	0.6 m	0.6 m
Scaevola aemula 'Mauve Mist'	Fan Flower	0.3 m	0.5 m
Strelitzia reginae	Birds Nest Flower	1.0 m	2.0 m

OVERLAND FLOWPATH PLANT SCHEDULE

Trees and specimen shrubs

Botanical name	Common Name	Hight	Spread
Melaleuca quinquenervia	Paperbark	10.0 m	5.0 m
Hibiscus tiliaceus 'Redleaf'	Red-leafed Hibiscus	6.0 m	4.0 m
Livistona australis	Cabbage Palm	9.0 m	4.0 m

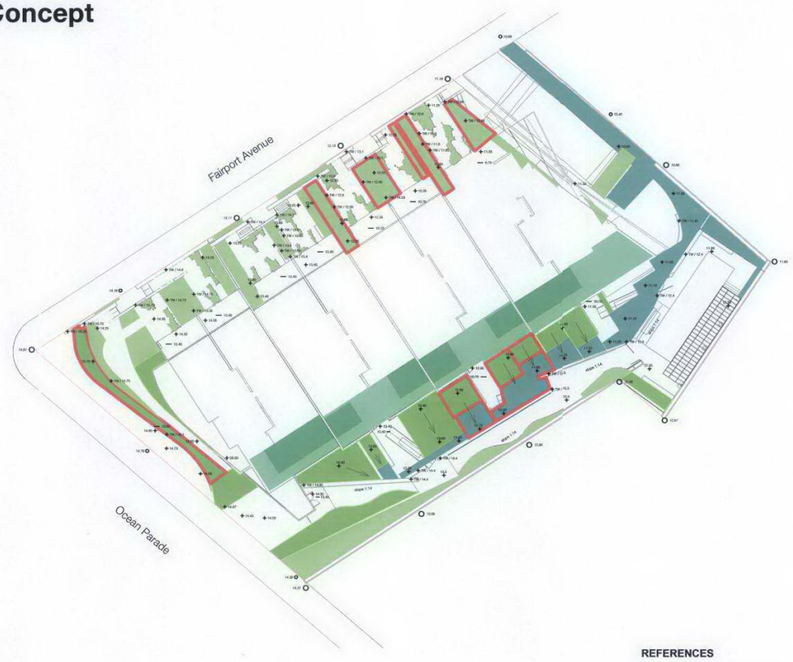
Shrubs and climbers

Botanical name	Common Name	Hight	Spread
Austromyrtus tenuifolia	Narrow Leaf Myrtle	1.5 m	1.0 m
Callistemon citrinus	Common Bottlebrush	3.0 m	2.5 m
Crinum pendiculatum	Swamp Lily	1.5 m	1.5 m
Melaleuca linarifolia	Snow in Summer	7.0 m	3.0 m

Groundcovers

Botanical name	Common Name	Hight	Spread
Lomandra longifolia	Mat Rush	1.0 m	1.0 m
Blechnum cartilagineum	Gristle Fern	0.8 m	0.6 m
Dianella caerulea	Blue Flax Lily	0.5 m	0.5 m
Imperata cylindrica	Blady Grass	1.0 m	0.5 m

Planting Concept



PLANTING CONCEPT

- pool
- turf
- 'forest' screen/feature planting to sheltered locations
- 'seaside' planting to exposed locations
- 'wetland' planting to overland flow path
- higher roof top planting (deeper soil depth)
- lower roof top planting
- deep planting areas with > 1m soil

SEASIDE PLANT SCHEDULE

Trees and specimen shrubs

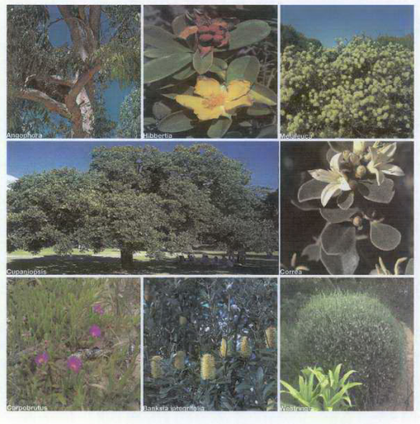
Botanical name	Common Name	Height	Spread
Angophora costata	Sydney Red Gum	12.0 m	7.0 m
Banksia integrifolia	Coast Banksia	10.0 m	5.0 m
Callitris rhomboidea	Port Jackson Cypress	8.0 m	2.0 m
Corymba gummifera	Red Bloodwood	12.0 m	4.5 m
Cordyline australis	NZ Cabbage Tree	8.0 m	4.0 m
Cupaniopsis anacardioides	Tuckeroo	9.0 m	6.0 m

Shrubs and climbers

Botanical name	Common Name	Height	Spread
Correa alba	White Correa	1.0 m	1.0 m
Dodonaea triquetra	Hop Bush	3.0 m	3.0 m
Hardenbergia violacea	Hardenbergia	2.0 m	2.0 m
Hibbertia scandens	Hibbertia	3.0 m	1.5 m
Leptospermum laevigatum	Coast Tea Tree	3.0 m	2.0 m
Melaleuca nodosa	Coastal Honeymyrtle	3.0 m	2.0 m
Myoporum boninense	Coastal Boobialla	3.0 m	2.0 m
Ricinocarpus pinifolius	Wedding Bush	1.5 m	1.0 m
Westringia fruticosa	Coastal Rosemary	1.2 m	1.2 m

Groundcovers

Botanical name	Common Name	Height	Spread
Actinotus helianthii	Flannel Flower	1.0 m	1.0 m
Canavalia rosea	Coastal Jack Bean	0.5 m	2.0 m
Carpobrotus glaucescens	Pigface	0.5 m	2.0 m
Dichondra repens	Kidney Weed	1.0 m	0.1 m
Dianella congesta	Coastal Flax Lily	0.5 m	0.4 m
Hibbertia scandens	Hibbertia	3.0 m	1.5 m
Imperata cylindrica	Blady Grass	1.0 m	1.0 m
Lomandra longifolia	Mat Rush	0.5 m	0.6 m
Scaevola albida	Small Fan Flower	1.0 m	0.5 m
Scaevola calendulacea	Dune Fan Flower	0.2 m	1.0 m



NOTES

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2. All levels shown are in meters Australian Height Datum unless otherwise specified.

DATE	REV	AMENDMENTS	APP
22.09.05	C	DA	
12.09.05	B	Consultant Review	
22.08.05	A	Consultant Review	

REFERENCES

CONSULTANT	DRAWING ID	DATE OF ISSUE
studio GA	psb zip	16.06.05
studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept - Planting

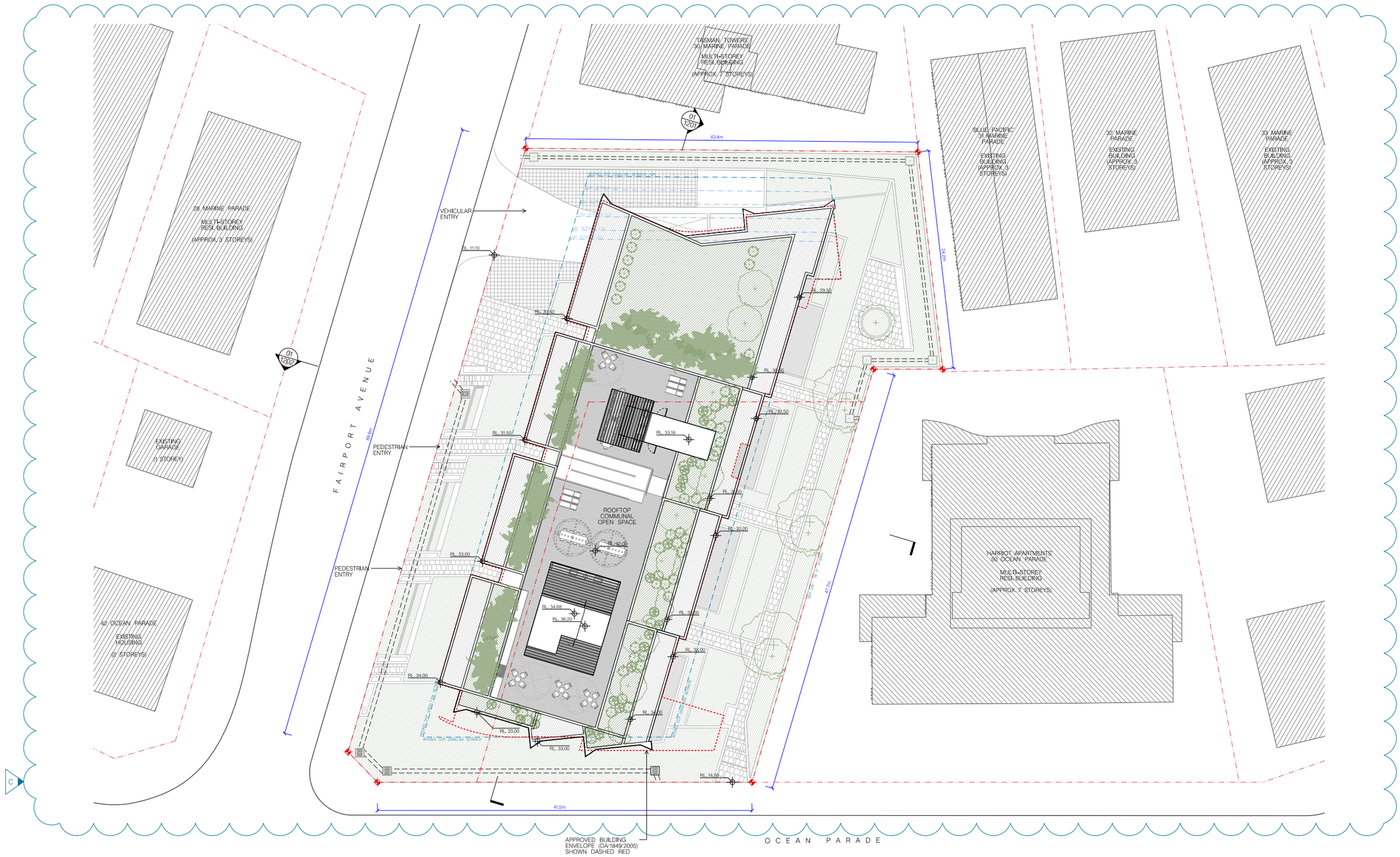
Landscape Concept - Planting

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au | W www.psb.com.au

Scale as shown
05062
01.07.05
DA06C



01 / – SITE PLAN
1:200

FOR S4.55 PURPOSES ONLY

ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

PROJECT:
2–4 FAIRPORT AVENUE, THE ENTRANCE

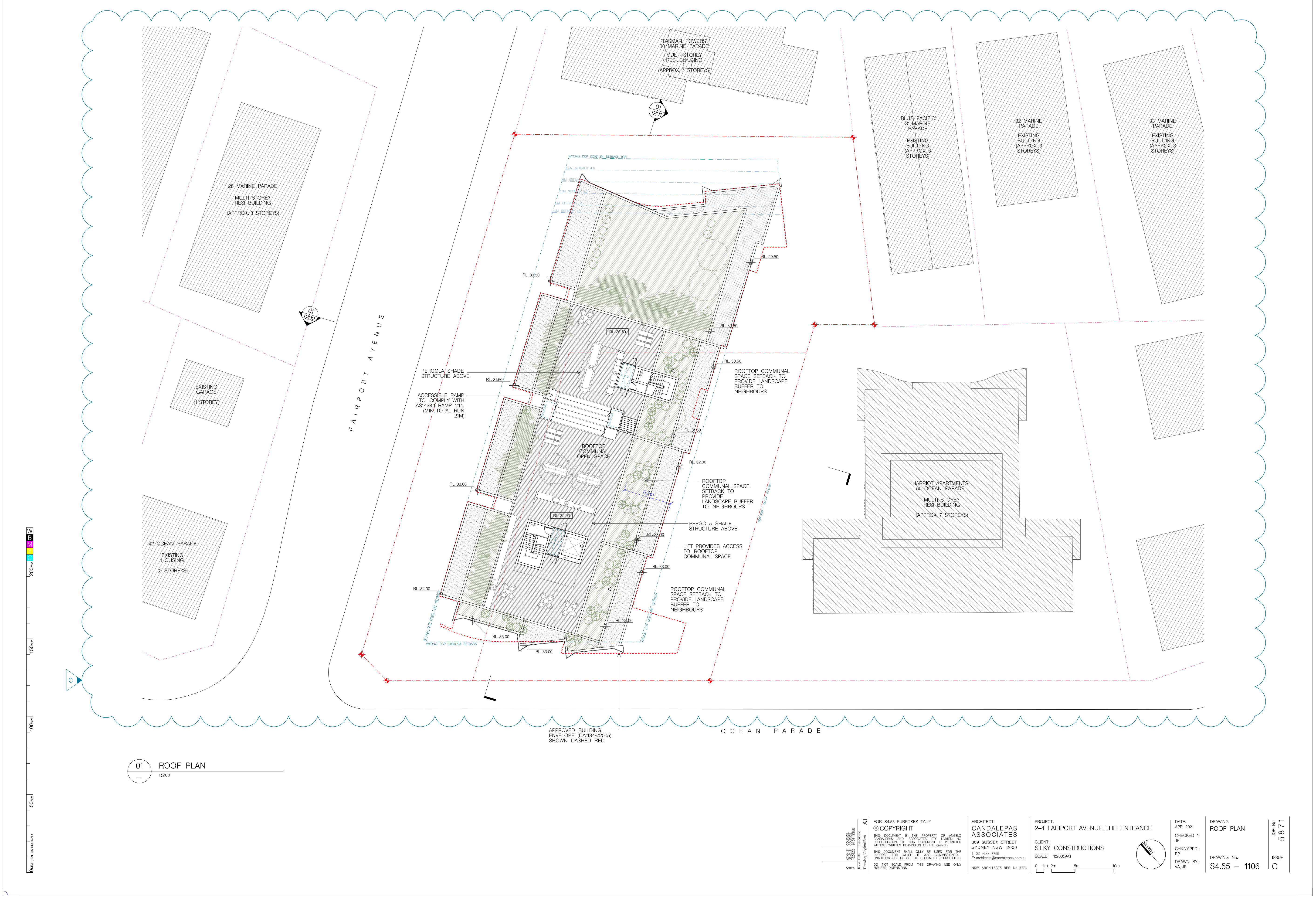
CLIENT:
SILKY CONSTRUCTIONS

SCALE: 1:200@A1

0 1m 2m 5m 10m

DATE: APR 2021
CHECKED 1: JH
CHK2/APPD: EP
DRAWN BY: VA, JE

DRAWING: SITE PLAN
DRAWING No. S4.55 – 1100
JOB No. 5871
ISSUE C


TASMAN TOWERS 30 MARINE PARADE
MULTI-STOREY RESI. BUILDING
(APPROX. 7 STOREYS)
'BLUE PACIFIC' 31 MARINE PARADE
EXISTING BUILDING (APPROX. 3 STOREYS)
32 MARINE PARADE
EXISTING BUILDING (APPROX. 3 STOREYS)
33 MARINE PARADE
EXISTING BUILDING (APPROX. 3 STOREYS)
28 MARINE PARADE
MULTI-STOREY RESI. BUILDING
(APPROX. 3 STOREYS)
EXISTING GARAGE (1 STOREY)
42 OCEAN PARADE
EXISTING HOUSING (2 STOREYS)
FAIRPORT AVENUE
OCEAN PARADE
'HARRIOT APARTMENTS' 50 OCEAN PARADE
MULTI-STOREY RESI. BUILDING
(APPROX. 7 STOREYS)
PERGOLA SHADE STRUCTURE ABOVE.
ACCESSIBLE RAMP TO COMPLY WITH AS1428.1. RAMP 1:14. (MIN. TOTAL RUN 21M)
ROOFTOP COMMUNAL OPEN SPACE
ROOFTOP COMMUNAL SPACE SETBACK TO PROVIDE LANDSCAPE BUFFER TO NEIGHBOURS
PERGOLA SHADE STRUCTURE ABOVE.
LIFT PROVIDES ACCESS TO ROOFTOP COMMUNAL SPACE
APPROVED BUILDING ENVELOPE (DA/1849/2005) SHOWN DASHED RED
RL 30.50
RL 29.50
RL 31.50
RL 32.00
RL 33.00
RL 34.00
01 ROOF PLAN
1:200
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ARCHITECT: CANDALEPAS ASSOCIATES
309 SUSSEX STREET SYDNEY NSW 2000
PROJECT: 2-4 FAIRPORT AVENUE, THE ENTRANCE
CLIENT: SILKY CONSTRUCTIONS
SCALE: 1:200@A1
DATE: APR 2021
DRAWING: ROOF PLAN
DRAWING No. S4.55 – 1106
ISSUE C
JOB No. 5871

01 NORTH ELEVATION
1:200

A. OFF FORM CONCRETE
CANDALEPAS ASSOCIATES
– ALL SAINTS PRIMARY SCHOOL

B. WHITE CONCRETE
CANDALEPAS ASSOCIATES
– PELICAN STREET

C. DECORATIVE CONCRETE OPENINGS
CANDALEPAS ASSOCIATES
– PRESIDENT AVE

D. ARTICULATED WINDOW
CANDALEPAS ASSOCIATES
– PINDARI RANDWICK

E. ALUMINIUM FRAMED GLAZING
CANDALEPAS ASSOCIATES
– PRINCE STREET

F. BRICKWORK
CANDALEPAS ASSOCIATES
– BARSBYS AVENUE

G. TIMBER BALUSTRADE
CANDALEPAS ASSOCIATES
– PRESIDENT AVENUE

H. METAL FENCING /SCREENING
CANDALEPAS ASSOCIATES
– PUNCHBOWL MOSQUE

i. PROFILED PRECASTE CONCRETE PANEL

Issue	Date	Description
C	07.04.21	COUNCIL
B	23.02.21	COUNCIL
A	16.09.20	S4.55 ISSUE

Drawing Original Size A1

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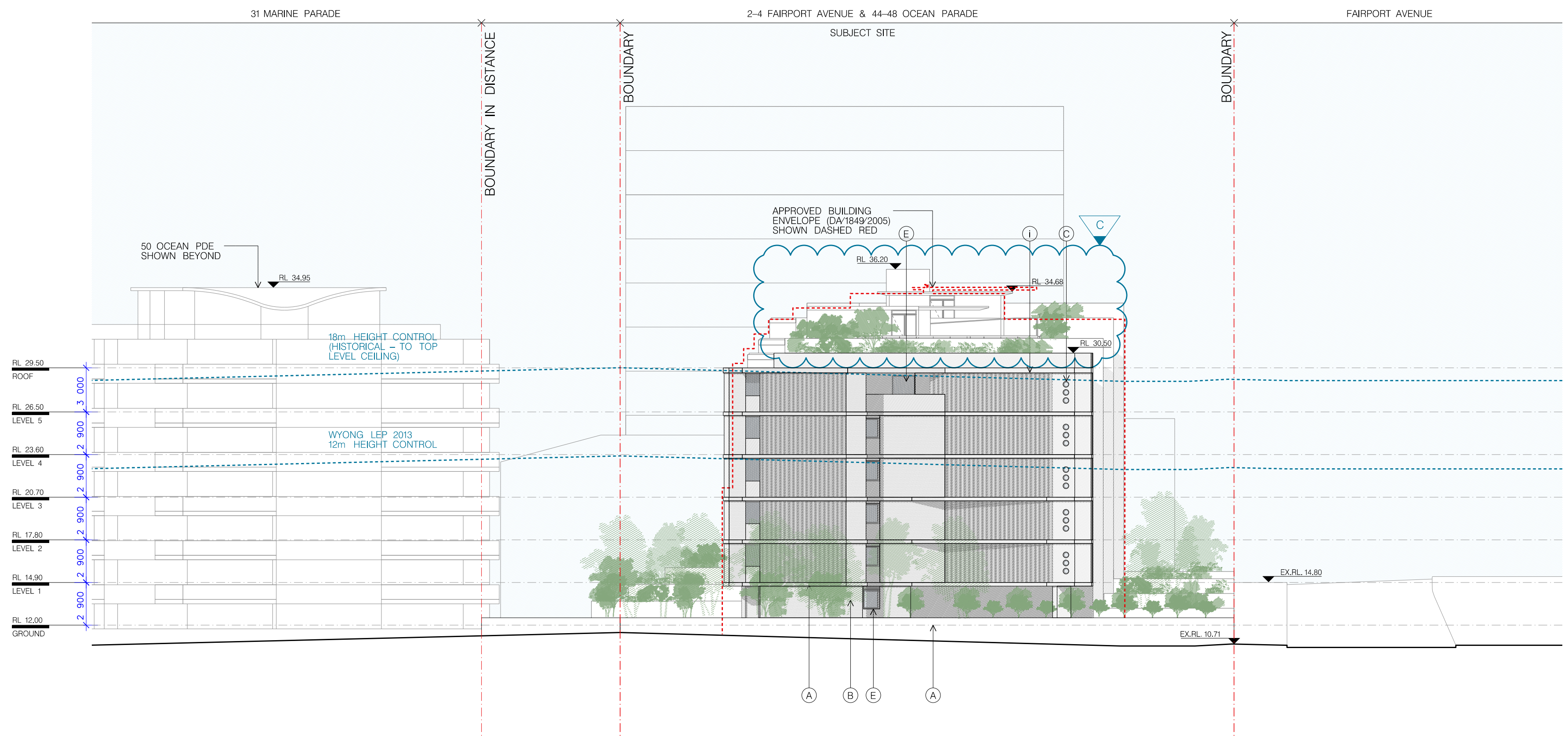
ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

PROJECT: 2–4 FAIRPORT AVENUE, THE ENTRANCE
CLIENT: SILKY CONSTRUCTIONS
SCALE: 1:200@A1
0 1m 2m 5m 10m

DATE: APR 2021
CHECKED 1: JE
CHK2/APPD: EP
DRAWN BY: VA, JE

DRAWING: ELEVATION – NORTH
DRAWING No. S4.55 – 1301
JOB No. 5871
ISSUE C



01 EAST ELEVATION
1:200

A. OFF FORM CONCRETE CANDALEPAS ASSOCIATES – ALL SAINTS PRIMARY SCHOOL
B. WHITE CONCRETE CANDALEPAS ASSOCIATES – PELICAN STREET
C. DECORATIVE CONCRETE OPENINGS CANDALEPAS ASSOCIATES – PRESIDENT AVE
D. ARTICULATED WINDOW CANDALEPAS ASSOCIATES – PINDARI RANDWICK
E. ALUMINIUM FRAMED GLAZING CANDALEPAS ASSOCIATES – PRINCE STREET
F. BRICKWORK CANDALEPAS ASSOCIATES – BARSBYS AVENUE
G. TIMBER BALUSTRADE CANDALEPAS ASSOCIATES – PRESIDENT AVENUE
H. METAL FENCING /SCREENING CANDALEPAS ASSOCIATES – PUNCHBOWL MOSQUE
i. PROFILED PRECASTE CONCRETE PANEL

Issue	Date	Description
C	07.04.21	COUNCIL
B	23.02.21	COUNCIL
A	16.09.20	S4.55 ISSUE

Drawing Original Size A1

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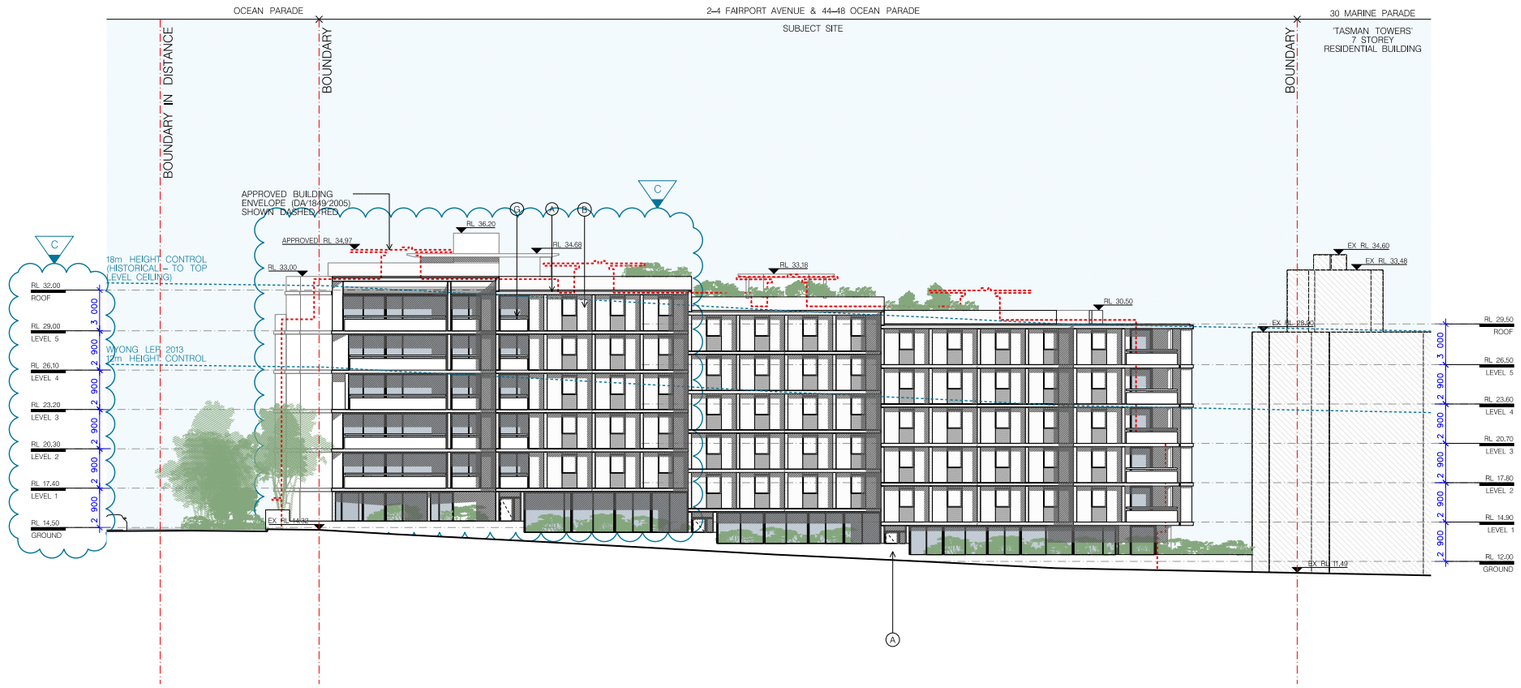
ARCHITECT: CANDALEPAS ASSOCIATES
309 SUSSEX STREET SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

PROJECT: 2-4 FAIRPORT AVENUE, THE ENTRANCE
CLIENT: SILKY CONSTRUCTIONS
SCALE: 1:200@A1

DATE: APR 2021
CHECKED 1: JE
CHK2/APPD: EP
DRAWN BY: VA, JE

DRAWING: ELEVATION – EAST
DRAWING No. S4.55 – 1302
JOB No. 5871
ISSUE C



01 SOUTH ELEVATION
1:200

A. OFF FORM CONCRETE
CANDALEPAS ASSOCIATES
– ALL SAINTS PRIMARY SCHOOL

B. WHITE CONCRETE
CANDALEPAS ASSOCIATES
– PELICAN STREET

C. DECORATIVE CONCRETE OPENINGS
CANDALEPAS ASSOCIATES
– PRESIDENT AVE

D. ARTICULATED WINDOW
CANDALEPAS ASSOCIATES
– PINDARI/RANDWICK

E. ALUMINIUM FRAMED GLAZING
CANDALEPAS ASSOCIATES
– PRINCE STREET

F. BRICKWORK
CANDALEPAS ASSOCIATES
– BARSBYS AVENUE

G. TIMBER BALUSTRADE
CANDALEPAS ASSOCIATES
– PRESIDENT AVENUE

H. METAL FENCING /SCREENING
CANDALEPAS ASSOCIATES
– PUNCHBOWL MOSQUE

I. PROFILED PRECASTE CONCRETE PANEL

W
R
Y
C
200mm
150mm
100mm
50mm
10mm MIN (ON HEDHES)

