Woolacotts.
CONSULTING ENGINEERS

ALTERATIONS AND ADDITIONS

1184-1186 PITTWATER ROAD, NARRABEEN

STORMWATER MANAGEMENT REPORT

18-183 / 9 April 2021 / Revision D

Contents

Document control

Rev No	Date	Revision details	Approved	Verified	Prepared
-	18/09/06	Approved issue	SETB		
A	04/07/08	Building layouts revised	SETB		
B	25/03/14	S96 application	SETB		HLJ
C	13/09/18	S4.55 submission	SETB		SETB
D	09/04/21	S4.55 modification submission	SETB		SETB

1.0 Introduction

This Stormwater Management Report has been prepared to detail stormwater drainage issues associated with the proposed alterations and additions to the existing residence at 1184-1186 Pittwater Road, Narrabeen. It is intended to accompany the S4.55 modification submission with Architectural drawings DA01 – DA17 dated January 2021.

Issues under consideration in this report include details of the existing site, the proposed development, Council's stormwater drainage policy at the time of Development Consent and the proposed stormwater drainage system.

2.0 Existing Site

The proposed development is located at the corner of Clarke Street and Pittwater Road. It has a total area of 1577m2 with 553m2 impervious. The area around the existing property falls towards Narrabeen Beach at a grade of 1%. The geotechnical report indicates the sub-surface soil is fine grain marine sand deposits.

Figure 1: Existing site, 1186 Pittwater Road, Narrabeen

3.0 Proposed Development

It is proposed to demolish the outer sections, internal walls and roof of the existing building and construct new 2-storey apartments with attic space and a basement carpark.

The works are to be staged as detailed on the Architects Staging Plan (refer Appendix A) and summarised as follows:

- Stage 1 – Sea wall and east portion of basement carpark roof
- Stage 2 – Southern portion of basement carpark and new apartment
- Stage 3 - Remainder

4.0 Council's Policy Design Standards

Council's Stormwater drainage requirements were obtained from Warringah Council's publications "Warringah Local Environment Plan 2000" and "On site stormwater detention technical specification, 2000" and through requirements imposed on the previous 2006 Development Application.

Council does not require on-site detention for properties where the discharge from the development does not pass through drainage control structures before reaching receiving water. Runoff from hard paved area is required to drain to the absorption trench as a measure to improve water quality control.

All pipes should have the capacity to carry flow from a 1 in 20 year storm event and surface flow paths must be capable of carrying flows in excess of 1 in 100 year storm event.

5.0 Stormwater Management

The site has a catchment area of 1577m2 with new impervious area of 577m2. Narrabeen Beach and the Pacific Ocean are at the downstream end of the site. The site does not require an on site detention system but requires an absorption trench for runoff from hard paved area.

The geotechnical investigation shows the site is underlain by fine to medium grained sand to depths exceeding 8.5m. The design of the absorption trench is based on an absorption rate of 0.25L/s/m2 as nominated by the geotechnical consultant in their letter dated 5 March 2007. Refer Appendix C for copy of this letter and Geotechnical Report dated 21 February 2007. The trench is designed for storm events up to the 50 year ARI storm and consists of a 20m long trench with storage of 6.5m3, constructed across the downstream part of the catchment. Overflow paths are provided at both ends of the absorption trench, towards the Pittwater Road kerb and gutter for storm events in excess of the 50 year ARI storm. Refer to calculations in Appendix B.

The small hard paved area at the basement carpark entry is lower than the ground level and cannot drain to the absorption trench. Therefore a grated drain and a 150∅ mm pipe along the southern side of the property will divert the flow to the bank adjacent to the beach within the property. A sump pump pit is provided in the basement to collect and pump out any water that may enter the basement carpark. A rising main connects to the 150∅ mm pipe behind the proposed building and to absorption trench.