FOR S4.55 PURPOSES ONLY

A1

ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

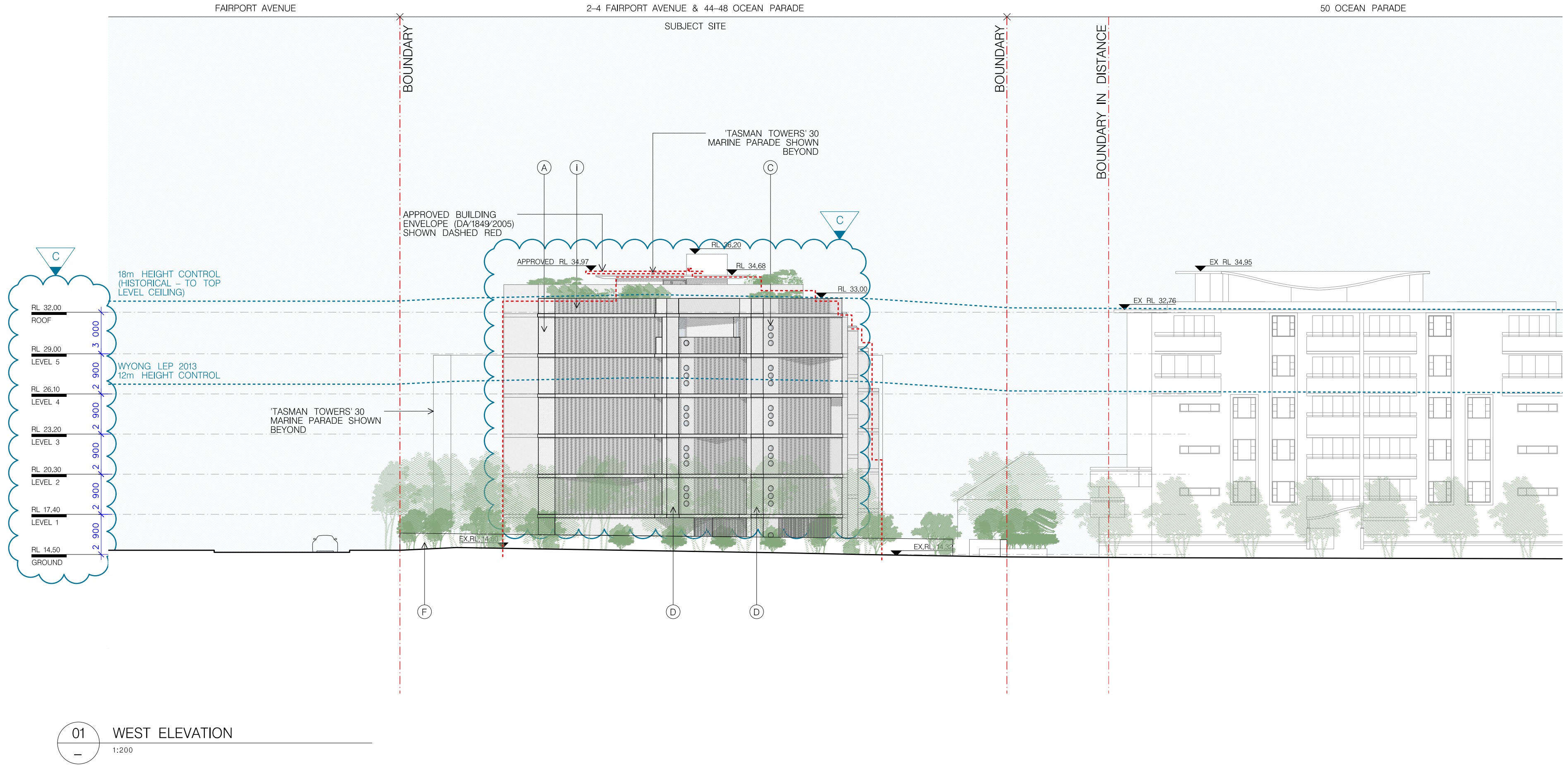
PROJECT:
2–4 FAIRPORT AVENUE, THE ENTRANCE

CLIENT:
SILKY CONSTRUCTIONS

SCALE: 1:200@A1
0 1m 2m 5m 10m

DATE: APR 2021
CHECKED 1: JE
CHK2/APPD: EP
DRAWN BY: VA, JE

DRAWING: ELEVATION – SOUTH
DRAWING No. S4.55 – 1303
JOB No. 5871
ISSUE C



01 WEST ELEVATION
1:200

A. OFF FORM CONCRETE CANDALEPAS ASSOCIATES – ALL SAINTS PRIMARY SCHOOL

B. WHITE CONCRETE CANDALEPAS ASSOCIATES – PELICAN STREET

C. DECORATIVE CONCRETE OPENINGS CANDALEPAS ASSOCIATES – PRESIDENT AVE

D. ARTICULATED WINDOW CANDALEPAS ASSOCIATES – PINDARI RANDWICK

E. ALUMINIUM FRAMED GLAZING CANDALEPAS ASSOCIATES – PRINCE STREET

F. BRICKWORK CANDALEPAS ASSOCIATES – BARSBYS AVENUE

G. TIMBER BALUSTRADE CANDALEPAS ASSOCIATES – PRESIDENT AVENUE

H. METAL FENCING /SCREENING CANDALEPAS ASSOCIATES – PUNCHBOWL MOSQUE

i. PROFILED PRECASTE CONCRETE PANEL

Issue	Date	Description
C	07.04.21	COUNCIL
B	23.02.21	COUNCIL
A	16.09.20	S4.55 ISSUE

Drawing Original Size A1

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ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

PROJECT: 2–4 FAIRPORT AVENUE, THE ENTRANCE

CLIENT: SILKY CONSTRUCTIONS

SCALE: 1:200@A1

0 1m 2m 5m 10m

DATE: APR 2021

CHECKED 1: JE

CHK2/APPD: EP

DRAWN BY: VA, JE

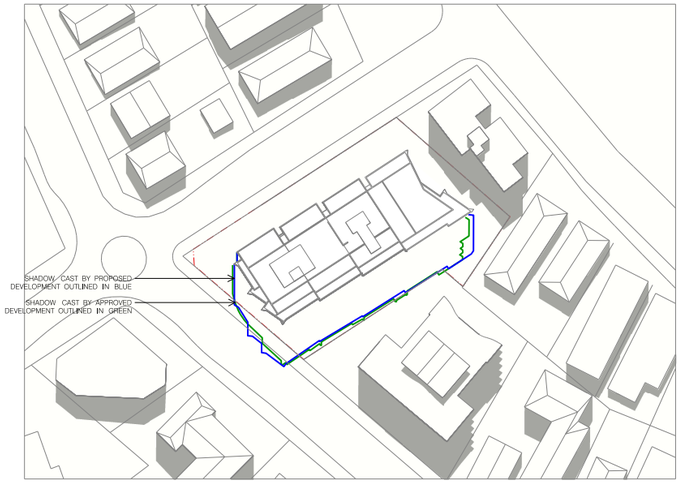
DRAWING: ELEVATION – WEST

DRAWING No. S4.55 – 1304

JOB No. 5871

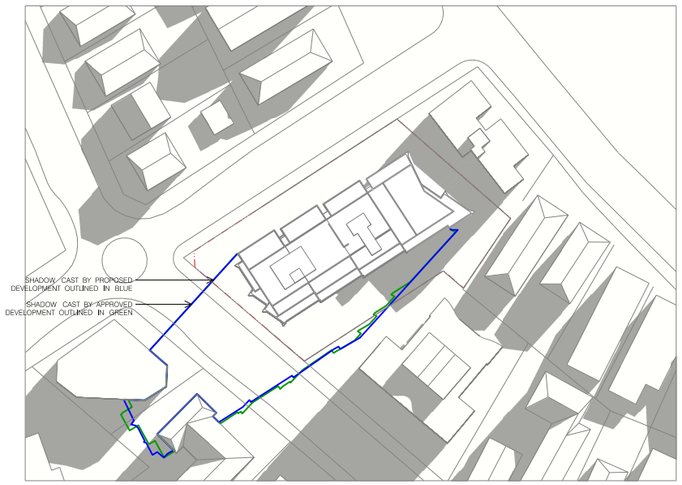
ISSUE C

01 SHADOW DIAGRAM – 21 MARCH 9:00 AM
NTS



02 SHADOW DIAGRAM – 21 MARCH 12:00 PM
NTS

03 SHADOW DIAGRAM – 21 MARCH 3:00 PM
NTS



04 SHADOW DIAGRAM – 21 JUNE 9:00 AM
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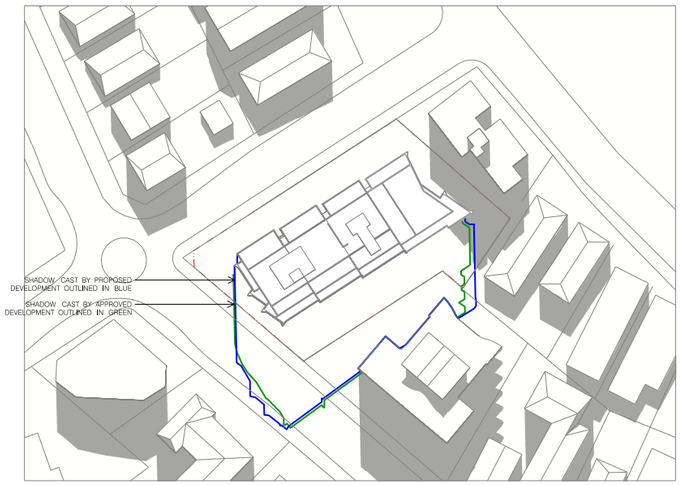

05 SHADOW DIAGRAM – 21 JUNE 12:00 PM
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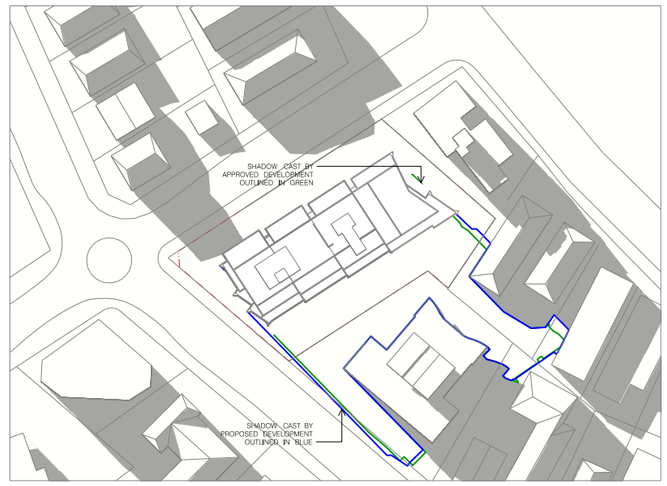

06 SHADOW DIAGRAM – 21 JUNE 3:00 PM
NTS

LEGEND
- SITE BOUNDARY
- SHADOW CAST BY EXISTING NEIGHBOURING BUILDINGS
- SHADOW CAST BY APPROVED DEVELOPMENT
- SHADOW CAST BY PROPOSED DEVELOPMENT

W B M Y C
0mm (ADD ON ORIGINAL) 50mm 100mm 150mm 200mm

A Amendment Date Issue
Drawing Schedule A1

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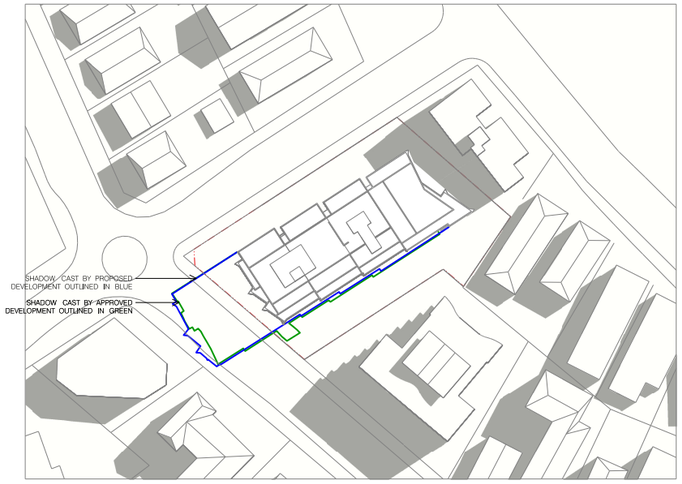
ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No.5773

PROJECT:
2-4 FAIRPORT AVENUE, THE ENTRANCE
CLIENT:
SILKY CONSTRUCTIONS
SCALE:

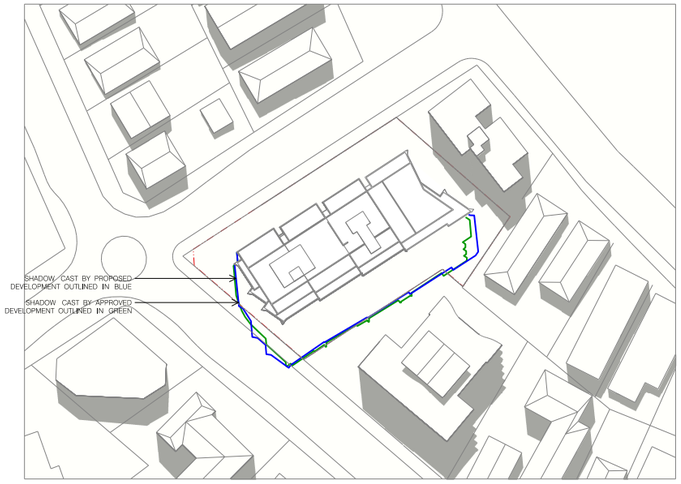
DATE: SEPT 2020
CHECKED 1: JE, VA
CHK2/APPD: EP
DRAWN BY: KC, VA

DRAWING:
SHADOW ANALYSIS 01
DRAWING No.
S4.55 – 1651

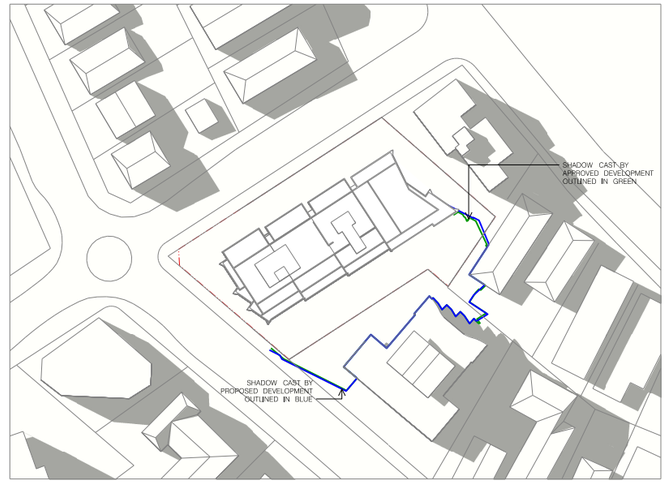
JOB No. 5871
ISSUE A



01 SHADOW DIAGRAM – 21 SEPTEMBER 9:00 AM
NTS



02 SHADOW DIAGRAM – 21 SEPTEMBER 12:00 PM
NTS



03 SHADOW DIAGRAM – 21 SEPTEMBER 3:00 PM
NTS

LEGEND
- SITE BOUNDARY
- SHADOW CAST BY EXISTING NEIGHBOURING BUILDINGS
- SHADOW CAST BY APPROVED DEVELOPMENT
- SHADOW CAST BY PROPOSED DEVELOPMENT

A ISSUED FOR S4.55 A1

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ARCHITECT:
CANDALEPAS ASSOCIATES
309 SUSSEX STREET
SYDNEY NSW 2000
T: 02 9283 7755
E: architects@candalepas.com.au
NSW ARCHITECTS REG No. 5773

PROJECT:
2–4 FAIRPORT AVENUE, THE ENTRANCE

CLIENT:
SILKY CONSTRUCTIONS

SCALE:

NORTH

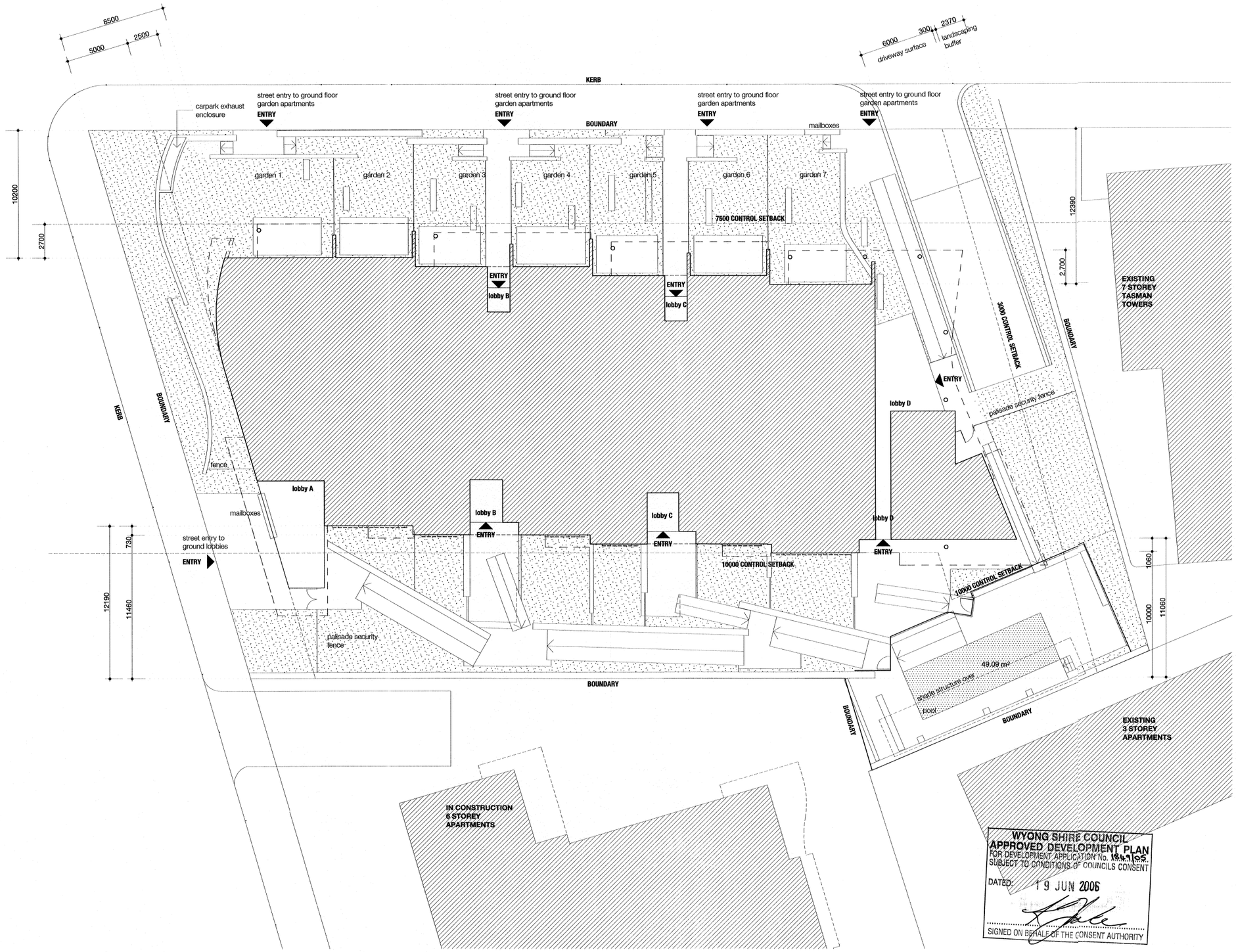
DATE: SEPT 2020
CHECKED 1: JE, VA
CHK2/APPD: EP
DRAWN BY: KC, VA

DRAWING:
SHADOW ANALYSIS 02

DRAWING No.
S4.55 – 1652

JOB No. 5871

ISSUE A



issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
SITE PLAN

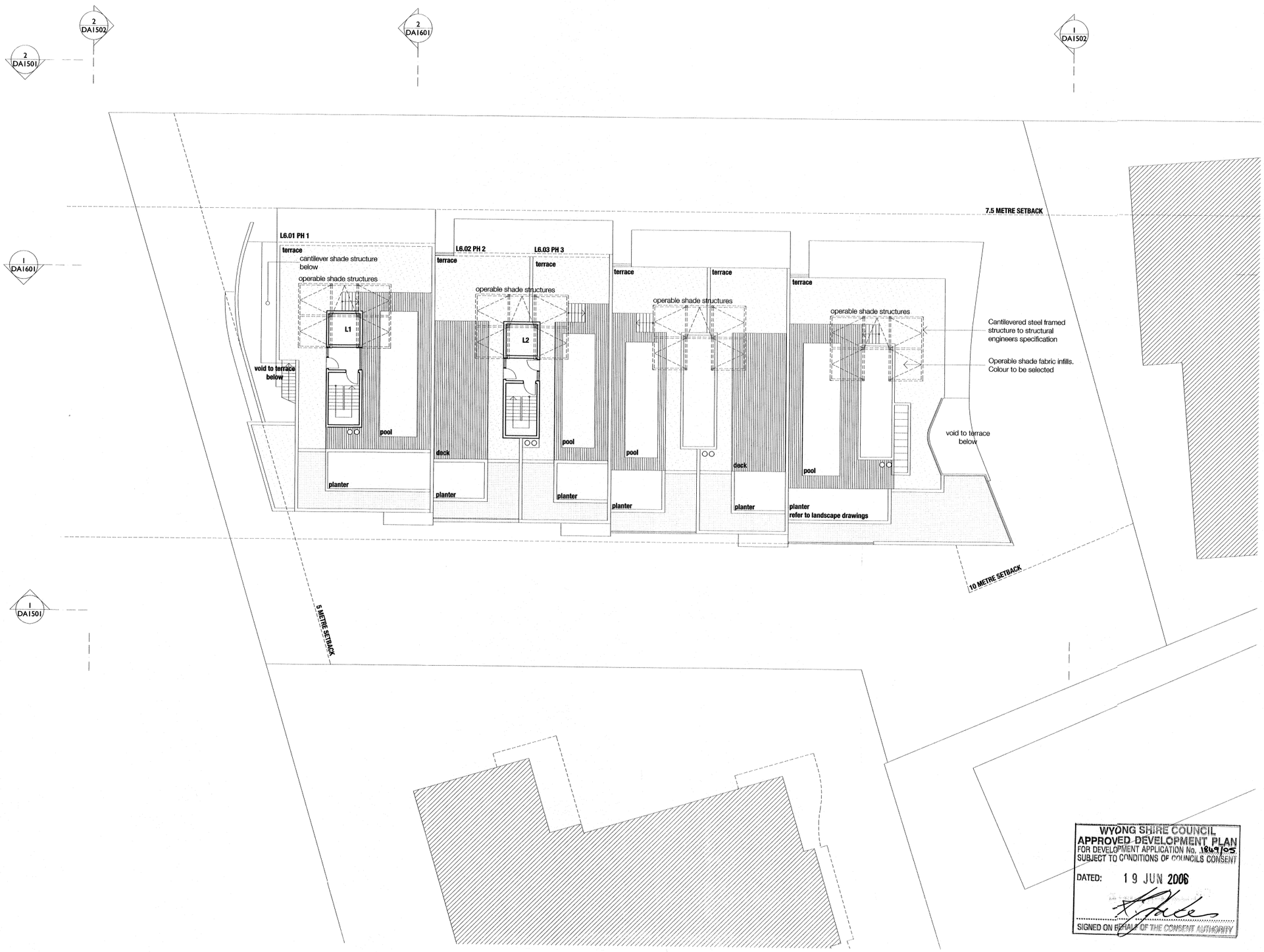
WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

drawing scale	1:200 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA0501 issue C

server files:Projects_CAD:5.01 Fairport:11.0 CAD:11.11 Layout Books (lbk's):5.01_1/200.lbk 2:20 PM

issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	CO-ORDINATION WITH LANDSCAPE	07.02.06
D	RE-ISSUE FOR DA	24.05.06



landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
ROOF TERRACE

WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

drawing scale	1:200 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1401 issue D

server files:Projects_CAD:5.01 Fairport:11.0 CAD:11.11 Layout Books (lbk's):5.01_1/200.lbk 2:20 PM

NORTH ELEVATION 1 : 200

SOUTH ELEVATION 1 : 200

issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford, NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
ELEVATIONS

drawing scale	1:200 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1501 issue C

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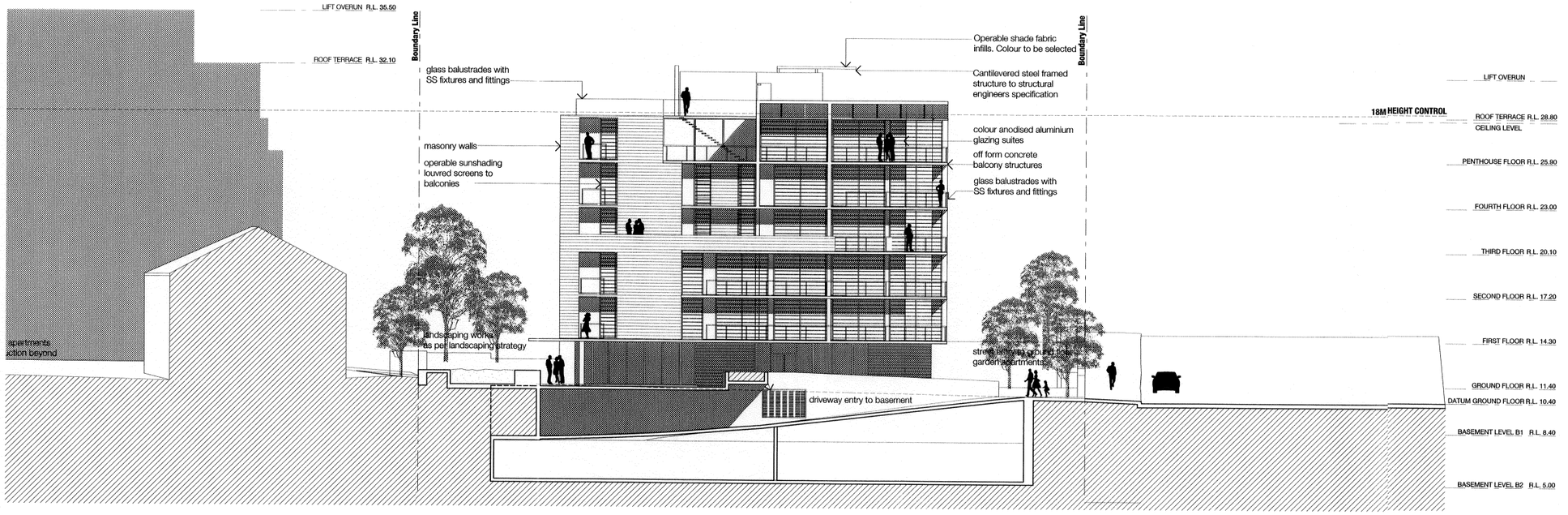
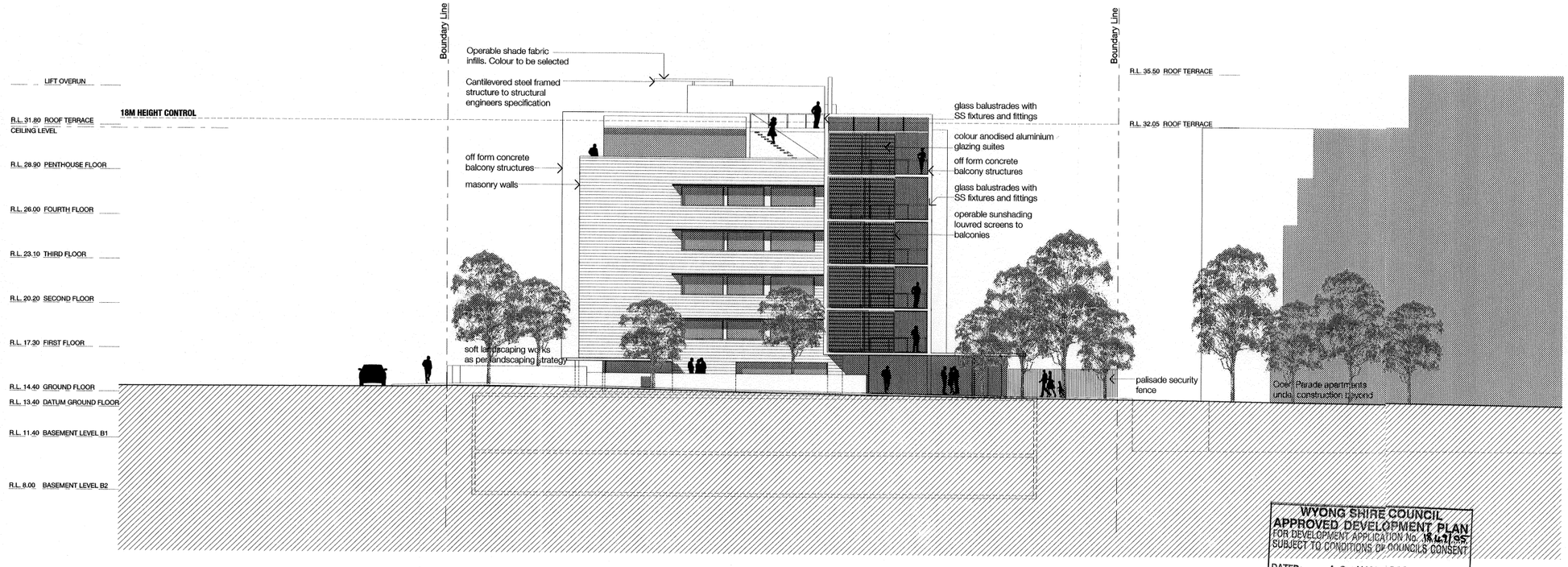


EAST ELEVATION



WEST ELEVATION

issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	RE-ISSUE FOR DA	24.05.06

WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

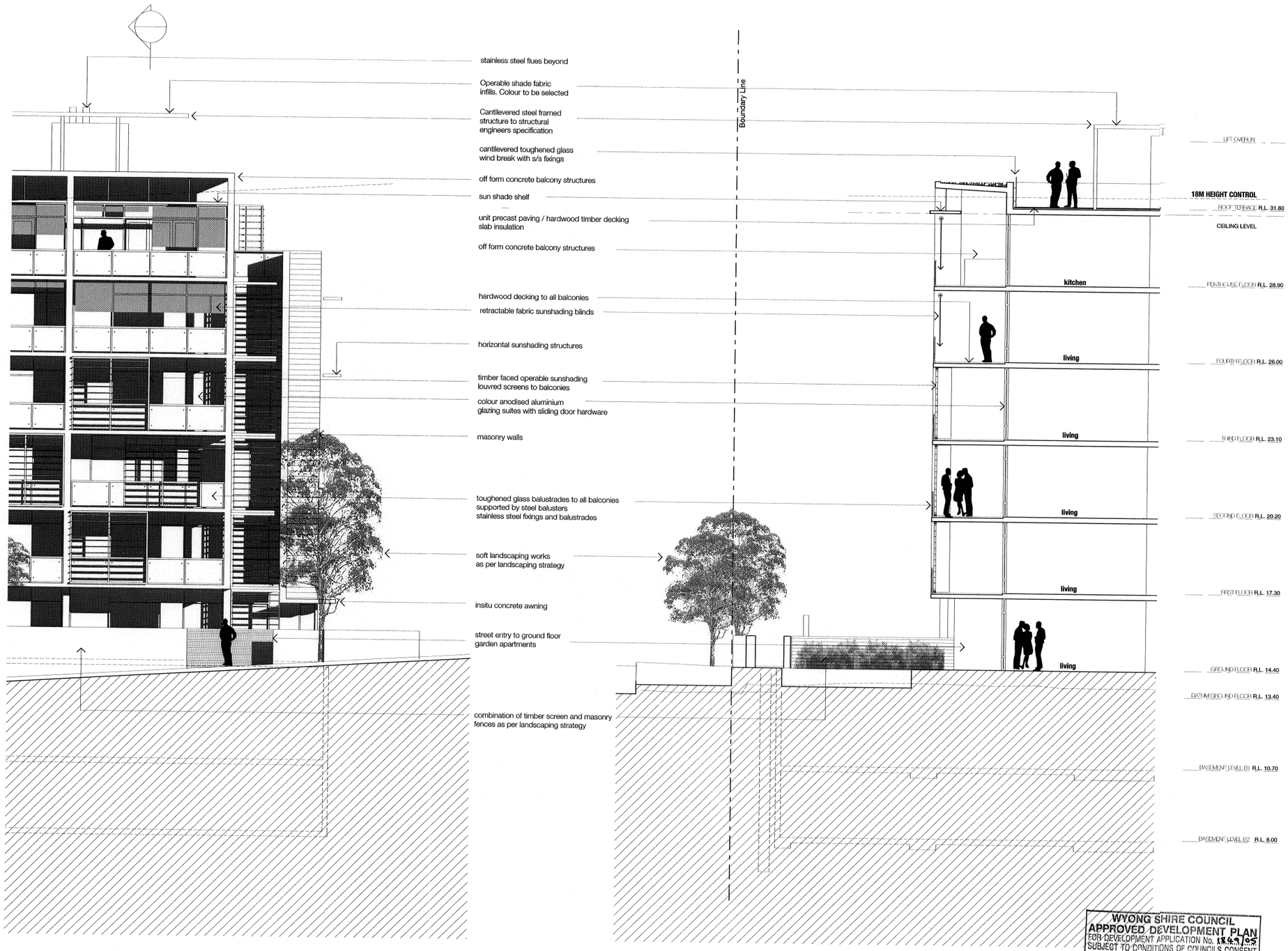
project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
ELEVATIONS

drawing scale	1:200 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1502 issue C

server files:Projects_CAD:5.01 Fairport:11.0 CAD:11.11 Layout Books (lbk's):5.01_1/200.lbk 2:20 PM



issue	description	date
A	ISSUE FOR DA	23.09.05
B	RE-ISSUE FOR DA	15.12.05
C	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
FACADE DETAILS NORTH

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1602 issue C

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issue	description	date
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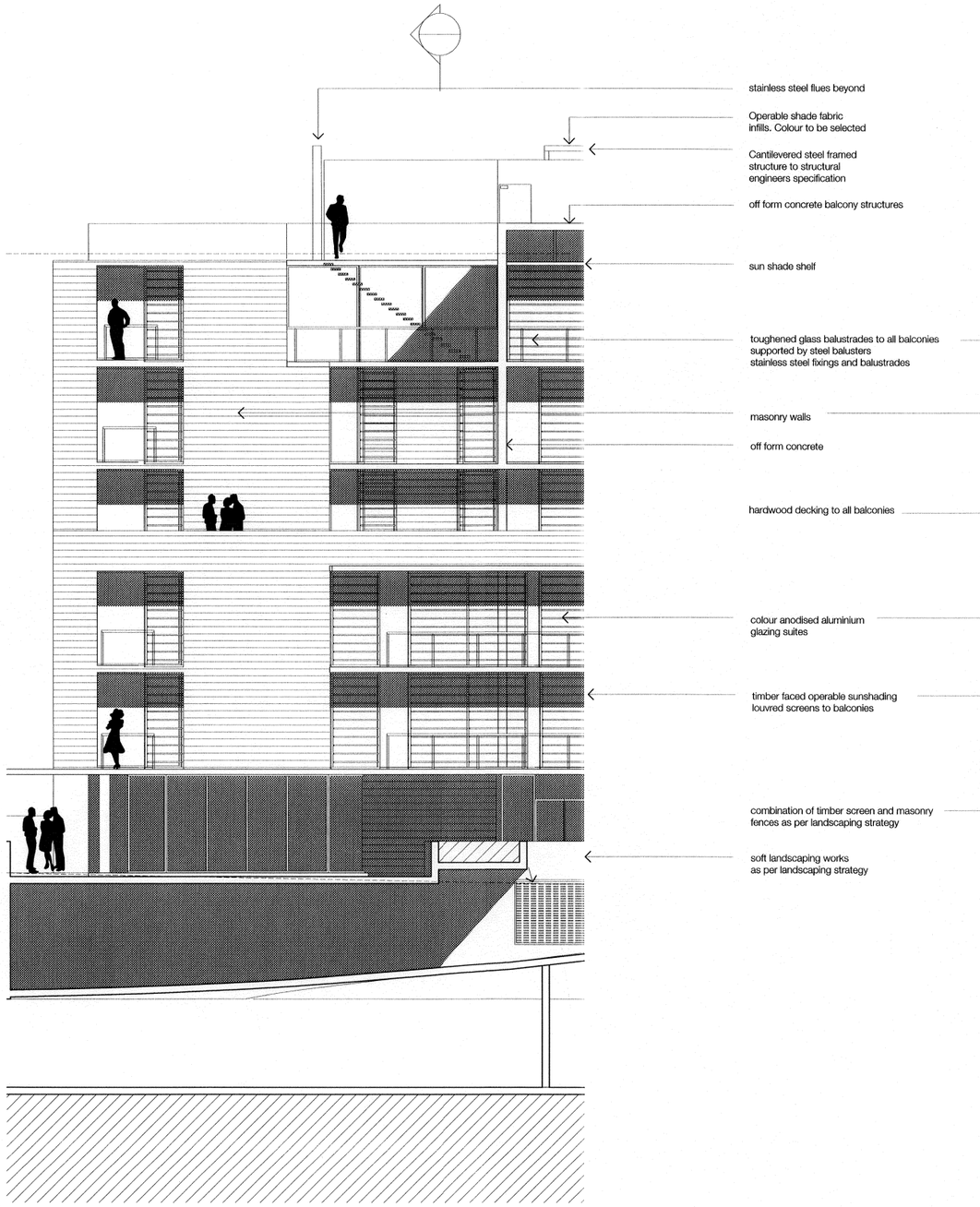

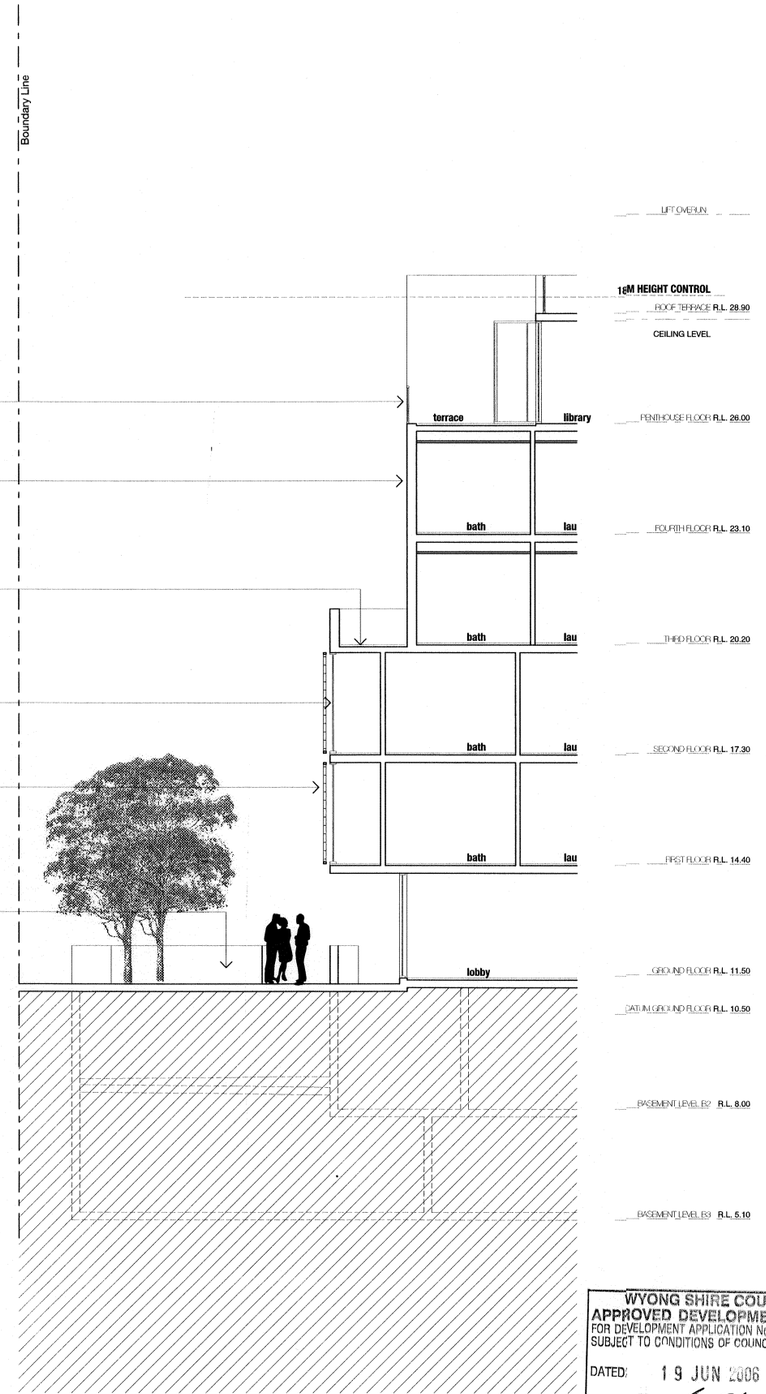

WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
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landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
FACADE DETAILS EAST

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. **DA1603** issue **A**

server files:Projects_CAD:5.01 Fairport:11.0 CAD:11.11 Layout Books (lbk's):5.01_1/200.lbk 2:20 PM

stainless steel flues beyond

Operable shade fabric
infills. Colour to be selected

Cantilevered steel framed
structure to structural
engineers specification

toughened glass balustrades to all balconies
supported by steel balusters
stainless steel fixings and balustrades

hardwood decking to all balconies

toughened glass balustrades to all balconies
supported by steel balusters
stainless steel fixings and balustrades

timber faced operable sunshading
louvred screens to balconies

off form concrete balcony structures

masonry walls

colour anodised aluminium glazing suites

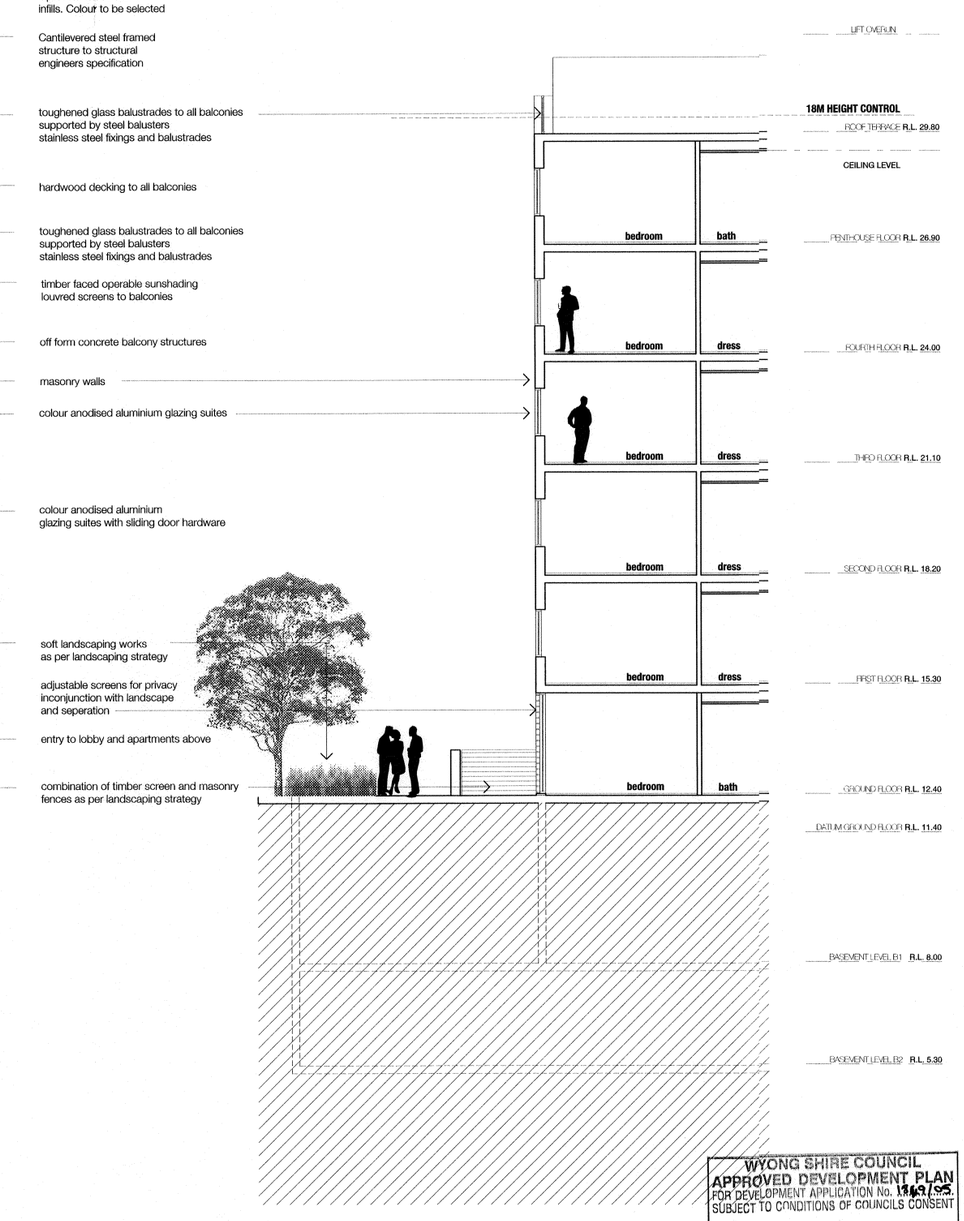
colour anodised aluminium
glazing suites with sliding door hardware

soft landscaping works
as per landscaping strategy

adjustable screens for privacy
inconjunction with landscape
and seperation

entry to lobby and apartments above

combination of timber screen and masonry
fences as per landscaping strategy



issue	description	date
A	RE-ISSUE FOR DA	15.12.05

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
FACADE DETAILS SOUTH

WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 1849/05B
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: 19 JUN 2006
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1604 issue A

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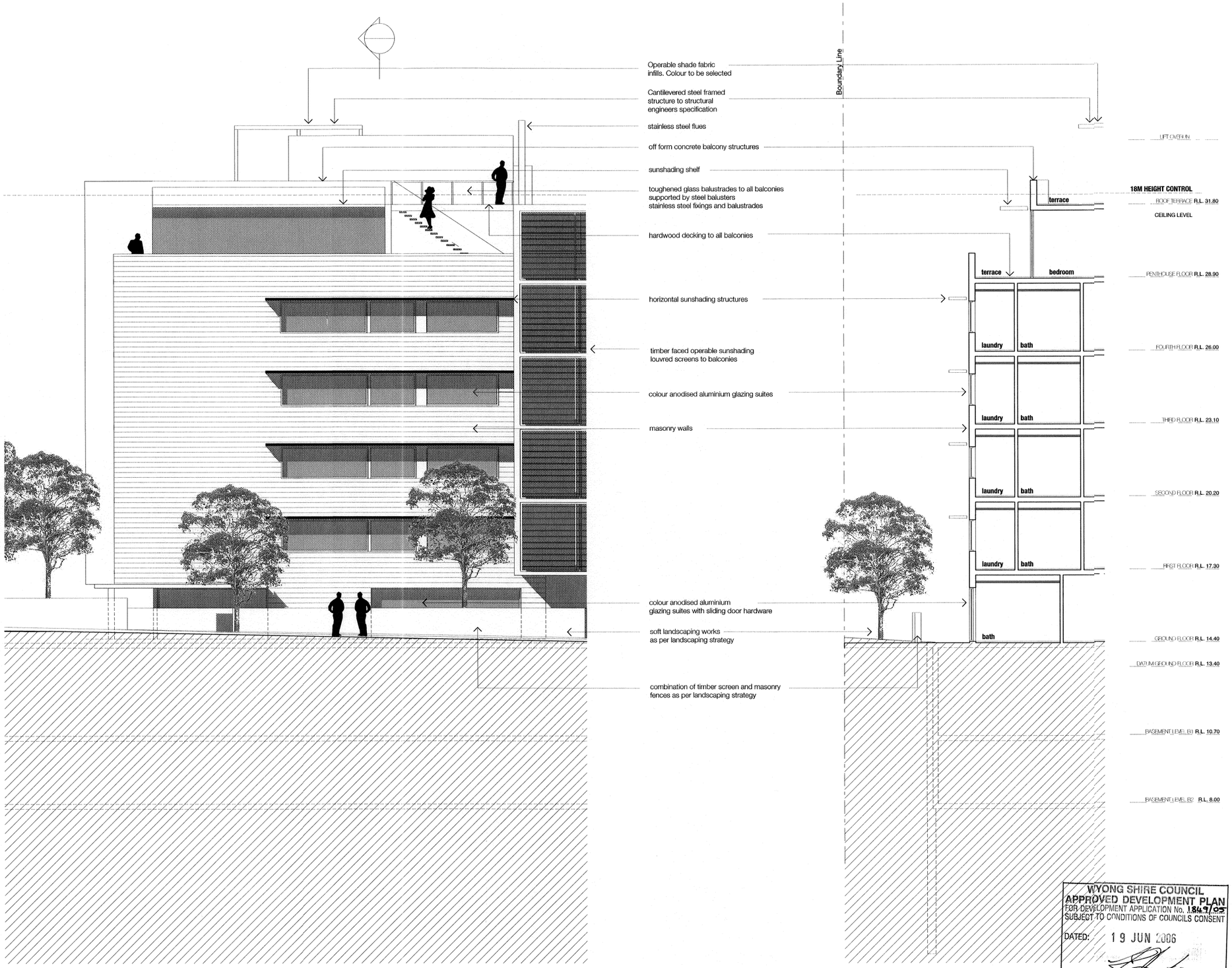

issue	description	date
A	RE-ISSUE FOR DA	15.12.05
B	RE-ISSUE FOR DA	24.05.06

landscape consultant
PSB
2-14, Mountain Street, Ultimo
NSW, 2007
Tel: 612 9212 3666 Fax: 612 9212 4499
Email psb@psb.com.au

structural / hydraulic / mechanical engineer
CARDNO MBK Pty. Ltd
Suite 34, 205-207 Albany Street, North Gosford,
NSW, 2250
Tel: (02) 4323 2558 Fax: (02) 4323 2558
Email vcubis@cardno.com.au

architect
STUDIO GA Pty Ltd
Level 4, 2A Glen Street
Milsons Point, 2061
NSW
Tel : 612 9929 2414 Fax : 612 9929 2412
Email architects@studioga.com.au

client
BEACH VIEWS(NSW) Pty.Ltd.
82 Patrick Street
Avalon, NSW 2107
Australia

project title
THE ENTRANCE APARTMENTS
Cnr Ocean Parade & Fairport Avenue
The Entrance

drawing title
FACADE DETAILS WEST

drawing scale	1:100 @ A2
drawn by	SDG / DM
verified	PG
date	01.08.05

drawing no. DA1605 issue B

server files:Projects_CAD:5.01 Fairport:11.0 CAD:11.11 Layout Books (lbk's):5.01_1/200.lbk 2:20 PM

legend

- in-situ concrete
- paving strips
- concrete slabs
- gravel 1
- gravel 2
- paving
- timber deck
- stone seating wall (min. 0.4 m to 1.6 m depending on terrain)
- rendered feature wall (2.0 m high)
- stone retaining wall to boundaries (1.6 m high)
- concrete planter/retaining wall (1.0 m high, depending on terrain)
- semitransparent screening wall (1.6 m high)
- screening fence (1.6 m high)
- pool fence (1.2 m high)
- pool
- turf
- 'forest' screen/feature planting to sheltered locations
- 'seaside' planting to exposed locations
- 'wetland' planting to overland flow path
- higher roof top planting (deeper soil depth)
- lower roof top planting
- hedge
- tree to be planted

- O 14.32 existing level
- +64.50 proposed level
- −64.50 level of slab under

NOTES

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DATE	REV	AMENDMENTS	APP
22.09.05	C	DA	
12.09.05	B	Consultant Review	
22.08.05	A	Consultant Review	

REFERENCES

CONSULTANT	DRAWING ID	DATE OF ISSUE
studio GA	psb zip	16.06.05
studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept

Landscape Concept

The Fairport Apartments

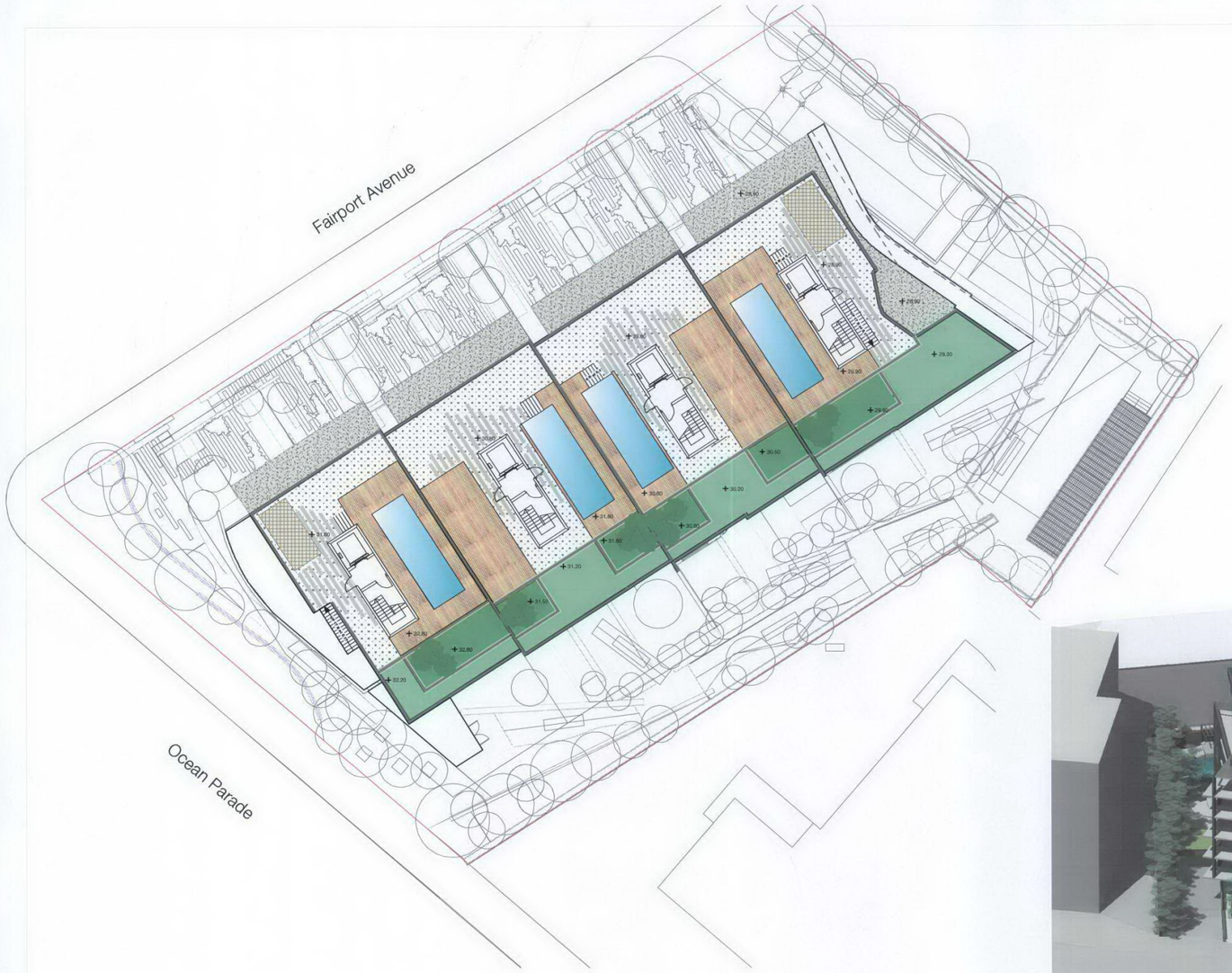
Beachview Pty Ltd c/- Studio GA Pty Ltd.