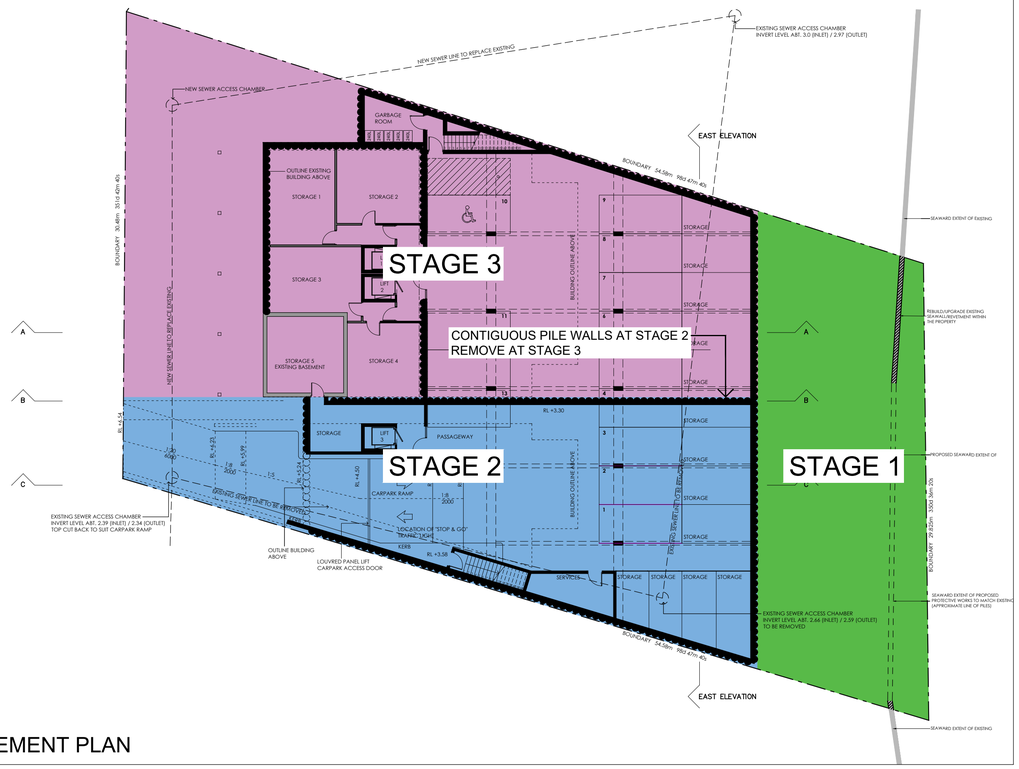
All pipes within the development will be designed to carry the flow from the 1 in 20 year average recurrence interval (ARI) design storm, with overflow paths provided for the 1 in 100 year flow.