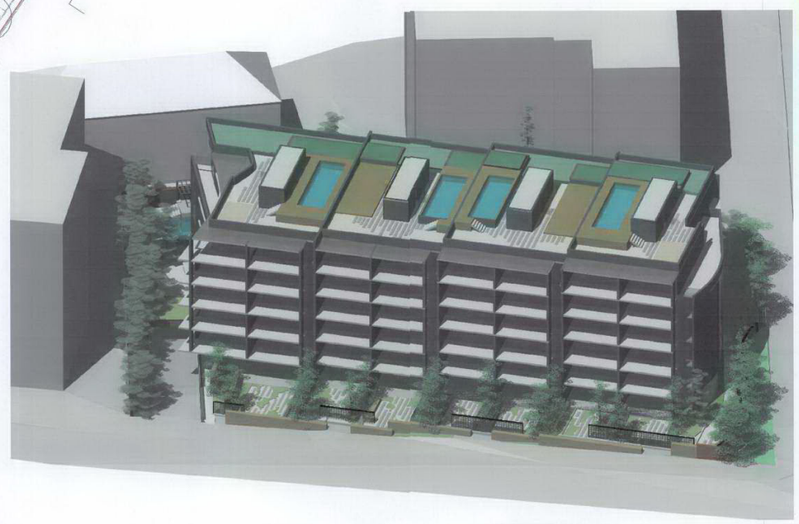
0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au W www.psb.com.au

Scale	1:200@A1
	05062
	01.07.05

DA01C





legend

- in-situ concrete
- paving strips
- concrete slabs
- gravel 1
- gravel 2
- paving
- timber deck
- stone seating wall (min. 0.4 m to 1.6 m depending on terrain)
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- higher roof top planting (deeper soil depth)
- lower roof top planting
- hedge
- shrub to be planted
- 14.32 existing level
- +64.50 proposed level
- −64.50 level of slab under

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REFERENCES

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studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept - Rooftop Planting

Landscape Concept - Rooftop Planting

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | **F** 02 9212 4499
E psb@psb.com.au | **W** www.psb.com.au

Scale	1:200@A1
	05062
	01.07.05

DA02C

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22.09.05	C	DA	
12.09.05	B	Consultant Review	
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REFERENCES

CONSULTANT	DRAWING ID	DATE OF ISSUE
studio GA	psb zip	16.06.05
studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept hardworks

Landscape Concept - Hardworks

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

0 5 10 15 20 25 m

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | F 02 9212 4499
E psb@psb.com.au | W www.psb.com.au

Scale 1:200@A1
05062
01.07.05
DA03C

Trees and specimen shrubs

Botanical name	Common Name	Height	Spread
Angophora costata	Sydney Red Gum	12.0 m	7.0 m
Acmena smithii	Lilly Pilly	8.0 m	5.0 m
Syzygium paniculatum	Magenta Lilly Pilly	5.0 m	5.0 m
Howea belmoreana	Kentia	6.0 m	3.0 m
Ceratopetalum gummiferum	NSW Xmas Bush	6.0 m	2.0 m
Elaeocarpus reticulatus	Blueberry Ash	10.0 m	5.0 m
Corymba gummifera	Red Bloodwood	16.0 m	7.0 m
Nyssa sylvatica	Tupelo	15.0 m	10.0 m

Shrubs and Hedges

Botanical name	Common Name	Height	Spread
Banksia spinulosa var. spinulo	Hairpin Banksia	2.0 m	2.0 m
Callandra tweedii	Red Tassle-flower	2.0 m	3.0 m
Camelia sasanqua	Camelia	1.5 m	1.0 m
Doryanthes revoluta	Doryanthes	1.5 m	1.5 m
Fatsia japonica	Aralia	2.0 m	1.0 m
Gardenia augusta 'Florida'	Gardenia	1.0 m	1.0 m
Hebe 'Inspiration'	Veronica	1.0 m	1.0 m
Lavandula angustifolia	Dwarf Lavender	1.0 m	1.0 m
Melaleuca thymifolia	Thyme Honey Myrtle	1.0 m	1.0 m
Philodendron 'Xanadu'	Dwarf Philodendron	1.0 m	0.8 m
Pittosporum 'Miss Mauffett'	Pittosporum	1.0 m	1.0 m
Raphiolepis indica	India Hawthorn	1.8 m	1.5 m
Rhaphis excelsa	Little Lady Palm	2.0 m	1.0 m
Rosmarinus officinalis	Rosemary	1.2 m	1.2 m
Schefflera aboricola	Dwarf Umbrella	2.0 m	1.5 m
Strelitzia reginae	Birds Nest Flower	1.0 m	2.0 m
Syzygium 'Cascade'	Lilly Pilly	2.0 m	2.0 m
Viburnum odoratissimum	Viburnum	3.0 m	2.0 m

Groundcovers

Botanical name	Common Name	Height	Spread
Agapanthus x orientalis	Dwarf African Lily	0.5 m	0.5 m
Brachycome 'White'	Rock Daisy	0.3 m	0.4 m
Clivia miniata	Clivia	0.5 m	0.6 m
Crinum asiaticum		0.6 m	0.6 m
Hardenbergia violaceae	False Sarsparilla	2.0 m spread	
Hemerocallis fulva	Orange Day Lily	0.4 m	0.6 m
Hibbertia scandens	Snake Vine	1.5 m spread	
Liriope muscari 'Evergreen Gia	Giant Turf Lily	0.6 m	0.5 m
Myoporum parvifolium	Creeping Boobialla	0.4 m	1.0 m
Phormium 'Bronze Baby'	Bronze Baby Flax	0.6 m	0.6 m
Scaevola aemula 'Mauve Mist'	Fan Flower	0.3 m	0.5 m
Trachelospermum jasminoides	Star Jasmine	2.0 m spread	
Viola hederaceae	Native Violet	0.3 m	0.5 m

Grass and Fern Mix

Adiantum aethopicum	Maidenhair Fern	0.5 m	0.5 m
Asplenium nidus	Mother Fern	1.0 m	1.0 m
Cyathea cooperii	Cooper's Tree Fern	6.0 m	5.0 m
Cycas revoluta	Sago Palm	2.0 m	2.0 m
Dianella caerulea var. caerulea	Blue Flax Lily	0.5 m	0.5 m
Dianella revoluta	Mauve Flax Lily	0.5 m	0.5 m
Festuca glauca	Blue Fescue	0.3 m	0.4 m
Pteridium esculentum	Bracken Fern	0.8 m	0.7 m

ROOFTOP PLANT SCHEDULE

Botanical name	Common Name	Height	Spread
Agapanthus x orientalis	Dwarf African Lily	0.5 m	0.5 m
Banksia spinulosa var. spinulosa	Hairpin Banksia	2.0 m	2.0 m
Brachicome "White"	Rock Daisy	0.3 m	0.4 m
Carpobrotus glaucescens	Pigface	0.5 m	2.0 m
Dianella caerulea var. caerulea	Blue Flax Lily	0.5 m	0.5 m
Festuca glauca	Blue Fescue	0.3 m	0.4 m
Grevillea sericea	Pink Spider Flower	1.0 m	1.0 m
Lavandula angustifolia	Dwarf Lavender	1.0 m	1.0 m
Phormium 'Bronze Baby'	Bronze Baby Flax	0.6 m	0.6 m
Scaevola aemula 'Mauve Mist'	Fan Flower	0.3 m	0.5 m
Strelitzia reginae	Birds Nest Flower	1.0 m	2.0 m

OVERLAND FLOWPATH PLANT SCHEDULE

Trees and specimen shrubs

Botanical name	Common Name	Hight	Spread
Melaleuca quinquenervia	Paperbark	10.0 m	5.0 m
Hibiscus tiliaceus 'Redleaf'	Red-leafed Hibiscus	6.0 m	4.0 m
Livistona australis	Cabbage Palm	9.0 m	4.0 m

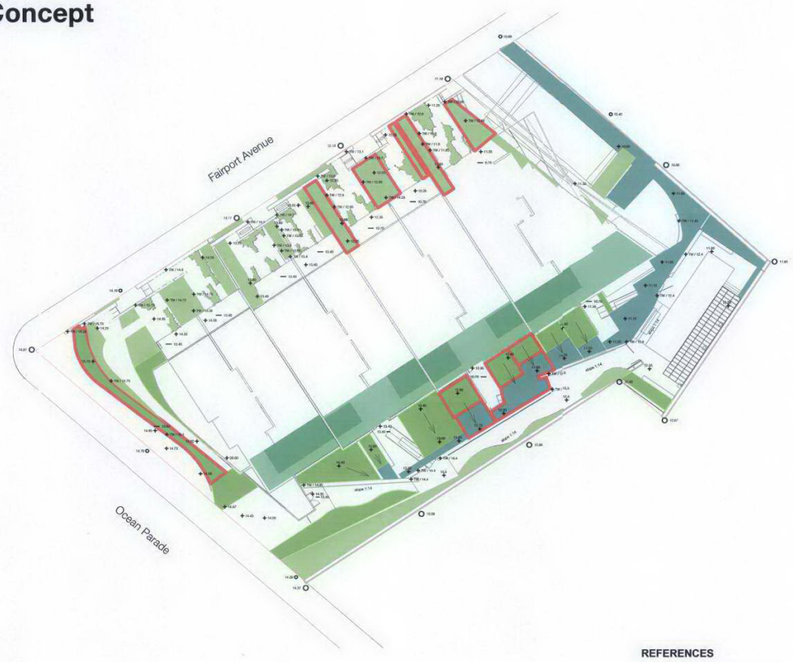
Shrubs and climbers

Botanical name	Common Name	Hight	Spread
Austromyrtus tenuifolia	Narrow Leaf Myrtle	1.5 m	1.0 m
Callistemon citrinus	Common Bottlebrush	3.0 m	2.5 m
Crinum pendiculatum	Swamp Lily	1.5 m	1.5 m
Melaleuca linariifolia	Snow in Summer	7.0 m	3.0 m

Groundcovers

Botanical name	Common Name	Hight	Spread
Lomandra longifolia	Mat Rush	1.0 m	1.0 m
Blechnum cartilagineum	Gristle Fern	0.8 m	0.6 m
Dianella caerulea	Blue Flax Lily	0.5 m	0.5 m
Imperata cylindrica	Blady Grass	1.0 m	0.5 m

Planting Concept



PLANTING CONCEPT

- pool
- turf
- 'forest' screen/feature planting to sheltered locations
- 'seaside' planting to exposed locations
- 'wetland' planting to overland flow path
- higher roof top planting (deeper soil depth)
- lower roof top planting
- deep planting areas with > 1m soil

SEASIDE PLANT SCHEDULE

Trees and specimen shrubs

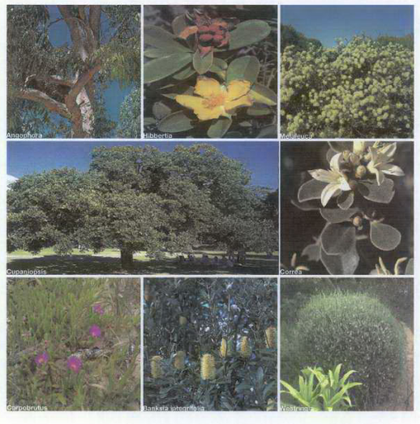
Botanical name	Common Name	Height	Spread
Angophora costata	Sydney Red Gum	12.0 m	7.0 m
Banksia integrifolia	Coast Banksia	10.0 m	5.0 m
Callitris rhomboidea	Port Jackson Cypress	8.0 m	2.0 m
Corymba gummifera	Red Bloodwood	12.0 m	4.5 m
Cordyline australis	NZ Cabbage Tree	8.0 m	4.0 m
Cupaniopsis anacardioides	Tuckeroo	9.0 m	6.0 m

Shrubs and climbers

Botanical name	Common Name	Height	Spread
Correa alba	White Correa	1.0 m	1.0 m
Dodonaea triquetra	Hop Bush	3.0 m	3.0 m
Hardenbergia violacea	Hardenbergia	2.0 m	2.0 m
Hibbertia scandens	Hibbertia	3.0 m	1.5 m
Leptospermum laevigatum	Coast Tea Tree	3.0 m	2.0 m
Melaleuca nodosa	Coastal Honeymyrtle	3.0 m	2.0 m
Myoporum boninense	Coastal Boobialla	3.0 m	2.0 m
Ricinocarpus pinifolius	Wedding Bush	1.5 m	1.0 m
Westringia fruticosa	Coastal Rosemary	1.2 m	1.2 m

Groundcovers

Botanical name	Common Name	Height	Spread
Actinotus helianthii	Flannel Flower	1.0 m	1.0 m
Canavalia rosea	Coastal Jack Bean	0.5 m	2.0 m
Carpobrotus glaucescens	Pigface	0.5 m	2.0 m
Dichondra repens	Kidney Weed	1.0 m	0.1 m
Dianella congesta	Coastal Flax Lily	0.5 m	0.4 m
Hibbertia scandens	Hibbertia	3.0 m	1.5 m
Imperata cylindrica	Blady Grass	1.0 m	1.0 m
Lomandra longifolia	Mat Rush	0.5 m	0.6 m
Scaevola albida	Small Fan Flower	1.0 m	0.5 m
Scaevola calendulacea	Dune Fan Flower	0.2 m	1.0 m



NOTES

1. This drawing and design is subject to copyright to Pittendrigh, Shinkfield and Bruce Pty ltd and may not be reproduced without prior written consent.
2. All levels shown are in meters Australian Height Datum unless otherwise specified.

DATE	REV	AMENDMENTS	APP
22.09.05	C	DA	
12.09.05	B	Consultant Review	
22.08.05	A	Consultant Review	

REFERENCES

CONSULTANT	DRAWING ID	DATE OF ISSUE
studio GA	psb zip	16.06.05
studio GA	Basement B1-Level	10.08.05
studio GA	Basement Level B2	10.08.05
studio GA	Basement Level B3	10.08.05
studio GA	Groundlevel	10.08.05
studio GA	Entry Level Landscape	12.08.05
studio GA	Entry Level Landscape	17.08.05

Project The Fairport Apartments

Client Beachview Pty Ltd c/- Studio GA Pty Ltd.

Drawing Landscape Concept - Planting

Landscape Concept - Planting

The Fairport Apartments

Beachview Pty Ltd c/- Studio GA Pty Ltd.

PSB
2-14 Mountain Street | Ultimo | NSW 2007
P 02 9212 3666 | **F** 02 9212 4499
E psb@psb.com.au | **W** www.psb.com.au

Scale as shown
05062
01.07.05
DA06C

I, Rob Micheli, Area Manager Hunter Region, Department of Planning, Industry & Environment - Crown Lands, hereby consent to the making of this application under delegated authority on behalf of the Crown being the owner of the land to which this application relates. Delegated Officer Level 4 – Environmental Planning & Assessment Regulation 2000 Clause 49(1)(b) 11/5/2021

ARBORICULTURAL IMPACT REPORT

TERRIGAL SLSC
THE PROMENADE TERRIGAL NSW

17TH SEPTEMBER 2020

PREPARED FOR TERRIGAL SLSC

Prepared by:
Guy Paroissien
Landscape Matrix Pty Ltd.
ABN 53 110 564 102
T/F. 9943 6510, M. 0425 342 051
40 Timbarra Road St Ives NSW 2075
E-mail: landscapematrix@optusnet.com.au

1. BACKGROUND

Landscape Matrix Pty Ltd has been engaged by the Terrigal SLSC to prepare an Arboricultural Impact Report in respect to 3 trees potentially affected by proposed additions to the existing Surf Life Saving Club building at The Promenade, Terrigal Beach (the site). The trees assessed for this report are located in the street frontage to the SW of the clubhouse building.

This report has been prepared by Guy Paroissien a Director of Landscape Matrix Pty Ltd. The site was inspected on 8th September 2020 to collect the data for 3 trees adjoining the site.

The assessment of the trees is based upon a visual inspection of the trees from ground level using elements of the Visual Tree Assessment (VTA) method described by Mattheck & Breloer (1994). The Useful Life Expectancy (ULE) categories identified in the report follows Barrell (1996).

The inspection was limited to visual inspection of the trees without dissection, probing or coring. No aerial inspection of the trees was carried out and the assessment did not include any woody tissue testing or subterranean root investigation.

The tree heights and canopy spreads were estimated and are expressed in metres and the tree diameters at breast height (DBH) were measured using a standard metal tape and are expressed in millimetres.

Measurements from the trees referred to in this report are to be taken as if measured from the centre of the trees' trunks.

2. TREES ASSESSED FOR THIS REPORT

Three mature trees have been assessed in preparing this report. The trees assessed for this report are located in the street frontage to the SW of the clubhouse building. The location and context of the site is illustrated in the photograph on the cover page of this report.

A summary of these trees, their dimensions, condition, Useful Life Expectancy (ULE) and landscape significance is attached in Appendix B. The ULE categories identified in Appendix B follow those of Barrell (1996).

The locations of the trees are shown on the attached Site Plan prepared by White Dickson Architects dated 30/01/2020 and identified as Drawing Number D02, Issue DA.

The three trees are summarised in table 1 as follows:

Table 1: Summary of trees assessed at the Terrigal SLSC The Promenade Terrigal Beach

Tree Number	Species and Common Name	Summary
1	*Araucaria heterophylla* (Norfolk Island Pine)	A semi mature, single trunked specimen approximately 16 metres in height with a canopy spread of 9 metres and a diameter at breast height (DBH) of 390mm. In good health and of moderate landscape significance. Slight canopy bias to the north. At the time of inspection the tree was of fair vigour and exhibited reduced foliage density and low levels of dieback.
2	*Araucaria heterophylla* (Norfolk Island Pine)	A mature, single trunked specimen approximately 32 metres in height with a canopy spread of 16 metres and a DBH of 1060mm (measured at 1 metre). In good health and of high landscape significance. Slight canopy bias to north in lower crown due to adjacent Fig Tree (T3). Electric lights cord and solar panels attached to lower part of the tree up to 5 metres. One small woody root girdling basal trunk on the west side. There is evidence of tissue dysfunction on a branch at approx. 12 metres on NW side. - cause unknown.
3	*Ficus rubiginosa* (Port Jackson Fig, Rusty Fig)	A mature, single trunked specimen approximately 12 metres in height with a canopy spread of 15 metres and a DBH of 1080mm. In good health and of high landscape significance. The tree displays fair to poor branch attachment with evidence of multiple past failures in the lower crown area. Evidence of past mechanical damage to underside of branch growing over the roadway (vehicle impacts). Fruit and foliage not a perfect match for the species so potentially not *F. rubiginosa*.

None of the trees assessed for this report is listed individually as a threatened species on the Schedules of the NSW *Biodiversity Conservation Act 2016* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

3. IDENTIFICATION OF SETBACKS FOR THE TREES

A number of methods to determine the likely extent of root zones and appropriate setbacks for tree root protection zones for trees on development sites have been developed in the past. The key criteria used in determining setbacks is the tree's trunk diameter at breast height (DBH) in conjunction with other factors including the sensitivity of the species in question to environmental disturbance/change, the age of the tree and the tree's health and vigour at the time.

Harris et al (2004) provide formulae for calculating tree protection zones based on the above criteria and modified from the 1991 British Standard for protection of trees on construction sites (BS 5837:1991). The 2005 version of the British Standard (BS

5837:2005) recommends a radius of 12 times the tree's DBH. For multi trunked trees BS 5837:2005 recommends a setback of 10 times the basal trunk diameter.

The Australian Standard *AS 4970 Protection of trees on development sites* also identifies a 'Tree Protection Zone' of 12 times the tree's DBH. The Australian Standard also provides a formula for calculating the "Structural Root Zone' of trees on development sites. In regard to palms, other monocots, cycads and tree ferns the Standard identifies the Tree Protection Zone should not be less than 1 metre outside the crown projection. (Australian Standards Association 2009)

The tree protection zones identified below have been calculated using the Australian Standard *AS 4970 Protection of trees on development sites* and are the identified setback from the trees where disturbance (e.g. soil level changes, compaction, excavation etc.) should be minimised to reduce potential impacts on the long term health of the trees.

Table 2: Tree Protection Zones - Terrigal SLSC The Promenade Terrigal Beach

Tree Number	Species and Common Name	Tree Protection Zone*	Structural Root Zone*
1	*Araucaria heterophylla* (Norfolk Island Pine)	4.7 metres	2.5 metres
2	*Araucaria heterophylla* (Norfolk Island Pine)	13 metres	3.6 metres
3	*Ficus rubiginosa* (Port Jackson Fig, Rusty Fig)	12.7 metres	3.6 metres

* = Radial offset measured from centre of trunk.

Preferably, no more than 10% of the root protection zone should be disturbed with compensation made by extension of other areas of the TPZ to compensate for the area(s) disturbed. Where greater than 10% of the tree protection zone is potentially disturbed the tree's viability needs to be investigated and demonstrated by the project arborist. The structural root zone is the area required for stability and where disturbance of any sort should be avoided.

4. POTENTIAL IMPACTS ON THE TREES

The extent of impacts to the trees has been assessed using the following plans:

- Site Plan prepared by White Dickson Architects dated 30/01/2020 and identified as Drawing Number D002, Issue DA.
- Elevations Plan prepared by White Dickson Architects dated 30/01/2020 and identified as Drawing Number D008, Issue DA.

The extent of potential impacts to the trees is summarised in the table 3 as follows and has been rated using the following guideline:

0% of root zone impacted – no impact of significance
0 to 10% of TPZ impacted – low level of impact
10 to 15% of TPZ impacted – low to moderate level of impact
15 to 20% of TPZ impacted – moderate level of impact
20 to 25% of TPZ impacted – moderate to high level of impact
25 to 35% of TPZ impacted – high level of impact
>35% of TPZ impacted – significant level of impact

The root zone calculations referred to in this report were made using scale drawings of the trees' identified tree protection zones (TPZ) in a CAD program (TurboCAD®) with potentially affected areas added to the drawing. The area of potential impact was converted to a percentage of TPZ using a spreadsheet (Microsoft Excel®).

Table 3: Summary of potential impacts on the trees – Terrigal SLSC The Promenade Terrigal Beach

Tree Number	Species and Common Name	Summary
1	*Araucaria heterophylla* (Norfolk Island Pine)	Below ground impacts The proposed addition to the surf club building is located 2.9 metres from the tree at the closest point and is calculated to encroach within 8.54m² or 12.42% of the tree's identified TPZ – this is a low to moderate level of impact and within an acceptable threshold. In addition, the area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts. Above ground impacts The outer extent of a small number of lower branches will require reduction pruning to accommodate the addition to the clubhouse – this pruning will not have any impact of substance on either the tree's long-term health or its landscape value.
2	*Araucaria heterophylla* (Norfolk Island Pine)	Below ground impacts The proposed addition to the surf club building is located 2.75 metres from the tree at the closest point and is calculated to encroach within 29.46m² or 5.59% of the tree's identified TPZ – this is a low level of impact and within an acceptable threshold. In addition, the area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts.

		Above ground impacts Four small diameter lower branches will require reduction pruning to accommodate the addition to the clubhouse – These branches can be summarised as follows: 1 x 1st order branch on the east side at 4.5 metres of ca. 100mm diameter; 1 x 1st order branch on the east side at 5.5 metres of ca. 100mm diameter; 1 x 1st order branch on the east side at 6.5 metres of ca. 140mm diameter; 1 x 1st order branch on the NE side at 7.5 metres of ca. 160mm diameter; This pruning is estimated to affect less than 5% of the tree's live crown area and will not have any impact of substance on either the tree's long-term health or its landscape value.
3	*Ficus rubiginosa* (Port Jackson Fig, Rusty Fig)	Below ground impacts The proposed addition to the surf club building is located 6.75 metres from the tree at the closest point and is calculated to encroach within 16.89m² or 3.32% of the tree's identified TPZ – this is a … level of impact and within an acceptable threshold. In addition, the area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts. Above ground impacts The outer extent of a small number of lower small diameter branches will require reduction pruning to accommodate the addition to the clubhouse – this pruning will not have any impact of substance on either the tree's long-term health or its landscape value.

The potential impacts can be summarised as follows:

- The proposed works will encroach within 3.32% of the identified TPZ of tree number 3 - this is a low level of encroachment and within an acceptable threshold.
- The proposed works will encroach within 5.59% of the identified TPZ of tree number 2 - this is a low level of encroachment and within an acceptable threshold.
- The proposed works will encroach within 12.42% of the identified TPZ of tree number 1 - this is a low to moderate level of encroachment and within an acceptable threshold.
- In addition to the above all three trees will require minor pruning that will not have any impact of substance on either the trees' long-term health or their landscape value – details of the pruning is summarised in table 3 on pages 5 and 6 of this report.

5. TREE PROTECTION MEASURES

The following generic tree protection measures are recommended to assist in minimising potential impacts to trees proposed for retention.

A. Measures to be implemented prior to the commencement of any works on the site.

1. Tree to be retained are to be clearly identified by signage as protected trees.

2. The tree protection zones (TPZ) of trees to be retained are to be protected by fencing during the entire construction period except for specific areas directly required to achieve construction works.

3. The tree protection fence shall be constructed of galvanised pipe at 2.4 metre spacing and connected by securely attached chain mesh fencing to a minimum height of 1.8 metres and shall be installed prior to work commencing.

4. The tree protection fencing shall be installed as closely as possible to the alignment of the identified TPZ and shall be approved and certified by the site arborist prior to commencement of any construction or demolition works on the site.

B. Measures to be implemented and maintained during the life of construction works on the site.

5. Any excavation within the identified TPZ of trees to be retained shall be carried out by hand to minimize disturbance to tree roots. Roots greater than 25mm are not to be damaged or severed without prior assessment by an arborist to determine likely level of impact and the restorative actions required to minimise the impacts of root damage.

6. Tree roots between 10mm and 25mm diameter, severed during excavation, shall be cut cleanly by hand by an experienced Arborist/Horticulturist with a minimum qualification of the Horticulture Certificate or Tree Surgery Certificate.

7. The following activities/actions are prohibited from the tree protection zones:

- Soil cut or fill including excavation and trenching
- Soil cultivation, disturbance or compaction
- Stockpiling storage or mixing of materials
- The parking, storing, washing and repairing of tools, equipment and machinery
- The disposal of liquids and refueling
- The disposal of building materials
- The sitting of offices or sheds
- Any action leading to the impact on tree health or structure

8. Canopy pruning of trees identified for protection which is necessary to accommodate approved building works shall be undertaken in accordance with *Australian Standard 4373-2007 'Pruning of Amenity Trees'*.

6. CONCLUSION

Three mature trees have been assessed for this report. The trees assessed for this report are located in the street frontage to the SW of the clubhouse building.

The trees comprise planted Australian species. The trees were of good health at the time of inspection and did not exhibit evidence of significant pest or disease.

The potential impacts can be summarised as follows:

- The proposed works will encroach within 3.32% of the identified TPZ of tree number 3 - this is a low level of encroachment and within an acceptable threshold.
- The proposed works will encroach within 5.59% of the identified TPZ of tree number 2 - this is a low level of encroachment and within an acceptable threshold.
- The proposed works will encroach within 12.42% of the identified TPZ of tree number 1 - this is a low to moderate level of encroachment and within an acceptable threshold.
- In addition to the above all three trees will require minor pruning that will not have any impact of substance on either the trees' long-term health or their landscape value – details of the pruning is summarised in table 3 on pages 5 and 6 of this report.

Generic tree protection measures are identified in section 5 of this report.

Guy Paroissien MAIH, MIACA, MISA, MAA
M Env. Mgt. & Restor., Dip. Arboriculture, Hort. Cert., Tree Care Cert.
Director
Landscape Matrix Pty Ltd
17th September 2020

BIBLIOGRAPHY/REFERENCES

Australian Standards Association (2007) AS 4373- 2007 - Australian Standard 4373-2007 'Pruning of Amenity Trees'.

Australian Standards Association (2009) AS 4790- 2009 - Australian Standard 4790-2009 'Protection of trees on development sites'.

Barrell J (1996) - Pre-planning Tree Surveys: SULE is the Natural Progression. Arboricultural Journal 17, 33-46.

Harris et al (2004). Harris RW, Clark JR, Matheny NP: Arboriculture – Integrated Management of Landscape Trees Shrubs and Vines 4TH Edition. Prentice Hall, New Jersey 07458.

Mattheck & Breloer (1994) – The Body Language of Trees – a handbook for failure analysis - Research for Amenity Trees No. 4. Published by TSO (The Stationary Office) Norwich UK.

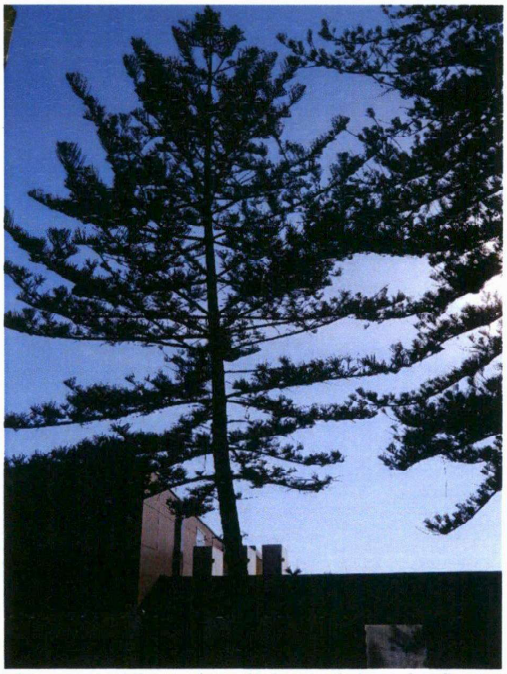
White Dickson Architects (2020) - Site Plan prepared by White Dickson Architects dated 30/01/2020 and identified as Drawing Number D002, Issue DA.

White Dickson Architects (2020) - Elevations Plan prepared by White Dickson Architects dated 30/01/2020 and identified as Drawing Number D008, Issue DA.

APPENDIX A

Photograph 1: Illustrating the location and context of trees 1, 2 and 3.

Photograph 2: Illustrating the crowns of trees 1 and 2.



Photograph 3: Tree # 1 – Illustrating slight trunk lean for first 4 metres fence.

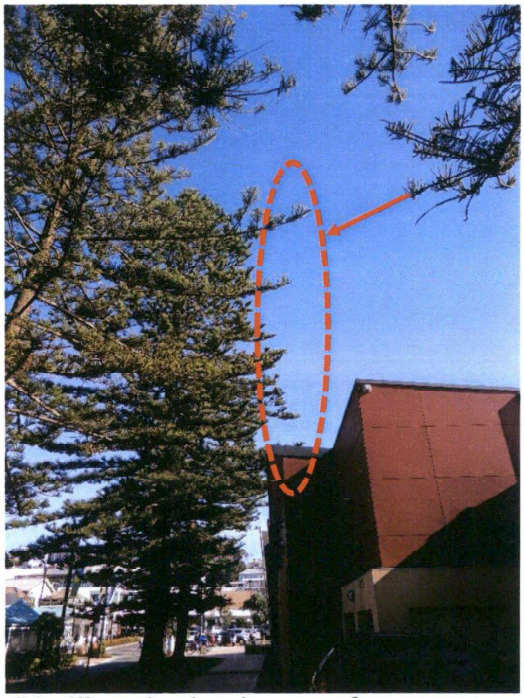
Photograph 4: Tree # 2 - Illustrating tissue dysfunction on a branch at 12 metres on NW.

Photograph 5: Tree # 1 - Illustrating reduced foliage density and low dieback

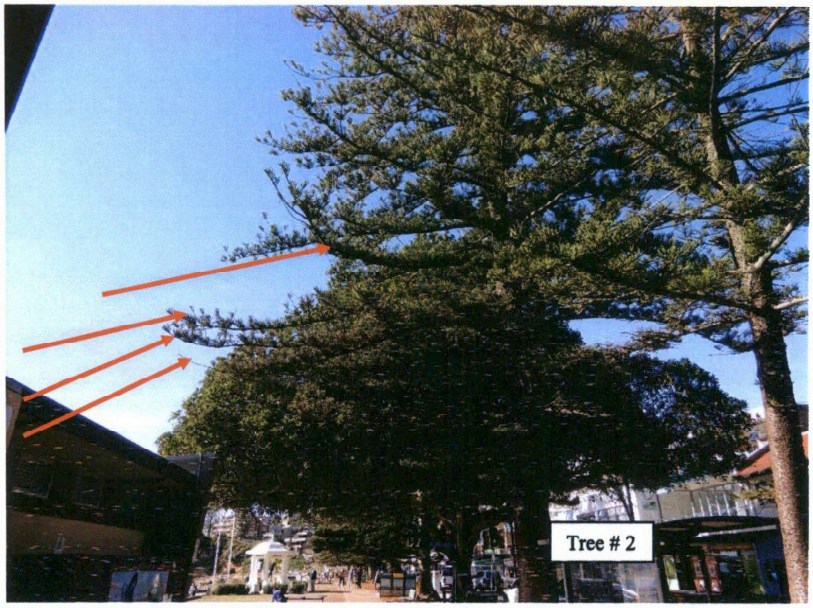
Photograph 6: Tree # 3 - Illustrating the past branch failures in the lower crown.

Photograph 7: Tree # 8 – Illustrating a closer view of a past branch failure.

Photograph 8: Illustrating the paved surface where the additions are proposed.



Photograph 9: Tree # 1 – Illustrating the minor area of outer canopy potentially impacted.



Photograph 10: Tree # 2 – Illustrating the lower branches that will require pruning.

Photograph 11: Tree # 3 – Illustrating the small area of outer branches that will require pruning

APPENDIX B - TREE DATA SUMMARY - TERRIGAL SURF LIFE SAVING CLUB

Tree No.	Genus, Species (Common Name)	Height (m)	Canopy (m)	DBH (mm)	DBH for TPZ	DBL for SRZ	Foliage Condition	Age Class	Trunk	Trunk Lean	Crown balance	Past Pruning	Stability	Branch Attachment	Health	Vigour	Dead Wood	Past or disease	ULE	Landscape Significance	Retention Value*	Comments
1	*Asaucaria heterophylla* (Norfolk Island Pine)	16	9	390	360	510	Fair foliage condition	Semi Mature	Single trunk	Slight trunk lean to the north for 4 metres then upright	Majority of canopy to the north	Lower limbs pruned in past to 3 metres	Appears stable	Sound branch attachment	Good health	Fair vigour	5%	No visual evidence of significant pest or disease	1 Long (> 40 years)	Moderate landscape significance	2	Slight canopy bias to the north. At the time of inspection the tree was of fair vigour and exhibited reduced foliage density and low levels of dieback.
2	*Asaucaria heterophylla* (Norfolk Island Pine)	32	15	1086	1080	1260	Good foliage condition	Mature	Single trunk	Upright trunk	Balanced canopy area	Lower limbs pruned in past to 3 metres	Appears stable	Sound branch attachment	Good health	Good vigour	<5%	No visual evidence of significant pest or disease	1 Long (> 40 years)	High landscape significance	1	Slight canopy bias to north in lower crown due to adjacent Fig Tree (T3). Electric lights cord and solar panels attached to lower part of the tree up to 5 metres. One small woody root girdling basal trunk on the east side. There is evidence of tissue dysfunction on a branch at approx. 12 metres on NW side. - cause unknown.
3	*Ficus rubiginosa* (Port Jackson Fig, Rusty Fig)	12	16	990 ± 1144	1080	1210	Good foliage condition	Mature	Single trunk	Upright trunk	Balanced canopy area	Lower limbs pruned in past to 4 metres	Appears stable	Fair to poor branch attachment	Good health	Good vigour	<5%	No visual evidence of significant pest or disease	2 Medium (15 to 40 years)	High landscape significance	1	The tree displays fair to poor branch attachment with evidence of multiple past failures in the lower crown area. Evidence of past mechanical damage to underside of branch growing over the roadway (vehicle impacts). Final and foliage not a perfect match for the species so potentially not *F. rubiginosa*.

ca = approximate diameter at breast height (DBH) estimated from nearest property boundary or fence where trees were located on adjoining properties

* Retention Values: 1 - High (Priority for retention); 2 - Moderate (Consider for retention); 3 - Low or short ULE (Not warranting specific design consideration) and 4 - Remove (very short ULE, structurally unsound, weed species etc.)

Michael Leavey Consulting
Planning & Development Services

ABN 63 279 339 494

Statement of Environmental Effects

Alterations and Additions to Terrigal Surf Life Saving Club

81 Terrigal Esplanade, Terrigal

and part of 1 Terrigal Esplanade, Terrigal

Prepared for Terrigal Surf Life Saving Club Inc

November 2020

0449 536 694
michael@michaelleaveyconsulting.com.au
www.michaelleaveyconsulting.com.au

I, Rob Micheli, Area Manager Hunter Region, Department of Planning, Industry & Environment - Crown Lands, hereby consent to the making of this application under delegated authority on behalf of the Crown being the owner of the land to which this application relates. Delegated Officer Level 4 – Environmental Planning & Assessment Regulation 2000 Clause 49(1)(b) 11/5/2021

Table of Contents

Vers 1.1 Final for Submission 26.11.2020

1. INTRODUCTION

This Statement of Environmental Effects has been prepared on behalf of Terrigal Surf Life Saving Club Inc in support of a development application to Central Coast Council for alterations and additions to Terrigal Surf Life Saving Club.

The proposal has been designed as sympathetic additions to the existing club building which will expand the facilities and services provided for club members and the community.

The site is zoned RE1 Public Recreation under Gosford LEP 2014, and the proposal is permissible with the consent of Council.

This assessment considers the proposal against the provisions of relevant planning instruments, including Gosford LEP 2014, Gosford DCP 2013, draft Central Coast LEP 2018, and relevant state planning controls. The assessment also addresses the matters identified in Council's Development Application Guide and the matters for consideration under Section 4.15 of the *Environmental Planning & Assessment Act, 1979*.

The assessment of the proposal against Gosford LEP 2014, Gosford DCP 2013, other planning controls and the heads of consideration under Section 4.15 of the *Environmental Planning & Assessment Act, 1979* concludes that the proposal is permissible, meets the intent and objectives of relevant planning controls and standards, will not adversely impact on surrounding properties or the environment and should be supported by Council.

This Statement should be read in conjunction with the supporting information submitted with the development application, and in particular the architectural plans prepared by White + Dickson Architects.

2. THE SITE

2.1 Site Location and Description

The subject site is No. 81 and part of No. 1 Terrigal Esplanade, Terrigal, and the real property description is Lot 3 DP 1060783 and part of Lot 1 1060783. No.81 Terrigal Esplanade has an area of 942.4m² and the parts of No. 1 Terrigal Esplanade subject to the application have an area of 101m².

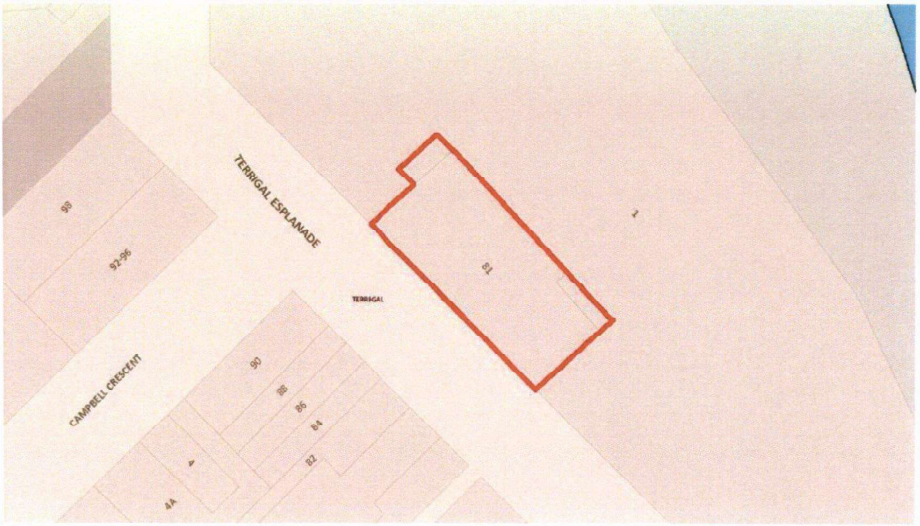


Figure 1 – Location Source: Central Coast Council Online Mapping

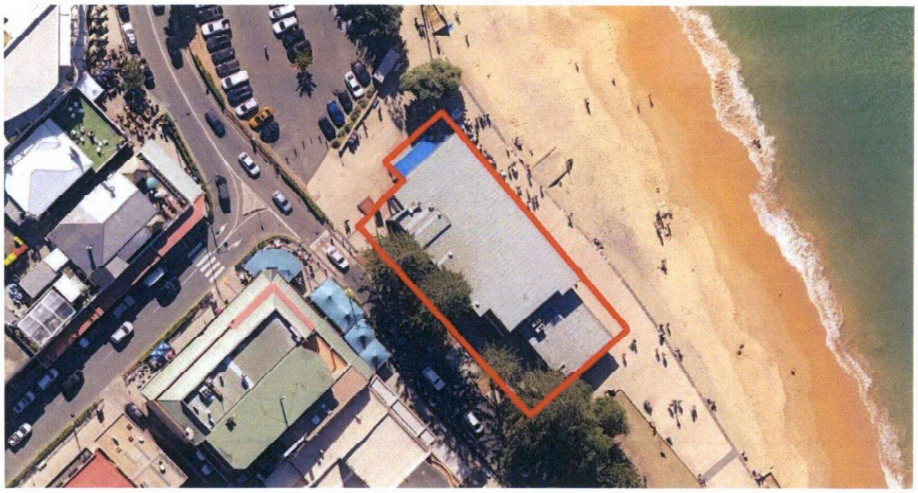


Figure 2 – Site Aerial Photograph Source: SIX Maps

2.2 Site Features and Existing Development

The site is the Terrigal Surf Life Saving Club, which is located on the beachfront at Terrigal Beach and has frontage to Terrigal Esplanade at the rear.

The existing surf club is a part two storey, part single storey building containing lifesaving equipment storage, first aid room, lifeguard room and change room areas and a gymnasium at the ground level, together public toilets on the south-eastern side of the building. One the north-western side of the building at the ground level is an entry foyer and stairs to the first floor and a café on the northern corner with a retractable awning that extends beyond the building to the north-west. On the first floor there is a patrol tower, training room, kitchen, amenities and storage, with covered deck areas facing the beach on the north-eastern side. The first floor area covers part of the ground floor level, and the south-western part of the building remains single storey.

The site is shown in the following photographs:

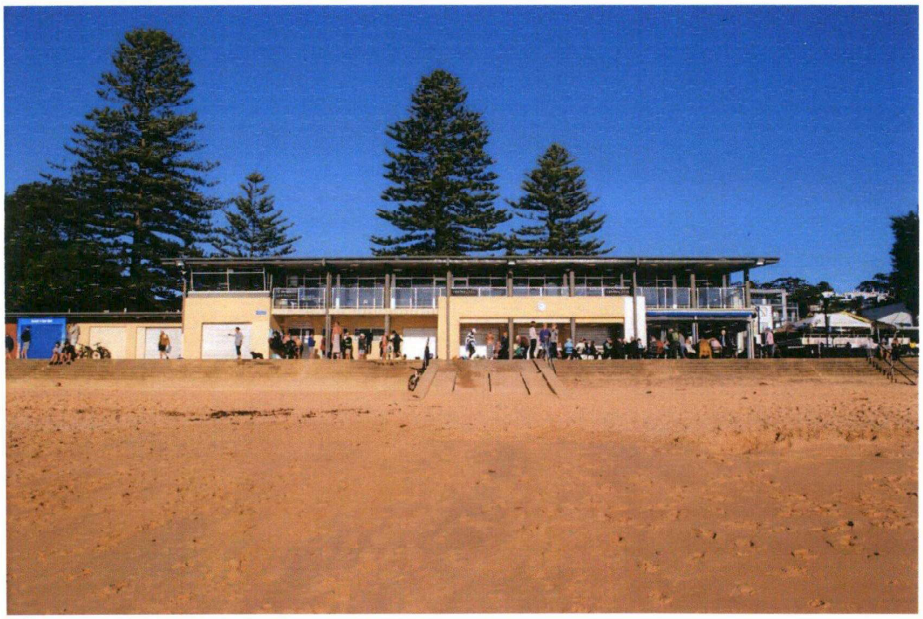


Figure 3 – Surf Club viewed from Terrigal Beach

Figure 4 – Front elevation of the surf club and cafe

Figure 5 – Side elevation to the north-west of the surf club and café

Figure 6 – Side elevation to the south-east of the surf club and public toilets

Figure 7 – Side and rear elevation of the surf club

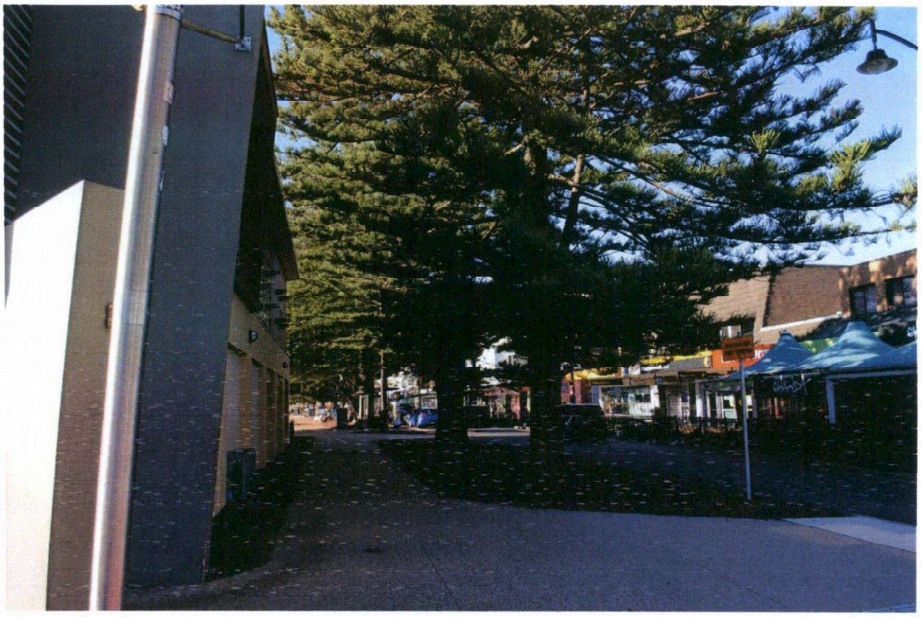


Figure 8 – Rear elevation of the surf club facing Terrigal Esplanade

2.3 Surrounding Land and Development

Surrounding land on the north-eastern side of Terrigal Esplanade includes Terrigal Beach to the north-east and a wide pedestrian pathway running along the length of the beach. To the south-east of the surf club are grassed open space areas with seating and tables, and on the north-western side is a wide paved area and public car park beyond that.

At the rear of the surf club, adjoining Terrigal Esplanade, are a number of large and visually prominent Norfolk Island Pine trees, and a large Port Jackson Fig, as addressed in the Arborist's Report prepared by Landscape Matrix. Land on the south-western side of Terrigal Esplanade is the Terrigal village centre, which is generally two storey commercial development, and primarily containing restaurants with footpath dining and other uses.

3.0 ZONING AND PLANNING CONTROLS

3.1 Zoning

The land is zoned RE1 Public Recreation under Gosford LEP 2014, as is adjoining land and Terrigal Beach. Terrigal Esplanade is zoned SP2 Infrastructure and land to the south-west is zoned B2 Local Centre and forms part of the defined Terrigal Village Centre.

The zoning of the site and surrounding land is shown in the following figure:

Figure 9 – Land zoning (NSW Planning Portal)

3.2 Other

The site does not have a LEP mapped building height or floor space ratio, and is not identified on the following LEP maps:

- Land Reservation Acquisition
- Additional Permitted Uses
- Development Incentives Application
- Street Frontages
- Urban Release Area

The site is mapped as being part Class 3 for Acid Sulfate Soils, on the south-western side and part Class 5 on the north-eastern side.

The existing Norfolk Island Pines along the south-western boundary of the site, adjoining Terrigal Esplanade, are identified as a heritage item, No.275 "Significant Trees", as per the following map, and further to the south-east the War Memorials is also a heritage item.

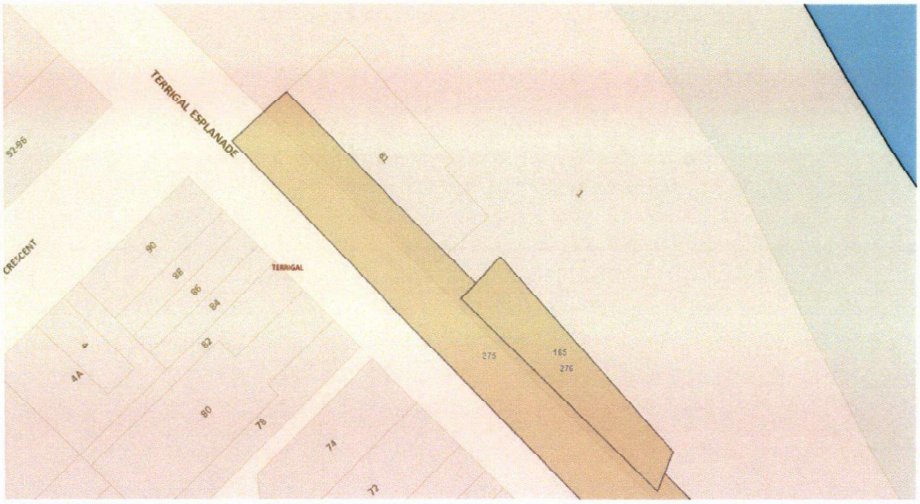


Figure 10 – LEP Heritage Items (Central Coast Council Online Mapping)

The land is subject to the Coastal Management State Environmental Planning Policy, 2018, and is in mapped Coastal *Environment* and Coastal *Use* areas, and the site is not mapped in Chapter 6.2 of Gosford DCP 2013 and does not have a Coastal Building Line.

The site is not mapped as being bushfire prone or flood prone.

Draft Central Coast LEP 2018

Under the draft Central Coast LEP 2018, which has been publicly exhibited, the site retains its RE1 Public Recreation zoning and the uses on the site remain permitted with Council consent. The draft Central Coast LEP also removes the heritage listing of the trees along the south-western boundary of the site.

4. THE PROPOSAL

The proposal is for alterations and additions to the existing surf club building, including:

Ground Level

- provide an enclosed café seating area of 71.29m² on the north-western side of the building, with glazed stacking doors, and to be used in conjunction with the existing café;
- remove the members gym (to be relocated to the first floor); and
- provide a plant area (for air conditioning, building systems and access to water tanks) and extend the women's change area on the rear southern corner, with an area of 38.28m².

First Floor

- extend the first floor level to the south-east, over the existing ground level public toilets and storage areas, to provide a new training room, gym, servery, storage and toilet facilities, and with a new deck on the north-eastern side to match the existing deck areas along the front of the club. The extension has a gross floor area of 215.86m² and deck area of 27.2m²;
- provide an extended deck area on the north-western side, with an area of 73.66m², located over the ground level café seating and alfresco area;
- Extend part of the existing training room to the north-east, to the edge of the existing deck alignment, and reusing the existing external windows; and
- Replace existing glazing suites between the existing training room and the deck with new stacking doors.

The alterations and additions are of a complementary design and appearance to the existing club building, which will also be repainted to further integrate the existing and proposed building elements. The additions will include a sloping roof to match the existing roof and the building height of the additions will be the same as the existing club building, which is 5.989m on the north-eastern (beach) side and 7.343m on the south-western (Terrigal Esplanade) side.

Terrigal Surf Life Saving Club is one of the largest surf clubs on the Central Coast, with 920 members in 2019/20, including 296 junior members, and the alterations and additions will expand the facilities provided by the club for members and the local community.

5. PLANNING CONSIDERATIONS

5.1 Gosford Local Environmental Plan 2014

Compliance with relevant controls in Gosford LEP 2014 is set out in the following table:

LEP Control/ Standard	Proposed	Complies
Permissibility	The proposal is for alterations and additions to a *community facility* and a *cafe*, both of which are permissible with consent in the RE1 zone.	**Yes**
RE1 Zone Objectives • To enable land to be used for public open space or recreational purposes. • To provide a range of recreational settings and activities and compatible land uses. • To protect and enhance the natural environment for recreational purposes. • To identify areas suitable for development for recreation, leisure and cultural purposes. • To ensure that development is compatible with the desired future character of the zone	The proposal is for alterations and additions to an existing surf club, which is well established on the site and in the locality, and serves a number of important local community functions. The proposal will expand the facilities and range of services the surf club provides, including the existing café operations, and is appropriate for the surf lifesaving and recreational functions the club provides. The design of the alterations and additions will complement the existing club building and will be appropriate for the site and its setting. The proposal addresses impacts on the adjoining Norfolk Island Pines, which are a major visual and landscape feature of the area, as well as impacts on surrounding land and development. An assessment of the proposal has been undertaken against the character requirements of Gosford DCP, and the proposal will be compatible with existing development on the site and the desired future character of the area.	**Yes**
5.10 Heritage Conservation	The Norfolk Island Pines at the rear of the existing club are an identified heritage item, and the proposal's compliance with clause 5.10 is addressed in further detail below.	**Yes**
Clause 7.1 Acid Sulfate Soils	The site is mapped as being partly Class 3 and partly Class 5 for Acid Sulfate Soils, and Council mapping indicates a low probability of occurrence of acid sulfate soils. The proposal does not involve excavation, with some infill development on the ground level which is on currently sealed areas.	**Yes**

Tree Impacts/ Clause 5.10 Heritage Considerations

The existing Norfolk Island Pines and other trees along the north-eastern side of Terrigal Esplanade, between the Terrigal Surf Club and the Crowne Plaza, are an identified heritage item under Gosford LEP 2014, being recognised as "Significant Trees". This significance reflects the size and visual/ landscape/ character qualities of the trees in their coastal setting and follows a

well established tradition commenced in Manly in 1877 with beachfront beautification and tree planting using Norfolk Island Pines and other species. Many of the trees in these settings were planted by early settlers and the local community, and mark the appreciation by the community and members of the local area of the value and amenity of trees and in particular where they are used to mark and define territory.

Relative to the surf club, there are four large Norfolk Island Pines planted at the rear of the surf club, adjoining Terrigal Esplanade, and as well as a (likely) Port Jackson Fig tree to the south of the club building. These trees are between 12m and 32m in height with canopies of between 9m and 16m and are in good health and of moderate to high landscape significance.

The proposal is supported by an Arboricultural Impact Report, prepared by Guy Paroissien of Landscape Matrix Pty Ltd, which addresses 3 trees at the rear in relation to proposed works on the southern corner of the building, which are both at the ground and first floor levels. The report outlines the potential impact on these trees, which is summarised below:

Trees	Below Ground Impacts	Above Ground Impacts
Tree 1 (Norfolk Island Pine)	The proposed works will encroach within 12.42% of the identified TPZ - this is a low to moderate level of encroachment and within an acceptable threshold. The area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts.	The outer extent of a small number of lower branches will require reduction pruning to accommodate the additions – this pruning will not have any impact of substance on either the tree's long-term health or its landscape value
Tree 2 (Norfolk Island Pine)	The proposed works will encroach within 5.59% of the identified TPZ - this is a low level of encroachment and within an acceptable threshold. The area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts.	Four small diameter lower branches will require reduction pruning to accommodate the additions, which is estimated to affect less than 5% of the tree's live crown area and will not have any impact of substance on either the tree's long-term health or its landscape value.
Tree 3 (Port Jackson Fig, Rusty Fig)	The proposed works will encroach within 3.32% of the identified TPZ - this is a low level of encroachment and within an acceptable threshold. The area of TPZ potentially impacted is already a paved area with reduced capacity to support finer absorptive root growth and this will assist in reducing impacts.	The outer extent of a small number of lower small diameter branches will require reduction pruning to accommodate the addition to the clubhouse – this pruning will not have any impact of substance on either the tree's long-term health or its landscape value.

The report also identifies protection measures to assist in minimising potential impacts on the trees at the rear of the surf club building, which can be implemented through conditions of consent.

Based on the arborist's assessment, the proposal will have a low level of encroachment on the TPZ of 2 of the trees and a low to moderate level of encroachment on 1 tree, and these are within an acceptable threshold and relate to areas that are already paved which will assist in reducing impacts. Some minor pruning of branches will be required above ground, and in all cases this will not have any impact of substance on either the tree's long-term health or its landscape value.

Clause 5.10 of Gosford LEP 2014 sets out heritage conservation considerations which are relevant to the significant trees at the rear of the club building, as well as the nearby war memorial, and consideration of impacts on archaeological sites and Aboriginal places of heritage significance. The objectives of the clause are:

(a) to conserve the environmental heritage of Gosford,
(b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views,
(c) to conserve archaeological sites,
(d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

Clause 5.10(4) requires that a consent authority must, before granting consent in respect of a heritage item, consider the effect of the proposed development on the heritage significance of the item concerned, and this applies regardless of whether a heritage management document is prepared or a heritage conservation management plan is submitted.

Based on the arboricultural assessment undertaken, and with tree protection measures as recommended, the proposal will not have an adverse impact on the heritage listed trees at the rear of the club building, including any adverse impact on the TPZ of the trees, the long term health of the trees or their landscape and visual values. The proposed additions will be of a complementary design and appearance to the existing surf club building, with only a minor addition to the building footprint on the south-eastern side, and the new addition will maintain a similar setback to, and visual relationship with the trees at the rear compared to the existing first floor level on the balance of the elevation. On this basis the proposal will not impact on the heritage significance of the trees, and will satisfy the requirements of Clause 5.10(4) of the LEP. The proposal does not require a heritage conservation management plan to be prepared, and it is noted that Council intends to remove the heritage listing of the trees under the draft Central Coast LEP 2018.

The proposed first floor additions on the south-eastern side will be located 29m from the war memorial located to the south-east, which is on an elevated grassed park area facing the beach. The new addition will maintain the same building setback to the war memorial as the existing ground floor public toilets on the south-eastern side, and the overall building design and appearance will be compatible with the existing surf club building and will not impact on the heritage values of the war memorial or any vistas to, or from the war memorial.

An AHIMS search has been undertaken (**Attachment A**) which confirms the subject land has not been identified as containing, or being within 200m of any Aboriginal sites or places, and the proposal will not impact on any identified archaeological sites, Aboriginal objects or Aboriginal places of heritage significance.

5.2 Gosford Development Control Plan 2013

In assessing the proposal against Gosford DCP 2013, Section 3.42 of the *Environmental Planning & Assessment Act 1979* provides that the purpose of a DCP is to provide guidance, and section 4.15(3A)(b) of the Act provides that DCP standards are to be flexibly applied and non-compliance can be addressed through alternative solutions or addressing how a proposal otherwise achieves the objectives of the standard.

Chapter 2 - Character

Chapter 2 of DCP 2013 contains Character Maps and Character Statements to be considered with development applications. The subject site is in the Terrigal *Mainstreet Centre* character area, and the DCP describes the desired future character for this area as:

> *"This should remain a mixed-use centre that provides a range of services and accommodation for local residents as well as visitors, where the scenic potential of a prominent backdrop to Gosford City's ocean beaches is enhanced by new developments that encourage high levels of street activity and also achieve improved standards of amenity plus urban-and-civic design quality.*
>
> *Protect and enhance existing levels of "main-street" activity with building forms that maintain both the pedestrian-friendly scale of existing one and two storey shop-front developments, and also the current level of midday sunlight along all footpaths and laneway frontages. Promote high levels of on-street activity by maximising the number of retailers or businesses and the continuity of shop-windows along all street and laneway frontages. Avoid indoor arcades that would draw people away from the street. Incorporate awnings, colonnades or balconies in all buildings to provide sheltered pedestrian settings that encourage pavement dining. Contribute to high levels of visible activity along all streets by surrounding upper storeys with balconies that accommodate restaurant dining or residents' outdoor recreation.*
>
> *Ensure that new developments (including alterations to existing buildings) do not dominate the informal scenic qualities of foreshore settings or disrupt the main-street development pattern in this established coastal shopping village. The height and form of buildings should maintain panoramic ocean and coastal views that are enjoyed from surrounding hillside dwellings, as well as providing a transition from residential areas to the middle storeys of the existing resort hotel. Along all public streets, shop-front facades should have a zero setback and a maximum height of two storeys, with taller storeys set back behind terraces to maintain a pedestrian-friendly scale as well as midday sunlight along all footpaths and laneways. Ensure that the height and siting of new buildings also preserve levels of privacy, sunlight and visual amenity that are enjoyed by existing dwellings and their private open spaces.*

Reflect the form of development that is typical of traditional coastal centres where a wide variety of retailers are accommodated by separate buildings upon narrow-fronted allotments. Along any street or waterfront, avoid the appearance of a continuous wall of development or uniform building heights. Vary the shape and height of all visible facades. Top-most storeys should be setback behind wide roof terraces, and roofs plus parapet heights should step from one building to the next. Street corners should be emphasised by taller forms. Neighbouring buildings should be separated by landscaped courtyards and alleyways that provide view corridors, access to apartment lobbies, and daylight plus an outlook for above-ground dwellings.

Disguise the scale and bulk of new buildings. All visible facades should employ extensive windows that are shaded by lightly-framed balconies, verandahs or exterior sunshades, plus painted finishes and some board or sheet cladding rather than expanses of plain masonry. Roofs should be gently-pitched to minimise the height of ridges, flanked by wide eaves that shade terraces and also disguise the scale of exterior walls. Side and rear facades should match the design quality of the street frontage.

Conceal off-street parking behind street-front shops or apartments, and provide unobtrusive vehicle entrances from laneways or secondary streets to minimise disruption of shopfronts and their associated pedestrian activity. Contribute to co-ordinated street improvements that include dedicated pedestrian crossings, footpath paving, landscaping and lighting to provide safe and secure settings for informal social interaction. Building colour schemes and commercial signs should be co-ordinated and limited in size and number to promote the identity of this coastal centre, rather than emphasising corporate sponsorship.

Around the Skillion, provide master planned landscape improvements that enhance the scenic potential, accessibility and recreation value. Maintain existing boatsheds that are distinguishing features of this foreshore, but allow alterations or additions to accommodate community or publicly-accessible facilities. New works should complement the modest scale, form and traditional marine architecture displayed by these existing buildings, incorporating in particular a light-weight appearance and gently-pitched roofs flanked by verandahs or balconies.."

The desired future character for the *Mainstreet Centre* area is focused on commercial development on the south-western Terrigal Esplanade rather than development within the RE1 zoned land along the beachfront. Notwithstanding, the proposal will be compatible with the existing surf club building, which is oriented towards the beach and set against the backdrop provided by the Norfolk Island Pines at the rear of the building, which also provide visual separation between the surf club building and development to the west. The alterations and additions will follow the same building lines and architectural treatment as the existing club building, with the same roof treatment and building heights, and it is proposed to repaint the building to further integrate the existing and new building elements. There are minor additions to the building footprint on the north-western side, which will cover an area already used for alfresco café seating, and on the south-eastern side where the first floor extension will largely be over existing structures already at the ground level.

An arboricultural assessment has been undertaken of impacts of the proposal on the visually significant trees at the rear of the surf club, which form a dominant part of the character of the local area, and the proposal will not have adverse impact on these trees or their landscape values or their contribution to the character of Terrigal Beach.

The proposal will be compatible with the appearance and character of the existing surf club, as well as the location and setting of the site, and will be compatible with the desired future character of the area.

The proposal has been considered against the Scenic Quality requirements in Chapter 2.2 of the DCP, and the site is located in the Terrigal Landscape Unit within the larger Northern Coastal Geographical Unit. The proposal will sit within the same building height as the existing surf club building, with minor additions to the existing building envelope, and will maintain an overall appearance which will be consistent with scenic character of the location and will not overpower the natural elements of the beach and views to surrounding natural backdrops.

The proposal's consistency with relevant provisions of Gosford DCP 2013 is detailed in the table below. The site is within the mapped Terrigal Village Centre under Chapter 4.3 of the DCP, which has application for alterations and additions on properties within Commercial and Special Purpose zones, however there is no reference to its application for alterations and additions on land zoned for Public Recreation. Notwithstanding, an assessment against the desired character and scenic quality provisions of Chapter 4.3 and other provisions is provided.

DCP Requirement	Proposed	Consistent
4.3.4 Terrigal Village Centre Desired Character and Scenic Quality	The proposal has been designed to complement the existing surf club building, including its interface with Terrigal Beach, and is largely located over the existing building footprint, and will follow the same roof line and overall appearance of the existing club. The surf club addresses the beach, and with an alfresco café area on the northern side, and the proposal will continue this interface and will not materially change the existing presentation of the club building with Terrigal Esplanade.	**Yes**
4.3.5 Terrigal Village Centre Street Frontage	The proposal will result in a similar presentation and interface with Terrigal Esplanade compared to the existing surf club, and the site is not mapped as requiring an active street frontage facing Terrigal Esplanade.	**Yes**
4.3.6 Terrigal Village Centre Height Form + Scale of Building	The height and scale of the alterations and additions will be consistent with the existing surf club building and will be compatible with the overall scale of the building and its setting.	**Yes**
4.3.7 Terrigal Village Centre Setbacks Siting + Scale of Building	The alterations and additions will largely be located within the footprint of the existing club building, and the setbacks as proposed are compatible with the setting and location of the site.	**Yes**

4.3.8 Terrigal Village Centre Architectural Character + Identity	The proposal will complement the architectural character and identity of the existing surf club building, including the roofline and external appearance, and it is proposed to paint the surf club so as to further integrate the existing and new building elements.	**Yes**
4.3.9 Terrigal Village Centre Street - Level activity + civic design	The proposal will not impact on the interface between the club and surrounding public areas, and the proposed extension on the northern side will provide shade and weather protection for an area already used for alfresco dining.	**Yes**
4.3.10 Residential Amenity	The proposal does not include residential accommodation, and the proposal will not adversely impact on views or the amenity of residential properties.	**Yes**
4.3.11 Natural Hazards	The site is not subject to a mapped coastal building line or identified coastal inundation area under Chapter 6.2 of the DCP, and the location of the surf club building is not identified as being flood prone. Notwithstanding, the alterations are largely on the first floor level, over the top of part of the existing building, and the proposed extension on the northern side is an open structure at the ground level, with glazed stacking doors, and will be compatible with the existing surf club building and coastal location of the site.	**Yes**
4.3.12 Servicing	The proposal will utilise existing car parking provided and available adjacent and nearby to the existing surf club, and the proposal will retain the same waste collection arrangements as currently exist, with a bin storage area located within the surf club car park.	**Yes**
4.3.13 Precinct Controls	The site is not within an identified precinct under Part 4.3.13 of the DCP, and there are no particular precinct controls that apply.	**N/A**

Car Parking

The proposal will result in additional gross floor area being provided on the first floor level, which is primarily a new training room for existing club members, a gym that is being relocated from the ground floor level, and additional amenities and storage areas, and remaining areas are decks which do not constitute gross floor area and are for general use by the club.

The proposal does not propose or require additional car parking to be provided, as the extensions will cater for existing club members who already park in the surf club car park or other surrounding car parking spaces, or who otherwise walk to the surf club. The proposal is unlikely to result in additional traffic generation beyond that of the existing club and its operations, and there is a large amount of car parking located nearby to the club and also other car parking provided in Terrigal.

Waste Collection

The proposal will not result in any material change to the current waste generation from the site, and waste storage and collection will be the same as per the existing arrangements for the surf club and café.

5.4 State Environmental Planning Policies

Relevant State Environmental Planning Policies (SEPPs) applying to the land are the Coastal Management SEPP 2018, SEPP 55- Remediation of Land, SEPP 19 - Bushland in Urban Areas and SEPP (Vegetation in Non-Rural Areas) 2017.

Coastal Management SEPP 2018

The site is subject to the Coastal Management SEPP 2018, and is located in mapped *coastal use* and *coastal environment* areas under the SEPP. The site is not mapped as containing *coastal wetlands* or *littoral rainforests*, or as being within a mapped proximity area. A table outlining compliance with the SEPP is provided below:

Consideration	Compliance
Clause 13 (1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:	
(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,	The proposal will be connected to reticulated sewer and stormwater will be managed in accordance with existing stormwater arrangements. Erosion and sediment controls will be in place during construction, and the proposal will not impact on the environment.
(b) coastal environmental values and natural coastal processes	The site is not subject to a *coastal building line* under Gosford LEP or DCP and the proposal will not impact on coastal environmental values or natural coastal processes.
(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,	The proposal will be connected to reticulated sewer and stormwater will be managed in accordance with existing stormwater arrangements. Erosion and sediment controls will be in place during construction, and the proposal will not impact on water quality or any sensitive coastal lakes as identified in Schedule 1.
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,	The proposal will not impact on these.
(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability	The proposal will not impact on public access to the foreshore.
(f) Aboriginal cultural heritage, practices and places,	An AHIMS search has been undertaken (**Attachment A**), and the subject land has not been identified as containing or being within 200m of any Aboriginal sites or places

(g) the use of the surf zone	The proposal will not impact on the surf zone
Clause 13 (2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:	
(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1)	The proposal is appropriately designed and sited having regard to LEP and DCP requirements, the location and setting of the site and the existing surf club building.
(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact	N/A – no adverse impacts
(c) if that impact cannot be minimised—the development will be managed to mitigate that impact	N/A – no adverse impacts
Clause 14 (1)(a) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:	
(i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability	The proposal will not impact on public access to the foreshore, and in part will cover an existing alfresco area associated with the existing café..
(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores	The proposal will not result in unreasonable overshadowing of the foreshore, and will not impact views from public spaces to foreshores having regard to existing development and nearby trees on the site.
(iii) the visual amenity and scenic qualities of the coast, including coastal headlands	The proposal will be visible from Terrigal Beach and coastal areas, and will maintain a consistent appearance with the existing surf club building.
(iv) Aboriginal cultural heritage, practices and places	An AHIMS search has been undertaken (**Attachment A**), and the subject land has not been identified as containing or being within 200m of any Aboriginal sites or places
(v) cultural and built environment heritage	The site adjoins a number of heritage listed trees, and as detailed in the submitted Arborist Report and an assessment against cl.5.10 of Gosford LEP, the proposal will not have an adverse impact on the trees or their setting.
Clause 14 (1)(b) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority is satisfied that:	
(i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a)	The proposal is appropriately designed and sited having regard to LEP and DCP requirements, the location and setting of the site and the existing surf club building. The proposal will maintain be compatible with, and will complement the existing surf club building.
(ii) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact	N/A – no adverse impacts
(iii) if that impact cannot be minimised—the development will be managed to mitigate that impact	N/A – no adverse impacts

Clause 14 (1)(c)	
Development consent must not be granted to development on land that is within the coastal use area unless the consent authority has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development:	The proposal is compatible with the location and visual setting of the site, as well as the zoning of the land, the zone objectives, permitted uses and allowed development standards in the zone. The proposal has been designed to complement the existing surf club building, and will continue the same roof line and overall appearance of the existing building.. The proposal is well designed and articulated and is of an appropriate bulk, scale and size having regard to the site and its location, and the existing surf club building on the site.
Clause 15 – Development within the coastal zone generally	
Development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land.	The site is not subject to a *coastal building line* under Gosford LEP or DCP and the proposal will not cause increased risk of coastal hazards on the land or other land.

SEPP 55 – Remediation of Land

SEPP 55 applies to all development and requires consideration and management of site contamination issues as part of the development assessment process. The current use of the site is for a surf club and recreational areas, which will remain the same, and there are no known previous uses that would lead to the site being contaminated or unsuitable for the proposed development.

SEPP 19 - Bushland in Urban Areas

SEPP 19 applies generally to all land in the former Gosford LGA and aims to protect and preserve remnant or representative natural vegetation within urban areas.

The proposal involves minor trimming of trees at the rear, which is supported by an Arborist's Report and recommendations, and which will not adversely impact on the trees or their landscape values.

The proposal will not involve the disturbance of any bushland zoned or reserved for open space (clauses 6 to 8), apart from minor trimming as supported by the Arborist's Report, and will not have an adverse impact on bushland zoned or reserved for public open space purposes (clause 9), and the proposal will be consistent with the SEPP.

SEPP (Vegetation in Non-Rural Areas) 2017

The proposal involves minor trimming of trees at the rear, which is supported by an Arborist's Report and recommendations, and which will not adversely impact on the trees or their landscape values. The subject land is not mapped as an area with biodiversity values under the NSW OEH Biodiversity Values Map, and the proposal will be consistent with the SEPP requirements.

6. ENVIRONMENTAL IMPACTS

The proposal is for alterations and additions to an existing surf club building, and environmental impacts have been considered in the assessment against planning controls and also as follows.

6.1 General Environmental Impacts

The proposal has considered a number of general environmental impacts including:

- Noise. The proposal will not generate noise in addition to the noise associated with the existing operations of the club.
- Waste. The proposal will not generate additional waste beyond that generated by the existing club and cafe and a Waste Management Plan is submitted with the application.

6.2 Site Suitability

The subject land is zoned for Public Recreation and contains the existing Terrigal surf club, and is suitable for the proposed development.

6.3 Stormwater Management

Stormwater from the development will be managed in the same way that currently exits on the site.

6.4 Tree Impacts

The proposal will require some minor trimming of trees at the rear, which is supported by an Arborist's Report, and the proposed works will not adversely impact on the trees or their landscape values.

6.5 View Impacts

Consideration has been given to the view impacts of the proposal, and the development will have a negligible impact, if any on views from nearby and surrounding properties.

The proposed first floor extension to the south-east, over the existing club and toilets, will largely be screened from view from properties to the south-west by the existing Norfolk Island Pine and Port Jackson Fig trees on the street frontage at the rear of the club building, as shown in Figure 11. These existing trees largely block through views from development on the opposite side of Terrigal Esplanade towards the Beach and ocean, including views gained from upper levels, and the proposed extension will have a negligible impact on views, if any, from adjoining development to the south-west due to the screening provided by the existing trees.

The proposed deck extension on the north-west side of the club building is a structure open at the front and the rear, which will still maintain through views for properties to the south-west, which are largely commercial properties, and would have a negligible impact on wider distant views from residential properties on the elevated hillsides in Terrigal Bowl, noting the wider views available from these areas.

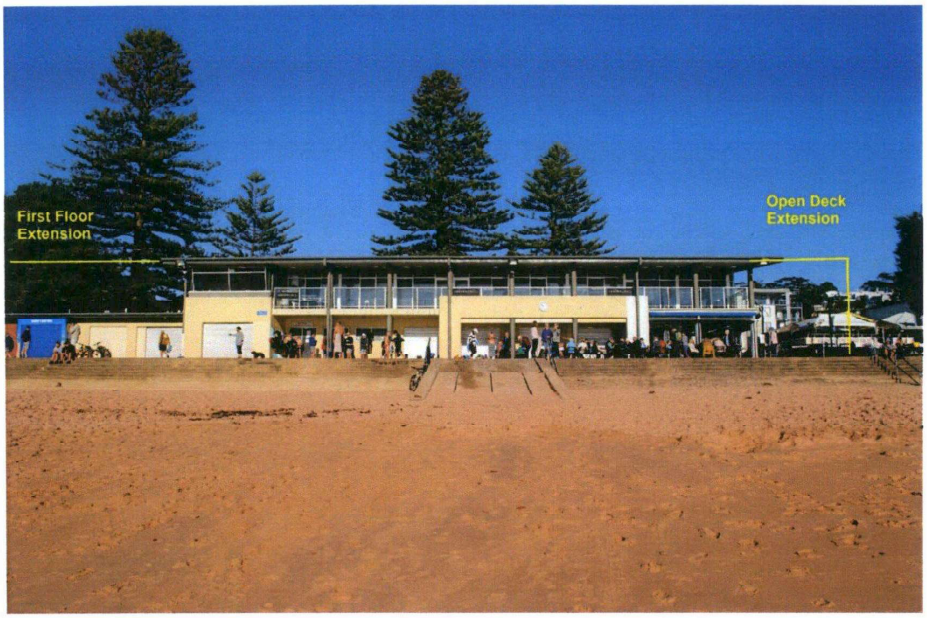


Figure 11 – Location of Extensions as viewed from Terrigal Beach

Having regard to screening provided by the existing trees along Terrigal Esplanade, and the through views maintained for the deck extension to the north-west, the proposal is unlikely to have an adverse or unreasonable impact on views.

6.6 Overshadowing

The proposal will not result in adverse overshadowing of the foreshore or public areas.

For the deck extension on the north-western side there will be a small area of additional shadowing on the north-eastern side of the deck area, which will be of a short duration in the morning, and in the afternoons there will be some shadowing of the entry area to the existing club building.

For the first floor extension on the south-eastern side there will be a minor increase to the shadows from the existing club building, and these will largely be on the access pathway area to the public toilets and there will be minimal additional shadow to the footpath area to the south-west of the club, which are areas already in shadow from the existing club building and the large trees at the rear of the site.

7. SECTION 4.15 CONSIDERATIONS

The following assessment addresses the matters required to be considered under Section 4.15 of the *Environmental Planning & Assessment Act 1979*.

(1) Matters for consideration—general

In determining a development application, a consent authority is to take into consideration such of the following matters as are of relevance to the development the subject of the development application:

(a) the provisions of:

(i) any environmental planning instrument

Comment: the proposal has been considered against both Gosford LEP 2014 and relevant State Environmental Planning Policies, and complies with all relevant requirement, including heritage considerations under clause 5.10 of the LEP;

(ii) any draft environmental planning instrument that is or has been placed on public exhibition and details of which have been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the draft instrument has been deferred indefinitely or has not been approved)

Comment: The site is subject to a Planning Proposal for the draft Central Coast Local Environmental Plan (CCLEP) which applies to the entire LGA and has completed public exhibition. Under the draft LEP the subject land retains its RE1 Public Recreation zoning, the proposal remains permitted with consent and the trees at the rear of the building are no longer identified as being heritage items. The proposal is consistent with the draft Central Coast Local Environmental Plan and the objectives for the RE1 Public Recreation zone.

(iii) any development control plan

Comment: the proposal has been assessed against the Gosford DCP 2013, and is consistent with relevant DCP requirements;

(iiia) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F

Comment: There is no planning agreement relevant to the subject land or the proposal.

(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), that apply to the land to which the development application relates

Comment: There are no matters prescribed in the regulations that impact on the proposal.

(b) *the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality*

Comment: The proposal is unlikely to result in any adverse environmental impacts and will maintain a positive social and economic impact by providing improved facilities for the surf club and its operations and for the wide community that the surf club serves.

(c) *the suitability of the site for the development*

Comment: The site is suitable for the proposed development and the proposal has been designed in response to the site's location and setting and having regard to the existing surf club building on the site.

(d) *any submissions made in accordance with this Act or the regulations*

Comment: This is a matter for Council to consider once the application is notified.

(e) *the public interest*

Comment: the proposal will result in improved facilities for the surf club, which will serve the local community and will be in the public interest. The proposal has architectural and design merit, which will be compatible with the existing surf club building, and will not result in adverse impacts on the heritage trees at the rear of the building or on other development in the surrounding area.

8. CONCLUSION

In conclusion, the proposal has been designed as sympathetic additions to the existing club building which will expand the facilities and services provided for club members and the Terrigal community. The proposal is permitted under Gosford Local Environmental Plan 2014 and is consistent with the objectives of the RE1 Public Recreation zone. The proposal is compatible with the existing surf club building and the location and setting of the site, and will not result in adverse impacts on the heritage trees along Terrigal Esplanade or on adjoining properties. The proposal is consistent with Gosford Development Control Plan 2013 and the desired future character of the area.

An assessment of the proposal has been carried out pursuant to Section 4.15 of the *Environmental Planning & Assessment Act 1979*, which supports the proposal, and it is recommended that Council approve the application.

Attachment A – AHIMS Search Results

Office of Environment & Heritage

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : Terrigal Surf Club
Client Service ID : 545402

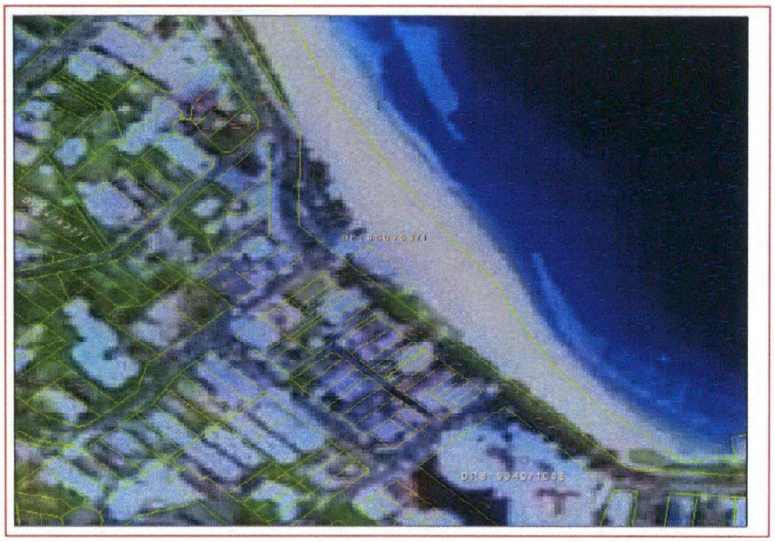
Michael Leavey Consulting
Suite 2.08 Platinum Building East 4 Ilya Ave
Erina New South Wales 2250
Attention: Michael Leavey
Email: michael@michaelleaveyconsulting.com.au

Date: 26 October 2020

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 3, DP:DP1060783 with a Buffer of 200 meters, conducted by Michael Leavey on 26 October 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

Limited Geotechnical Investigation

At

Lot 22 DP 243415
26 Panorama Terrace, Green Point

For

L Sprague

2 August 2021
5QS Ref: 212041

5QS CONSULTING GROUP

www.5QS.com.au

2 August 2021
5QS Ref: 212041

Mr L Sprague
26 Panorama Terrace
GREEN POINT NSW 2251

Dear Leo,

Re: Limited Geotechnical Investigation
Proposed Additions and Alterations
26 Panorama Terrace, Green Point

The following report presents the results of a limited geotechnical investigation undertaken at the above property.

If you have any further enquiries, please do not hesitate to contact the undersigned.

For and on behalf of
5QS Consulting Group

[redacted]

Peter Fennell
Principal

Contents

Attachments

1. Drawing 212041/G1
2. Dynamic Cone Penetrometer Logs
3. Engineering Logs
4. General Notes
5. Australian Geoguides LR7 (Landslide Risk) and LR8 (Hillside Construction Practice)
6. Tables M1 and M2 from Central Coast City Council's 'Development Control Plan 2013 – Geotechnical Requirements for Development Applications'.
7. Site Classification Notes
8. CSIRO Sheet BTF18

Limited Geotechnical Investigation

Lot 22 DP 243415
26 Panorama Terrace, Green Point

1. Introduction

As requested 5QS Consulting Group [5QS] has carried out a limited geotechnical investigation at the above property. The purpose of the investigation was to provide factual and interpretative data on subsurface conditions and comments on the following:

- The assessed risk of slope instability on the property, in accordance with the methodology set out in guidelines prepared by the Australian Geomechanics Society Sub-committee on Landslide Risk Management, in 'Australian Geomechanics', Vol 37 No 2 (Ref 1);
- Site classification to Australian Standard AS 2870–2011, 'Residential slabs and footings' (Ref 2);
- Geotechnical guidelines for development on the site.

For the purpose of the investigation, 5QS was provided with a copy of architectural plans by Osmond McLeod Architects, revision A, dated 12 January 2021.

Based on the supplied information, it is understood that proposed development of the property will comprise alterations to the existing two-storey split-level dwelling and construction of upper and lower storey additions.

For the purpose of a qualitative assessment of the risk of slope instability on the site, this report makes reference to the terms defined in the Australian Geomechanics Society Landslide Taskforce paper, *Practice note guidelines for landslide risk management*, in 'Australian Geomechanics' Vol 42 No 1 (Ref 3).

The scope of this assessment included a desktop review of available published information, field work and preparation of this report. The following sections give the results of the assessment and comments on the above investigation scope.

This report should be read in conjunction with the attached 'General Notes'.

2. Site Description

The property, identified as Lot 22 in DP 243415 [the site], is situated on the western side of Panorama Terrace, Green Point, and occupies a roughly rectangular-shaped allotment with a plan area of some 715 m^2.

The site is bounded by Panorama Terrace to the east, and by existing residential development to the north, south and west.

Ground slopes generally fall toward the west at an average grade of approximately 28 % (slope angle of 16°). The topography of the area local to the site comprises a concave side slope of a steeply undulating hill.

At the time of investigation, the site was occupied a two-storey split-level rendered and clad dwelling, timber deck, and concrete blockwork and timber retaining walls. It is understood a swimming pool had been decommissioned and backfilled within to the rear of the dwelling. Vegetation on the site comprised established lawn cover to the front of the dwelling, and garden shrubs and mature to intermediate trees throughout the property.

Various views of the site can be seen in photographs P1 through P3.

Photograph P1 – View towards south-west, taken from Panorama Terrace

Photograph P2 – View towards east, taken from near western corner of property

Photograph P3 – View of failed timber retaining wall along western boundary

3. Background Information

3.1 Geological Setting

Reference to the 'Gosford–Lake Macquarie 1:100 000 special geology sheet', (Ref 4) indicates that the site is underlain by rocks belonging to the Terrigal Formation of the Gosford Subgroup, Narrabeen Group of Middle Triassic age.

The Terrigal Formation typically comprises interbedded laminite, shale, fine to coarse grained quartz to quartz-lithic sandstone and minor red claystone.

3.2 Soil Landscape

Reference to the 'Gosford–Lake Macquarie 1:100 000 soil landscape series sheet 9131-9231' and associated report (Ref 5), the site is underlain by the Erina erosional landscape.

The Erina erosional soil landscape is characterised by undulating to rolling rises and low hills on the Terrigal Formation. Local relief is typically less than 60 m with ground slopes greater than 25 %. Topography typically comprises rounded narrow crests with moderately inclined slopes.

Limitations of the Erina erosional landscape include localised mass movement, high soil erosion hazard, localised foundation hazard, localised high run-on, seasonal waterlogging of footslopes and strongly acid soils of low fertility.

4. Fieldwork

4.1 Methods

The fieldwork, undertaken on 18 May 2021, consisted of a walkover assessment of the site and surrounding area, completion of two dynamic cone penetrometer [DCP] tests and drilling of two boreholes by hand auger methods.

Drawing 212041/G1 shows the approximate locations of the boreholes and DCP tests.

4.2 Results

The DCP probe was driven to termination at a depth of 3.1 m and to refusal at a depth of 1.85 m at test locations DCP 1 and DCP 2, respectively.

The boreholes at test locations BH1 and BH2 were drilled to termination at depths of 1.1 m and 1.5 m, respectively.

The subsurface profile encountered at test location BH1 comprised silty sand topsoil to 0.5 m depth, overlying sandy clay of estimated medium plasticity to the limit of investigation.

The subsurface profile encountered at test location BH2 comprised silty sand filling to 0.2 m depth, overlying clayey gravelly sand filling to 0.3 m depth, overlying clay of estimated high plasticity to 0.6 m depth, overlying sandy clay of estimated high plasticity to the limit of investigation.

No groundwater was encountered within the boreholes and no surface seepages were observed on the site.

Logs of the DCP tests and boreholes are provided in the attachment section of this report.

5. Data Interpretation

5.1 Proposed Development

Based on the supplied information, it is understood that proposed development of the property will involve alterations to the existing dwelling and construction of new lower and upper floor additions.

It is anticipated that earthworks for the proposed development will likely be limited to excavations for footings.

5.2 Interpretative Geotechnical Model

The subsurface conditions on site are interpreted to comprise the following:

- Sand FILLING / TOPSOIL – estimated loose to very loose density to depths up to 0.5 m below existing surface levels, overlying;
- Sandy CLAY and CLAY (RESIDUAL) – estimated medium to high plasticity, estimated stiff to very stiff consistency to depths ranging from 1.5 m to 3 m below existing surface levels, overlying;
- SANDSTONE – extremely to highly weathered, estimated low strength.

Groundwater seepages are unlikely to be encountered within the depths of excavations in the footprint of the proposed development.

6. Assessment of Slope Instability Risk

6.1 Central Coast Council's Slope Hazard Classification

The site was assessed as a **"Category 2 – Medium Hazard Area"** for potential landslip hazard as defined in Tables M1 and M2 of the document 'Development Control Plan 2013 – Geotechnical Requirements for Development Applications', for the Gosford local government area of Central Coast Council [CCC].

A copy of CCC's classification system, set out in Tables M1 and M2 of DCP 2013, has been attached to this report.

6.2 General

An assessment of the risk to both property and life as a result of failure mechanisms on the site has been undertaken with reference to the Australian Geomechanics Society Landslide Taskforce paper, 'Practice note guidelines for landslide risk management' [Ref 3].

Risk analysis can be broken up into four components, namely:

- Hazard identification;
- Frequency analysis;
- Consequence analysis; and
- Risk estimation.

The following sections give comments on analysis of risk to property and loss of life.
0

6.3 Slope Hazard Identification

Based on the observed site conditions, the following hazards relating to potential instability have been identified for the proposed development of Lot 22 in DP 243415:

- Hazard 1 – Creep of surface soils;
- Hazard 2 – Failure of retaining wall along western boundary;
- Hazard 3 – Failure of retaining walls; and
- Hazard 4 – Deep seated instability.

6.4 Risk to Property

A summary of the results of the site assessment is presented in Table 1, together with a qualitative assessment of the likelihood of occurrence of mass ground movements following

construction and its consequence and risk to post construction structures on the site and neighbouring lots.

Table 1 – Assessment of risk to property

Hazard		Likelihood	Consequence to Development	Risk to Proposed Development
1	Creep of surface soils	Possible	Minor	Moderate
2	Failure of retaining walls along western boundary	Almost Certain	Insignificant	Moderate
3	Failure of retaining walls	Likely	Insignificant	Low
4	Deep seated instability	Unlikely	Medium	Low

Hazard 1 has been assessed as having a likelihood category of **'Possible'** associated with the presence of steep slopes. Creep failure was assessed as having an **'Minor'** consequence for the proposed development; hence a risk rating of **'Moderate'** applies to this hazard.

Hazard 2 has been assessed as having a likelihood category of **'Almost Certain'** associated with the condition of the existing timber retaining wall and significant rotation observed during the fieldwork. Retaining wall failure was assessed as having a **'Insignificant'** consequence for the proposed development; hence a risk rating of **'Moderate'** applies to this hazard.

Hazard 3 has been assessed as having a likelihood category of **'Likely'** associated with the typical design life of engineer-designed retaining walls. Retaining wall failure was assessed as having a **'Insignificant'** consequence for the proposed development; hence a risk rating of **'Low'** applies to this hazard.

Hazard 4 has been assessed as having a likelihood category of **'Unlikely'** on the basis of the absence of unfavourably oriented strata with major defect planes and the lack of observable evidence of historic instability in the area of the proposed development. Deep seated slope failure would be expected to impact on the proposed development with a consequence level of **'Medium'**; hence a risk rating of **'Low'** applies to this hazard.

Table 2 gives a summary of the risk assessment data for the site.

Table 2 – Site assessment summary data

Assessor	William Maher			**Assessment date**		18 May 2021
Street No	26	**Street**	Panorama Terrace		**Suburb**	Green Point
Lot No	22		**Section**	-	**DP**	243415
Site Data:	**Land Area 1** (1)					**Land Area 2**
Site classification to AS 2870–2011	Class 'P'					Not applicable (2)
Land slope	16°					
Geology	Rnt					
Surface soils	Sand FILLING / TOPSOIL					
Instability risk type	Soil creep, retaining wall failure, deep seated instability					
Risk assessment	Moderate					
Geotechnical inspections required?	No					
Risks from adjoining land	No					

Notes to Table 2:
(1) Land Area 1 is the property identified as Lot 22 in DP 243415
(2) No additional land area divisions required

The risk of damage to the existing and proposed site development due to soil creep could be managed by including in engineering design and construction measures to support all footings on piers founded within weathered rock. The purpose of these measures would be to reduce to 'Unlikely' the likelihood of creep which might affect site structures and hence reduce rom 'Moderate' to 'Low' the risk of this hazard impacting the property.

Failure of the existing timber retaining wall along the boundary is also a hazard to the existing residential development at No 8 Amaroo Close. Management of the risk of wall failure impacting on No 8 Amaroo Close will likely involve removal and reconstruction of the retaining wall with an engineer-designed and properly installed structure. It is anticipated that the risk associated with failure of the existing timber retaining wall along the western boundary could be reduced from 'Moderate' to 'Low' provided the guidelines set out in Section 8 of this report are implemented during design and construction of the proposed development.

6.5 Assessment of Risk to Life

Ref 3 also provides a framework for landslide risk management, guidance on risk analysis methods and information on acceptable or tolerable risks for loss of life.

For loss of life, the individual risk can be calculated using:

$$R_{LOL} = P_H \times P_{S:H} \times P_{T:S} \times V_{D:T}$$

Where,

R_{LOL} is the risk, or annual probability of death of an individual
P_H is the annual probability of the hazardous event
$P_{S:H}$ is the probability of spatial impact by the hazard given the event
$P_{T:S}$ is the temporal probability given the spatial impact, and
$V_{D:T}$ is the vulnerability of the individual

A summary of the results of the assessment undertaken in relation to risk to life of the hazards identified at this site is presented in Table 3 below.

Table 3 – Assessment of risk to life

Hazard		$P_{(H)}$	$P_{(S:H)}$	$P_{(T:S)}$	$V_{(D:T)}$	Risk $R_{(LOL)}$
1	Creep of surface soils	1×10^{-3}	0.5	1×10^{-3} (1)	0.1 (2)	5×10^{-8}
2	Failure of retaining wall along the western boundary	1	0.1	1×10^{-3} (1)	0.1 (2)	1×10^{-5}
3	Failure of retaining walls	1×10^{-2}	0.1	1×10^{-3} (1)	0.1 (2)	1×10^{-7}
4	Deep seated instability	1×10^{-4}	0.5	0.1 (1)	0.5	3×10^{-6}

Notes to Table 3:
(1) Evacuation likely
(2) Person not buried by debris

There are no established individual or societal risk acceptance criteria for the loss of life due to a hazardous event such as a landslide or rock fall.

Australian Geoguide LR7 (attached) discusses “acceptable” and “tolerable” levels of risk which have been proposed by several authorities including the ANCOLD Guidelines for Risks from Large Dams.

Table 4 shows tolerable risk levels for existing and new developments.

Table 4 – Australian Geomechanics Society tolerable risk for loss of life

Situation	Suggested Tolerable Loss of Life Risk for the person most at risk
Existing Slope [1] / Existing Development [2]	10^{-4} / annum
New Constructed Slope [3] /New Development [4] /Existing Landslide [5]	10^{-5} / annum

Notes to Table 4:

1. 'Existing Slope' in this context refers to slopes that are not part of a recognizable landslide and have demonstrated non-failure performance over at least several seasons or events of extended adverse weather, usually being a period of at least 10 to 20 years.
2. 'Existing Development' includes existing structures, and slopes that have been modified by cut and fill, that are not located on or part of a recognizable landslide and have demonstrated non-failure performance over at least several seasons or events of extended adverse weather, usually being a period of at least 10 to 20 years.
3. 'New Constructed Slope' includes any change to existing slopes by cut or fill or changes to existing slopes by new stabilisation works (including replacement of existing retaining walls or replacement of existing stabilization measures, such as rock bolts or catch fences).
4. 'New Development' includes any new structure or change to an existing slope or structure. Where changes to an existing structure or slope result in any cut or fill of less than 1.0m vertical height from the toe to the crest and this change does not increase the risk, then the Existing Slope / Existing Structure criterion may be adopted. Where changes to an existing structure do not increase the building footprint or do not result in an overall change in footing loads, then the Existing Development criterion may be adopted.
5. 'Existing Landslides' have been considered likely to require remedial works and hence would become a New Constructed Slope and require the lower risk. Even where remedial works are not required intrinsically, it would be a reasonable expectation of the public for a known landslide to be assessed to the lower risk category as a matter of "public safety".

7. Site Classification

The site is classified as **Class 'P' (Problem site)** as defined in Ref 2. This classification was based on the presence of steep slopes, filling within the footprint of the proposed development at depths greater than 0.4 m and slope instability hazards.

The natural soils on this site are assessed to be highly reactive to moisture variation. Footings for the proposed development that are founded within weathered rock at depths in the order of 1.5 m to 3 m below existing ground levels and in line with the recommendations presented in Section 8.3 of this report, may be designed on the basis of a soil classification of **Class 'H1' (Highly reactive)**, in accordance with the provisions of Ref 2. The proposed footings system should be designed using a characteristic surface movement of 60 mm.

This site classification has made no allowance for poor site drainage or leaking plumbing. These factors should be taken into consideration in the design of footing systems.

The site should be maintained as outlined in the attached CSIRO Brochure BTF 18.

General information on site classification can be found in the attachment section of this report.

8. Geotechnical Guidelines for Site Development

8.1 General

Effective risk management on the site would be achieved by including in the proposed development design features which either reduce the likelihood of occurrence of a potential slope movement hazard or ameliorate the consequences of a landslip event.

Examples of such risk management measures are given in the following sections.

8.2 Slope Hazard Remediation

The timber retaining wall along the western boundary has deteriorated and has significantly rotated indicating that the retaining wall has failed. The retaining wall should be demolished and replaced by an engineer-designed retaining wall.

8.3 Footings

All proposed footing systems should be designed in accordance with Ref 2. Consideration will need to be given to the required extent of excavation and filling of the site, including removal of any existing trees and site regrading, when selecting and designing the footing system.

Within the area of the proposed additions, it is anticipated that stiff clays and weathered rock would be encountered at depths ranging from 1 m to 1.5 m and 1.5 m to 2 m, respectively. It is anticipated that shallow footings such as slabs and strip footings which are supported on piles / open-bored piers founded within weathered rock beneath all filling would be a suitable system of support for the proposed development. Footings founded weathered rock may be proportioned for a maximum allowable end bearing capacity of 500 kPa.

Under no circumstances should footings or slabs be founded on or within uncontrolled filling.

Proposed footing systems should be designed and founded such that they are outside or below the zone of influence of all trenches, excavations and retaining walls in their vicinity. The zone of influence is defined by an envisaged line drawn upwards, and away, from the base of the excavation at a grade of about 2H:1V for cohesive (clay) soils, 2.5H:1V for granular (sand/gravel) soils and 1H:8V in weathered rock.

All footing installation work should be inspected by an appropriately qualified engineer who can confirm the bearing capacities assumed for design.

8.4 Excavations

All permanent excavations in soil in excess of 0.6 m depth without battering on this site must be supported by engineer-designed retaining walls.

Permanent unsupported cuts in soil must be battered in accordance with the requirements of the Building Code of Australia, but in no case should be steeper than 2H:1V and must be protected from erosion.

Temporary excavations for the installation of permanent support measures may be made at batters of 1H:1V, or steeper where space on site is limited, provided that specific geotechnical advice regarding subsurface conditions and management of slope instability risk is sought at the time of bulk earthworks.

Where applicable, the excavation design should incorporate surcharge loads from slopes, retaining walls, structures and other improvements within the vicinity of the excavation.

Drainage measures should be implemented above and behind all excavations to intercept both surface and subsurface water movement.

8.5 Filling

All fill to be placed on site to heights in excess of 0.6 m without battering must be supported by engineer-designed retaining walls. Note that Council's planning guidelines may impose other restrictions.

All unsupported filling should be battered in accordance with the requirements of the BCA Volume 2, but in no case should be either greater than 1 m in height or steeper than 2H:1V and must be protected from erosion.

8.6 Earthworks in General

Council's development guidelines should be reviewed during site planning as development guidelines may impose height limitations or support requirements on site cuts and filling.

Where earthworks generate excess materials which require disposal to an off-site location, the excavated spoil is considered a waste material under current NSW environmental legislation. All materials to be disposed to an off-site location require a waste classification in accordance with the guidelines, Regulations and Orders of the NSW Environment Protection Authority [EPA].

All materials which cannot be classified as 'Special Waste' or 'Liquid Waste', or which cannot be pre-classified according to the EPA waste classification guidelines, must be sampled and tested for contamination in order to determine the appropriate waste classification prior to transport off site.

Note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Acts 1997 states that it is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. 5QS can accept no liability for the unlawful disposal of waste materials from any site.

8.7 Retaining Walls

All retaining walls on the site should be engineer-designed in accordance with the requirements of AS 4678–2002, 'Earth-retaining structures' (Ref 6). All retaining structures should be designed to support, where appropriate, surcharge loading due to any sloping ground surface above the retaining walls.

As a separate matter to the construction of new retaining walls in conjunction with proposed development of the site, the dilapidated treated-timber wall on the western boundary of the property presents a significant and unacceptably high risk of impact on the neighbouring development at No 8 Amaroo Close. The management of the collapse risk of this retaining wall will likely involve careful removal of the filling supported by it followed by demolition of the wall. Future retaining measures for bulk earthworks on the site should be constructed at a setback distance not less than about 2 m from the nearest point of the base of the existing retaining wall.

All retaining walls should be constructed with adequate surface and subsurface drainage to the design engineer's and council's requirements.

8.8 Site Drainage

The effective drainage from the site of surface and subsurface water is important to ensure the stability of the surface soil and the long-term performance of footing systems and retaining walls.

The property should be developed and maintained in accordance with the guidelines set out in Section 3 of the BCA and Appendix B of Ref 2.

In particular, the following measures are recommended:

- Catch/dish drains formed at the top, and dish and rubble drains installed at the toe of all batters, and subsoil drains installed behind new retaining walls;
- All surface water should be prevented from concentrating on this site;

- Cut areas sloped to fall away from proposed building areas and water not be allowed to pond around buildings, and the site graded to prevent water from ponding on all areas of compacted fill;
- Surface stormwater and subsoil water collected and disposed of in line with Council's requirements; and
- Sediment and erosion control measures are to be undertaken during construction to Council's requirements.

9. How to Use This Report

5QS Consulting Group [5QS] has prepared this report on a limited geotechnical investigation for a proposed additions and alterations at No 26 Panorama Terrace, Green Point, in accordance with the services proposal by 5QS dated 12 April 2021.

The following is a guide as to the intended scope and use of this report.

- This report has not been prepared for the purpose of informing design of any Class 2 development or mixed-use development with a Class 2 building component under the definitions of the Design and Building Practitioners Act 2020 and Regulation 2021.
- This report is provided for the exclusive use of Mr Leo Sprague for the purposes as described in the report. It may not be used or relied upon for other purposes or by a third party. 5QS can accept no responsibility for loss or damage arising out of the use of this report beyond its purpose as stated above, or incurred by any third party relying on the report without the express written consent of 5QS. In preparing this report 5QS has necessarily relied upon information provided by the client and/or their agents.
- The extent of testing associated with this assessment is limited to the borehole and DCP probe locations and variations in ground conditions may occur. The data from the test locations have been used to provide an interpretation of the likely subsurface profile at the site of the proposed development. The interpretation may or may not precisely represent the actual subsurface conditions at the site. 5QS should be contacted immediately if subsurface conditions are subsequently encountered that differ from those described in this report so that we can review and re-interpret the geotechnical model on the basis of the additional data.
- The scope of this investigation does not include any comment on the potential excavatability of the subsurface materials on site.

- Neither this report, nor sections from this report, should be used as part of a specification for a project without review and agreement by 5QS. This is because this report has been written as advice and opinion rather than instructions for construction.
- This report must be read in conjunction with all of the attachments.
- The recommendations provided in this report represent a summary of our technical advice. Please discuss the recommendations with the undersigned if you require any clarification.

For and on behalf of
5QS Consulting Group

[redacted]

William Maher
Professional Engineer

Reviewed

[redacted]

Peter Fennell
Principal

10. References

1. Landslide risk management concepts and guidelines, in 'Australian Geomechanics', Vol 37 No 2 (May 2002)

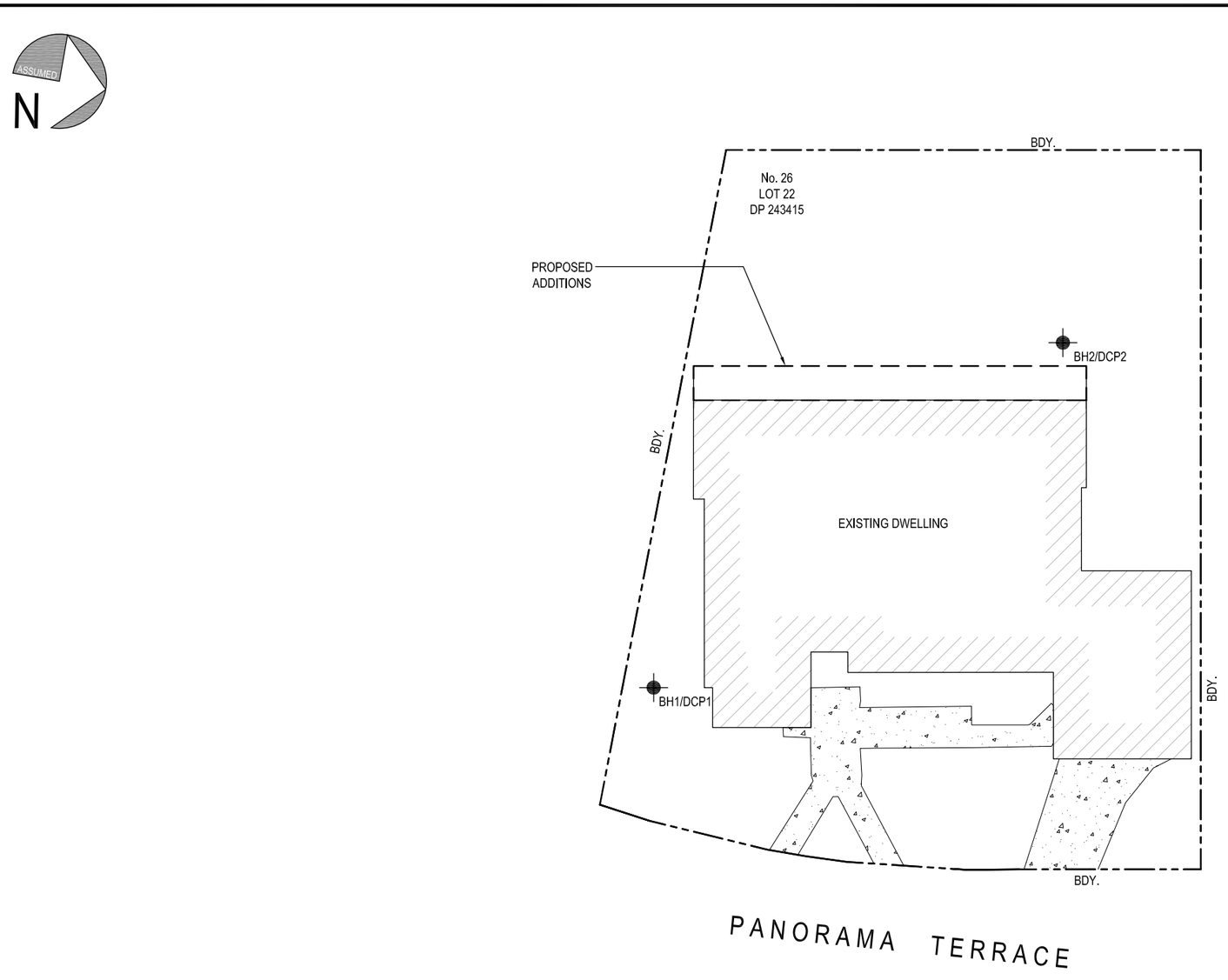
2. Australian Standard AS 2870–2011, 'Residential slabs and footings', Standards Australia (January 2011)

3. Practice note guidelines for landslide risk management, in 'Australian Geomechanics', Vol 42, No 1 (March 2007)

4. 'Gosford–Lake Macquarie special 1:100 000 geology sheet 9131 and part 9231', Geological Survey of NSW (2015)

5. 'Gosford–Lake Macquarie 1:100 000 soil landscape series sheet 9131-9231' and associated report, NSW Department of Conservation & Land Management (1993)

6. Australian Standard AS 4678–2002, 'Earth-retaining structures', Standards Australia (February 2002)



LEGEND

BH/DCP — APPROXIMATE LOCATION OF BOREHOLE & DYNAMIC CONE PENETROMETER TEST

TEST LOCATION PLAN

SCALE 1:200

REV.	DATE	ISSUE DESCRIPTION	DESIGN	DRAWN	CHECKED
-	2.06.21	Report Issue	-	CRV	WJM

Approved:

(02) 4952 1666
admin@5qs.com.au
Newcastle | Gosford | Sydney
Harden | Yass | Hall, ACT

TEST LOCATION PLAN
PROPOSED ADDITIONS & ALTERATIONS
26 PANORAMA TERRACE, GREEN POINT
L. SPRAGUE

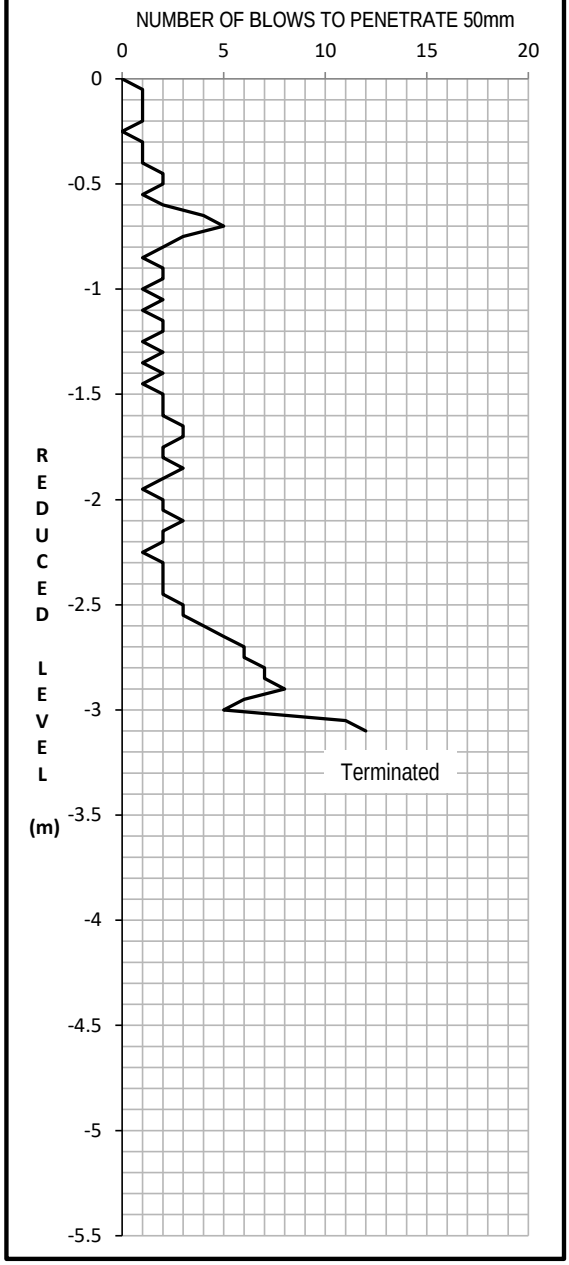
Drawing: 212041
Sheet: G1
Revision: -
Original Sheet Size: A3

DYNAMIC CONE PENETROMETER LOG

Location:	26 Panorama Terrace, Green Point		
Client:	L. Sprague	5QS Ref:	212041
Position:	Refer to test location plan - Drawing 212041/G1	Date:	18.05.21
Groundwater:	Nil encountered	Logged By:	JDF/WJM

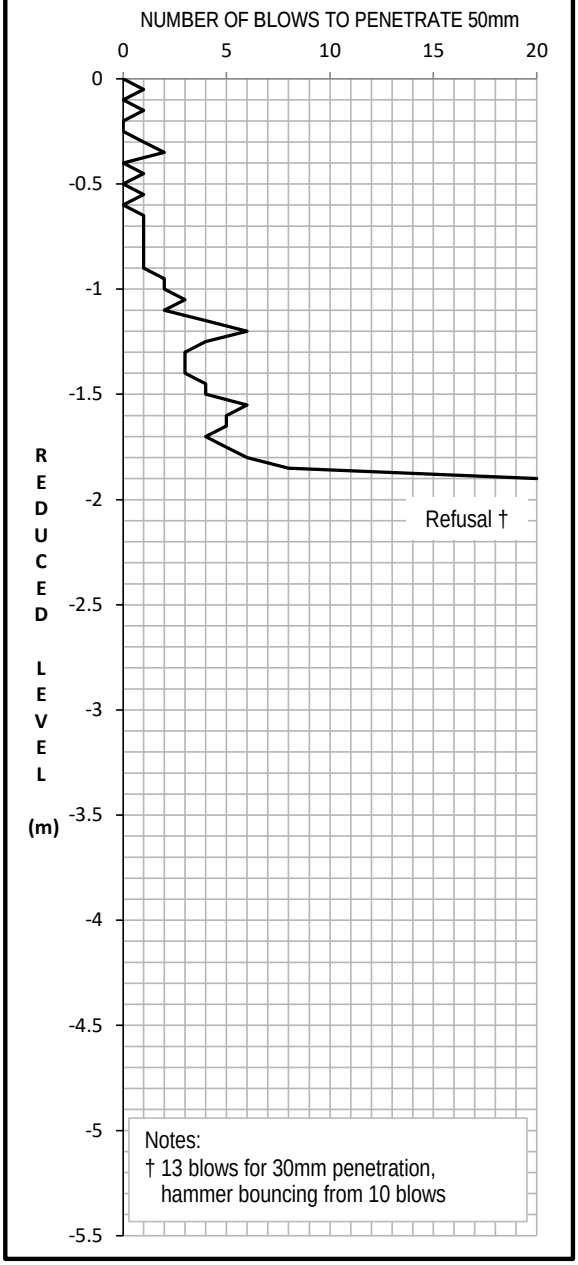
Surface RL: Not Known

DCP 1



Surface RL: Not Known

DCP 2



ENGINEERING LOG

Location:	26 Panorama Terrace, Green Point	Borehole No:	BH1
Client:	L. Sprague	Equipment:	Hand Augers †
Position:	See Test Location Plan - Drawing 212041/G1	Logged By:	JDF/WJM
Surface RL:	Not Known	Job No:	212041
Groundwater:	Nil Encountered	Date:	18 May 2021

Drilling Information			Sampling Data			Profile Description				Structure and Additional Comments
Depth in metres	Progress	Water	Sample Type	Graphic Log	USCS	Material/Strata	Consistency Rel. Density (VS Fb, S VL, F L, St M, VSt D, H VD)	Moisture (D, SM, M, W)	Plasticity	
0.5					SP	TOPSOIL - silty sand, fine to medium-grained, brown				
1.0					CL	Sandy CLAY - pale grey mottled red and orange, fine- to medium-grained sand, M < Wp Orange extremely weathered sandstone gravel from 0.8m depth			M	
1.5						BH1 terminated at 1.1m depth, limit of investigation				Density / consistency of soils below logged profile inferred from results of DCP testing
2.0										
2.5										
3.0										End DCP1 at 3.1m depth
3.5										
4.0										

Key

Water: seeping; free standing

Plasticity: NP Non Plastic; L Low; M Medium; H High

Moisture: D dry; M moist; W wet

Sampling Data: U50 undisturbed sample 50mm diameter; D disturbed sample; NC cone penetrometer; B bulk sample

Consistency / Relative Density: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; VL very loose; L loose; M medium dense; D dense; VSt very dense

USCS Summary

GW GRAVEL, well graded
GP GRAVEL, poorly graded
GM Silty GRAVEL
GC Clayey GRAVEL
SW SAND, well graded
SP SAND, poorly graded
SM Silty SAND
SC Clayey SAND
ML Low plasticity SILT
CL Low plasticity CLAY
MH High plasticity SILT
CH High plasticity CLAY
OL, OH, Pt Organic soils

Comments

† 63mm auger to limit of investigation

Refer to explanation sheet for description of terms and symbols used

ENGINEERING LOG

Location:	26 Panorama Terrace, Green Point	Borehole No:	BH2
Client:	L. Sprague	Equipment:	Hand Augers †
Position:	See Test Location Plan - Drawing 212041/G1	Logged By:	JDF/WJM
Surface RL:	Not Known	Job No:	212041
Groundwater:	Nil Encountered	Date:	18 May 2021

Drilling Information			Sampling Data			Profile Description				Structure and Additional Comments
Depth in metres	Progress	Water	Sample Type	Graphic Log	USCS	Material/Strata	Consistency Rel. Density	Moisture	Plasticity	
0					SP	FILLING - silty sand, fine- to medium-grained, brown	VS Fb S VL F L St M VSt D H VD	D SM M W		(Topsoil)
					SP	FILLING - clayey gravelly sand, fine- to medium-grained, brown, angular gravel to 5mm size				
0.5					CH	CLAY - pale brown, M > Wp, iron-indurated sandstone gravel to 50mm size			H	
1.0					CH	Sandy CLAY - pale grey mottled red and orange, fine- to medium-grained sand, M > Wp Band of red extremely weathered sandstone gravel at 1.1m depth Purple mottle from 1.1m depth			H	
1.5						BH2 terminated at 1.5m depth, limit of investigation				Density / consistency of soils below logged profile inferred from results of DCP testing End DCP2 at 1.85m depth
2.0										
2.5										
3.0										
3.5										
4.0										

Key

Water: seeping; free standing

Plasticity
NP Non Plastic
L Low
M Medium
H High

Moisture
D dry
M moist
W wet

Sampling Data
U50 undisturbed sample 50mm diameter
D disturbed sample
NC cone penetrometer
B bulk sample

Consistency / Relative Density
VS very soft
S soft — VL very loose
F firm — L loose
St stiff — M medium dense
VSt very stiff — D dense
H hard — VSt very dense

USCS Summary

GW GRAVEL, well graded
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CL Low plasticity CLAY
MH High plasticity SILT
CH High plasticity CLAY
OL, OH, Pt Organic soils

Comments

† 63mm auger to limit of investigation

Refer to explanation sheet for description of terms and symbols used

TERMS & SYMBOLS

Unified Soil Classification System (UCS)

COARSE-GRAINED SOILS More than half the material (by weight) is individual grains visible to the naked eye	GRAVELLY SOIL More than half of the coarse fraction is larger than 4.75mm	CLEAN GRAVEL Will not leave a stain on wet palm	Substantial amounts of all grain particle sizes	GW
			Predominantly one size or range of sizes with some intermediate sizes missing	GP
		DIRTY GRAVEL Will leave stain on wet palm	Non-plastic fines (to identify, see ML below)	GM
			Plastic fines (to identify, see CL below)	GC
	SANDY SOIL More than half of the coarse fraction is smaller than 4.75mm	CLEAN SAND Will not leave not leave a stain on wet palm	Wide range in grain size and substantial amounts of all grain particle sizes	SW
			Predominantly one size or range of sizes with some intermediate sizes missing	SP
		DIRTY SAND Will leave stain on wet palm	Non-plastic fines (to identify, see ML below)	SM
			Plastic fines (to identify, see CL below)	SC

	Ribbon	Liquid Limit	Dry crushing strength	Dilatancy reaction	Toughness	Stickiness	
FINE-GRAINED SOILS More than half the material (by weight) is individual grains not visible to the naked eye (< 0.074mm)	None	<50	None to slight	Rapid	Low	None	ML
	Weak	<50	Medium to high	None to very slow	Medium to High	Medium	CL
	Strong	>50	Slight to medium	Slow to medium	Medium	Low	MH
	Very Strong	>50	High to very high	None	High	Very high	CH
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture						OL, OH, Pt

Description and classification of soils and rock in accordance with AS1726 'Geotechnical Site Investigations'

Plasticity A2.4(b)

Symbol	Descriptive term	Liquid limit (%)
NP	Non plastic	-
L	of low plasticty	< = 35
M	of medium plasticity	> 35 < = 50
H	of high plastic	> 50

Moisture Condition A2.5(a)

'Dry' (D)	Cohesive soils; hard and friable or powdery, well dry of plastic limit. Granular soils; cohesionless and free-running
'Moist' (M)	Soil feels cool, darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
'Wet' (W)	Soil feels cool, darkened in colour. Cohesive soils usually weakened and free water forms on hand when handling. Granular soils tend to cohere.

Consistency terms - Cohesive soils TA4

Term	USS (kPa)	Field guide to consistency
Very soft	< = 12	Exudes between fingers when squeezed in hand
Soft	12 - 25	Can be moulded by light finger pressure
Firm	25 - 50	Can be moulded by strong finger pressure
Stiff	50 - 100	Cannot be moulded by fingers, can be indented by thumb
Vary stiff	100 - 200	Can be indented by thumb nail
Hard	> 200	Can be indented with difficulty by thumbnail

Consistency terms - Non-Cohesive soils TA5

Term	Density Index (%)
Very loose	< = 15
Loose	15 - 35
Medium dense	35 - 65
Dense	65 - 85
Very Dense	> 85

TERMS & SYMBOLS

Symbols

Soil

- Asphaltic Concrete or Hotmix
- Concrete
- Topsoil
- Fill
- Peat, Organic Clays and Silts (Pt, OL, OH)
- Clay (CL, CH)
- Silt (ML, MH)
- Sandy Clay (CL, CH)
- Silty Clay (CL, CH)
- Gravelly Clay (CL, CH)
- Sandy Silt (ML)
- Clayey Sand (SC)
- Silty Sand (SM)
- Sand (SP, SW)
- Clayey Gravel (GC)
- Silty Gravel (GM)
- Gravel (GP, GW)
- Loam

Rock

- Claystone (massive)
- Siltstone (massive)
- Shale (laminated)
- Sandstone (undifferentiated)
- Sandstone, fine grained
- Sandstone, coarse grained
- Conglomerate
- Limestone
- Coal
- Dolerite, Basalt
- Tuff
- Porphyry
- Granite
- Pegmatite
- Schist
- Gneiss
- Quartzite
- Talus
- Alluvium

Inclusions

- Rock Fragments
- Organic Material
- Ironstone Gravel, Laterite
- Shale Breccia in Sandstone

Seams

- Seam >0.1m thick
- Seam 0.01m to 0.1m thick

General Notes

Introduction
These notes are supplied with all geotechnical reports from **5QS Consulting Group** and therefore may contain information not necessarily relevant to this report.

The purpose of the report is set out in the introduction section of this report. It should not be used by any other party, or for any other purpose, as it may not contain adequate or appropriate information in these events.

Engineering Reports
5QS Consulting Group engineering reports are prepared by qualified personnel and are based on information obtained, and on modern engineering standards of interpretation and analysis of that information. Where the report has been prepared for a specific design proposal the information and interpretation may not be relevant if the design proposal is changed. If the design proposal or construction methods do change, **5QS Consulting Group** request that it be notified and will be pleased to review the report and the sufficiency of the investigation work.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, the report must be regarded as interpretative, rather than a factual document, limited, to some extent, by the scope of information on which it relies.

5QS Consulting Group *cannot accept responsibility for problems which may develop if it is not consulted after factors considered in the report's development have changed.*

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, **5QS Consulting Group** cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency.
- The actions of contractors responding to commercial pressures.

If these occur, **5QS Consulting Group** will be pleased to assist with investigation or advice to resolve the matter.

A Geotechnical Engineering Report May Be Subject To Misinterpretation
Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, **5QS Consulting Group** should be retained to review the adequacy of plans and specifications relative to geotechnical issues.

Engineering Logs Should Not Be Separated From The Engineering Report.
Final engineering logs are developed by the Geotechnical Engineer based upon interpretation of field logs and laboratory evaluation of field samples. Only final engineering logs are included in geotechnical engineering reports. To minimize the likelihood of engineering log misinterpretation, *give contractors ready access to the complete geotechnical engineering report*.

Site Inspection
5QS Consulting Group will always be pleased to provide inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit, to full time engineering presence on site.

Change In Conditions
Subsurface conditions may be modified by constantly changing natural forces. Because a geotechnical engineering report is based on conditions, which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time*.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and thus, the continuing adequacy of a geotechnical report. **5QS Consulting Group** should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, **5QS Consulting Group** requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed during construction, than at some later stage, well after the event.

Ground Water
Unless otherwise indicated the water levels given on the engineering logs are levels of free water or seepage in the test hole recorded at the given time of measuring. This may not accurately represent actual ground water levels, due to one or more of the following:

- In low permeability soils, ground water although present may enter the hole slowly, or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent prior weather changes. They may not be the same at the time of construction as indicated at the time of investigation.

Accurate confirmation of levels can only be made by appropriate instrumentation techniques and monitoring programs.

1.

General Notes – Continued

Foundation Depth

Where referred to in the report, the recommended depth of any foundation, (piles, caissons, footings etc) is an engineering estimate of the depth to which they should be constructed. The estimate is influenced and perhaps limited by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications based upon this report should provide for variations in the final depth depending upon the ground conditions at each point of support.

Engineering Logs

Engineering logs presented in the report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify economically. In any case, the boreholes or test pits represent only a very small sample of the subsurface profile.

Interpretation of information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling and the possibility of other than straight line variations between the test locations.

Drilling Methods

The following is a summary of drilling methods currently used by **5QS Consulting Group**, and some comments on their use and application.

Continuous Sample Drilling: The soil sample is obtained by screwing a 75 or 100mm auger into the ground and withdrawing it periodically to remove the soil. This is the most reliable method of drilling in soils as the moisture content is unchanged and soil structure, strength, appearance etc. is only partially affected.

Test Pits: These are excavated using a backhoe or tracked excavator, allowing close examination of insitu soil if it is safe to descend into the pit. The depth of digging is limited to about 3 metres for a backhoe, and about 5 metres for an excavator. A potential disadvantage is the disturbance of the site caused by the excavation.

Hand Auger: The soil sample is obtained by screwing a 75mm Auger into the ground. This method is usually restricted to approximately 1.5 to 2 metres in depth, and the soil structure and strength is significantly disturbed.

Continuous Spiral Flight Augers: The soil sample is obtained by using a 90 – 115mm diameter continuous spiral flight auger which is withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays, and in sands above the water table. Samples, returned to the surface, are very disturbed and may be contaminated. Information from the drilling is of relatively lower reliability. SPT's or undisturbed sampling may be combined with this method of drilling for reasonably satisfactory sampling.

Hand Penetrometers

Hand Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and recording the number of blows for successive 50mm increments of penetration.

Two, relatively similar tests are used:

1. Perth Sand Penetrometer (AS 1289.5.3.3) – A 16mm flat ended rod is driven with a 9kg hammer, dropping 600mm. This test was developed for testing the density of sands and is mainly used in granular soils and loose fill.

2. Cone Penetrometer/Scala Penetrometer (AS 1289.5.3.2) – A 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm. The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio (CBR) have been published by various road authorities.

Sampling

Sampling is carried out during drilling to allow engineering examination, and laboratory testing of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending on the amount of disturbance during drilling, some information on strength and structure.

Undisturbed samples are taken by pushing a think walled sample tube into the soils and withdrawing this with a sample of soil in a relatively undisturbed state contained inside. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 series, Methods of Testing Soils for Engineering Purposes. Details of the test procedure used are given on the individual report forms.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

LANDSLIDE RISK

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 2: LIKELIHOOD

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

TABLE 1: RISK TO PROPERTY

Qualitative Risk		Significance - Geotechnical engineering requirements
Very high	VH	**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 the value of the property.
High	H	**Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.
Moderate	M	**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 possible.
Low	L	**Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.
Very Low	VL	**Acceptable**. Manage by normal slope maintenance procedures.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

TABLE 3: RISK TO LIFE

Risk (deaths per participant per year)	**Activity/Event Leading to Death** (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

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 LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

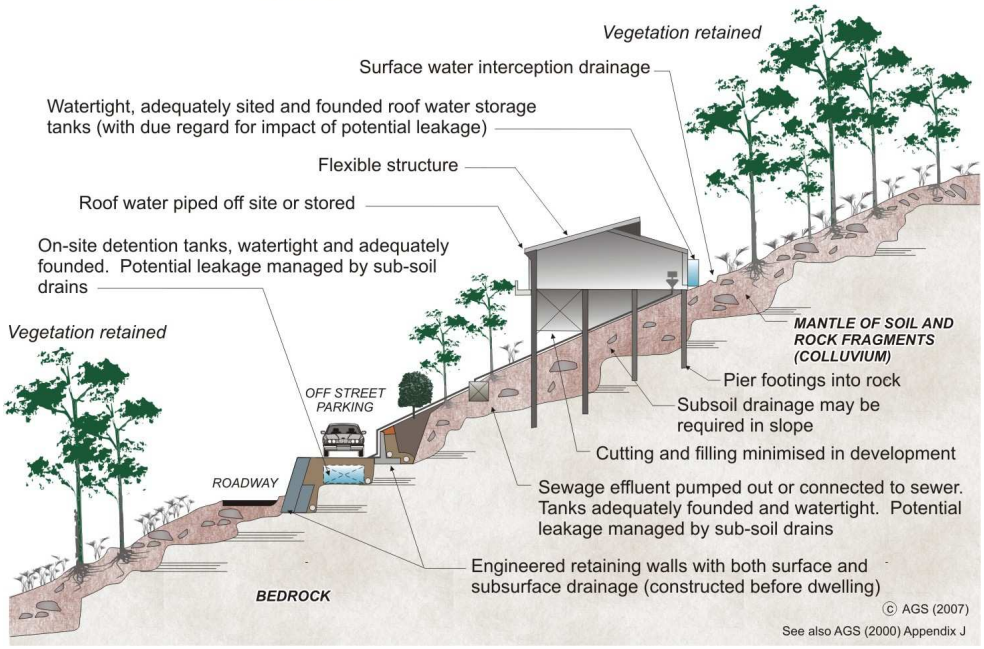
The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to 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.

AUSTRALIAN 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 lightweight 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.

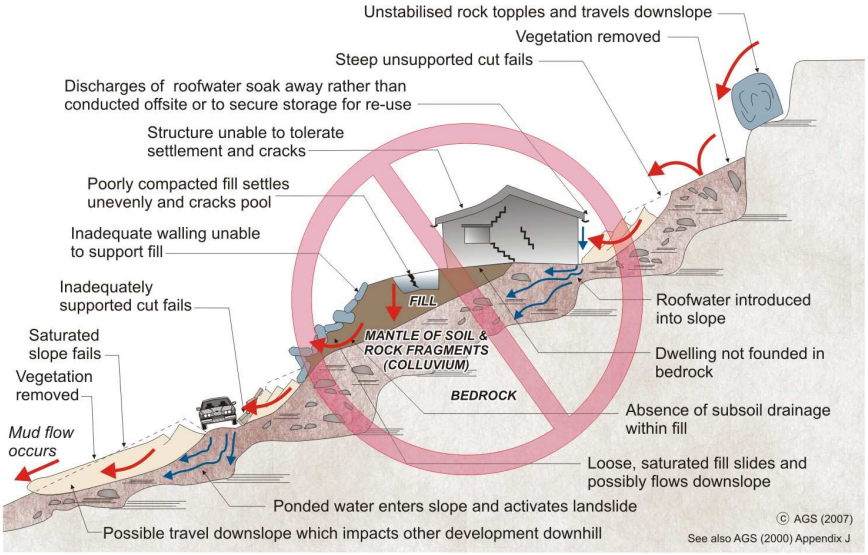
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing 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 flow paths". 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.

Table M1 – Low and Medium Hazard Areas

Category		Category 1 Low Hazard Area	Category 2 Medium Hazard Area
General Description		Areas not susceptible to significant landslip hazard; instability not expected unless major site changes occur. Often represented by low slope profiles in stratified rocks and nearly flat in alluvial deposits.	Land areas of potential landslip hazard and possible soil creep or a moderately steep soil covered slope. Instability may occur during and after extreme climatic conditions. Represented by relatively steeper topography in stratified rocks and low slope profiles in alluvial deposits.
Implications for Development		Good engineering and conventional building/development practices usually sufficient for safe development in these areas.	Restrictions on nature and extent of development [especially earthworks] may be required.
Identification Criteria	Rh	Slopes between 0° and ≤ 18° in plateau areas. At least 25 metres from any prominent cliff line.	Slopes > 18° and ≤ 23°. In proximity [within 25 metres] of cliff lines.
	Rnt Rnt-s Sandstone sequences. Rnt.-m Mudstone sequences	Slopes between 0° and ≤ 12½°. At least 100 metres from any prominent cliff line. Slopes between 0° and ≤ 10°. At least 100 metres from any prominent cliff line.	Slopes > 12½° and ≤ 22° In proximity [within 25 metres] of cliff lines. Slopes > 10° and ≤ 18°. In proximity [within 25 metres] of prominent cliff lines.
	Rnp	Slopes > 0° and ≤ 5°.	Slope > 6° and ≤ 12°.
	Qa & Qd Qhd & Qhbr	Slopes > 0° and ≤ 5° and • At least 50m away from a lake shore or river flat, and • At least 60m away from a beach.	Slope > 5° and ≤ 18° and where groundwater > 3m below surface. Slope > 5° and ≤ 24° and where groundwater < 3m below surface Or within 50m of lake shore/river flat.
	Qs [deeper than 2 metres]	Slopes > 0° and ≤ 5° And at least 25m away from a cliff area.	Slopes > 5° and ≤ 18° and where groundwater > 3m below surface. Slope > 5° and ≤ 12° and where groundwater < 3m below surface. Or within 25m of a cliff area.

Table M2 – High and immediate High Hazard Areas

Category		Category 3 High Hazard Area	Category 4 Immediate High Hazard Area
General Description		Land areas susceptible to soil creep, landslip and rockfalls due to steep slope profiles in stratified formations and proximity of land to cliff areas and alluvial deposits. Localised known areas of landslip and/or rockfalls may occur within the area. Commonly seepage problems occur in the area	Land areas of potential landslip hazard and possible soil creep or a moderately steep soil covered slope. Instability may occur during and after extreme climatic conditions. Represented by relatively steeper topography in stratified rocks and low slope profiles in alluvial deposits.
Implications for Development		Significant restrictions on nature and extent of development [especially earthworks and drainage] usually required. The risk associated with development in these areas are often higher than normal.	Unsuitable for development unless localised areas can be re-rated to Category 3 or better. Any development usually subject to substantial restriction.
Identification Criteria	Rh	Slopes > 23° and ≤ 33° and in proximity [within 10 metres] of cliff lines.	Slopes > 33°. Prominent cliff areas or coastal bluff areas.
	Rnt Rnt-s Sandstone sequences. Rnt.-m Mudstone sequences	Slopes > 22° and ≤ 29°. In proximity [within 10 metres] of cliff lines. Slopes > 18° and ≤ 24° and in proximity [within 10 metres] of cliff lines.	Slopes > 29°. Prominent cliff or coastal bluff areas. Slopes > 24°. Prominent cliffs or coastal bluff areas.
	Rnp	Slopes > 12° and ≤ 18°	Slopes > 18° and cliff or bluff areas.
	Qa & Qd Qhd & Qhbr	Slopes > 18° and ≤ 27° and where groundwater is > 3m below surface. Slopes > 12° and ≤ 15° and where groundwater > 3m below surface And at least 60m from a beach.	Slopes > 27° and where groundwater > 3m below surface. Slopes > 15° and where groundwater < 3m below surface. Beachfront areas and within 60m of beach.
	Qs [deeper than 2 metres]	Slopes > 18° and ≤ 27° and where groundwater > 3m below surface. Slopes > 12° and ≤ 15° and where groundwater < 3m below surface. And at least 25m from a cliff area.	Slopes > 27° and where groundwater > 3m below surface. Slopes > 15° and where groundwater < 3m below surface. Or within 25m of a cliff area.

5QS Consulting Group

Site Classification Notes

General

Site classification is a method adopted in residential development for quantifying the anticipated surface movements that may occur on a site, generally due to soil reactivity. Soil reactivity is an appreciable change in soil volume due to a change in the moisture content of the soil. The extent of ground movement due to a reactive clay soil depends on the degree of reactivity of the clay, depth of clay in the soil profile, the depth of potential moisture variation in the soil and the change in soil suction that occurs from dry to wet soil conditions.

AS2870 – 2011 "Residential Slabs and Footings" classifies soil profiles in terms of their potential for shrink/swell movement due to changes in moisture content, to be slight (Class S), moderate (Class M), high (Class H1 or H2) or extreme (Class E). Sites with little or no reactivity are classified rock or sand (Class A), see table 2.1 below.

For classes; M, H1, H2 and E, further classification may be required, based on the depth of the expected moisture change. For sites with deep-seated moisture changes characteristic of dry climates and corresponding to a design depth of suction change (refer to AS 2870 – 2011, clause 2.3.3) equal to or greater than 3m, the classification shall be M-D, H1-D, H2-D, or E-D as appropriate.

AS2870 – 2011 Table 2.1 "Classification Based on Site Reactivity"

Class	Foundation	Characteristic Surface Movement
A	Most sand and rock sites with little or no ground movement from moisture changes	
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 – 20mm
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 – 40mm
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 – 60mm
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	60 – 75mm
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	> 75mm

Site Classification Notes - Continued

Problem Sites

Sites which include soft soils such as soft clay, silt or loose sands, landslip, mine subsidence, collapsing soils, soils subject to erosion or fill sites greater than 0.8m for sand and 0.4m for material other than sand are classified as Problem sites (Class P).

Classification Methods

Classification for sites other than class P sites shall be determined from at least one of the following methods:

- Identification of the soil profile based upon a visual assessment of the site and surrounding areas, excavated test pits and falling weight penetrometers probes.
- Interpretation of the current performance of existing buildings within the region that are founded on a similar soil profile.
- Site classification based on characteristic surface movement in accordance with AS2870 – 2011, clause 2.2.3, with parameters obtained from laboratory test results.

Effect of Trees

The presence of trees on a site can potentially affect the performance of the footing system by having an exaggerated effect on the moisture conditions of the soil. As a general rule, sites where trees are located within the mature height of the tree from the property boundary, will be classified as a Problem site (Class P).

There are a number of methods used to assess the potential impact of a tree on the reactive performance of a site. These include:-

- AS2870 provides a design method to account for the presence of trees within and in the vicinity of the proposed building footprint.
- The ‘Foundation and Footings Society of Victoria Method’ proposes a grading of trees with respect to the effect of their roots on nearby structures and suggests how their influence may be reduced.

A tree effect score and tree effect are determined from tables CH5.1 and CH5.2 respectively.

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

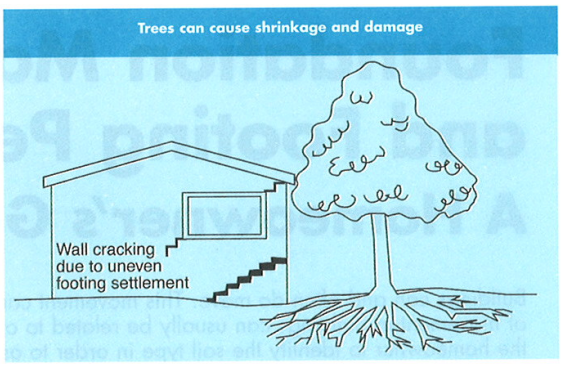
- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

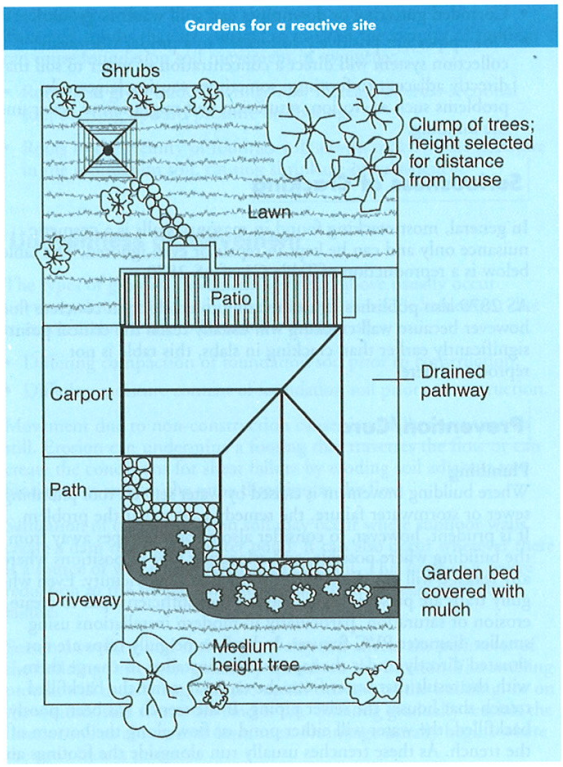
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

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