For further details refer to Drawings SW1, SW2 and SW3 presented in Appendix A

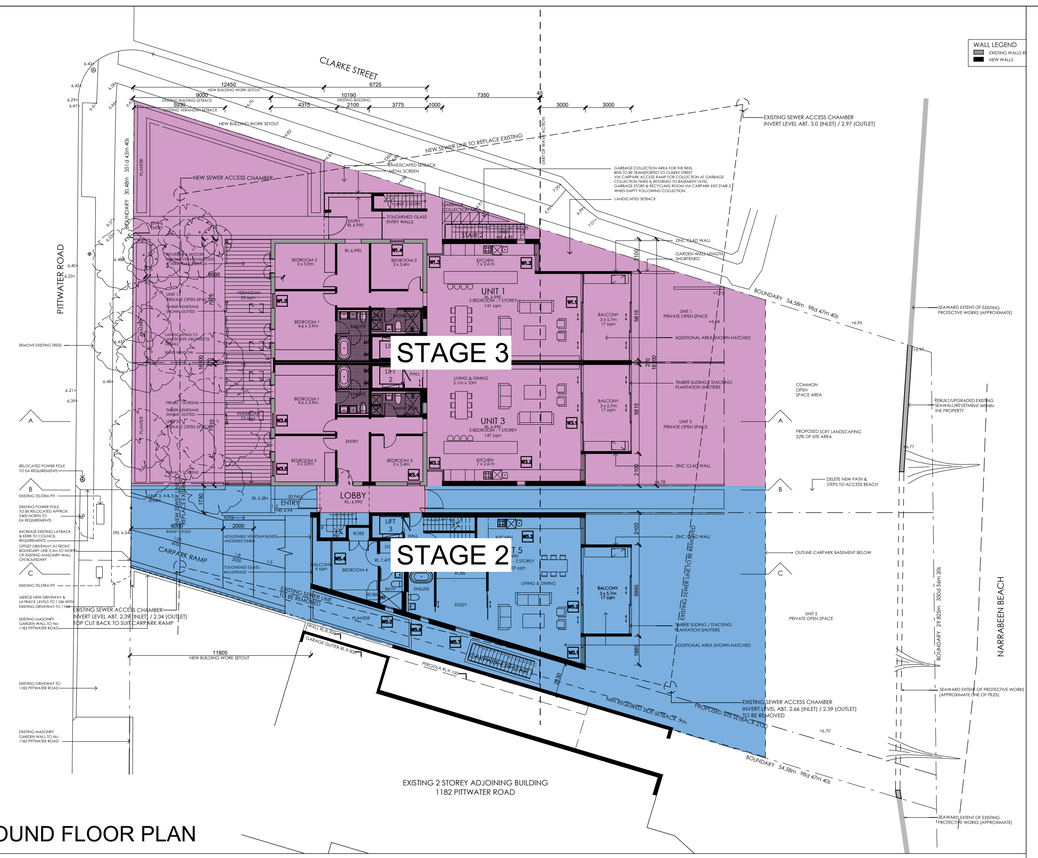
6.0 Erosion and Sediment Control

Erosion and sediment control will be implemented during construction. To minimise sediment loss, measures will be provided in accordance with "Managing Urban Stormwater – Soils and Construction", published by the Department of Housing and will include silt fences around the low side of the site and silt traps on any pits.

Appendix A
Drawings

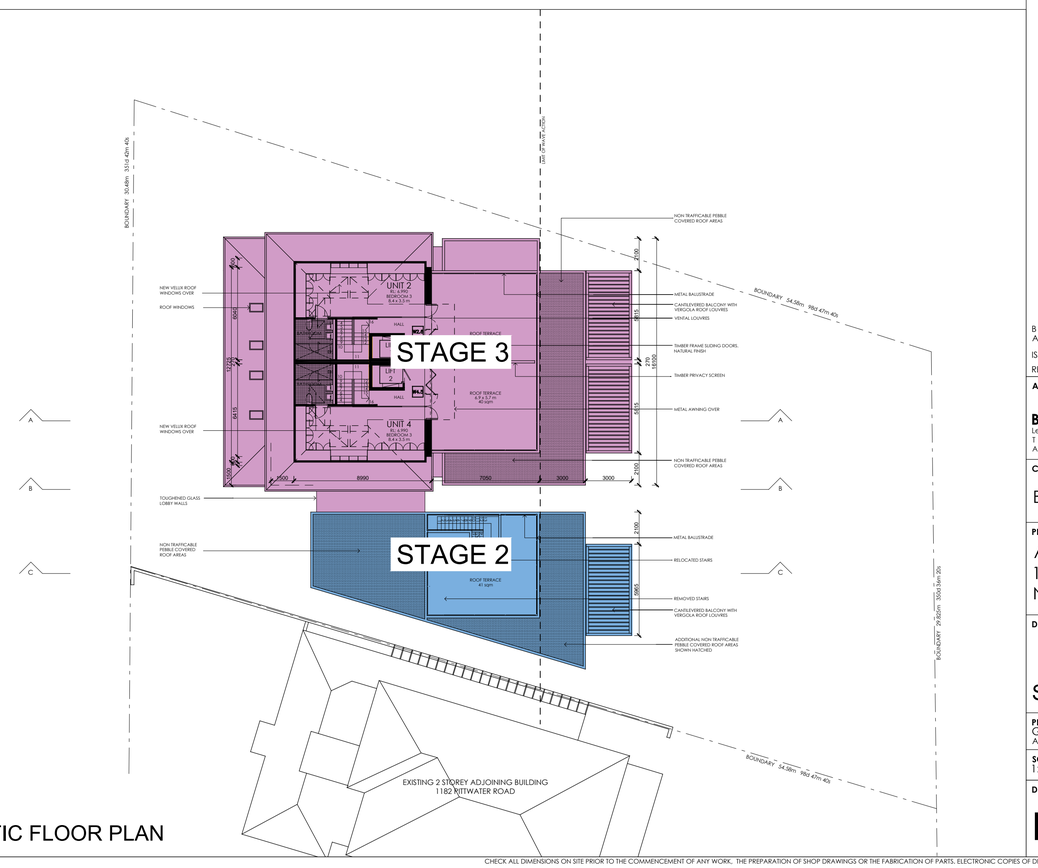


BASEMENT PLAN



GROUND LOOR PLAN

FIRST FLOOR PLAN



ATTIC FLOOR PLAN

ISSUE	DATE	DESCRIPTION
B	05.10.18	SEC 4.55 ISSUE
A	12.03.18	SEC 4.55 ISSUE

REVISIONS

ARCHITECT

BONUS + ASSOCIATES
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ACN 15 99 22 853

B+A

CLIENT

BEACH PROPERTIES TRUST

PROJECT

ALTERATIONS + ADDITIONS TO
1184-1186 PITTWATER ROAD
NARRABEEN

DRAWING TITLE

STAGING PLAN

JOB NORTH

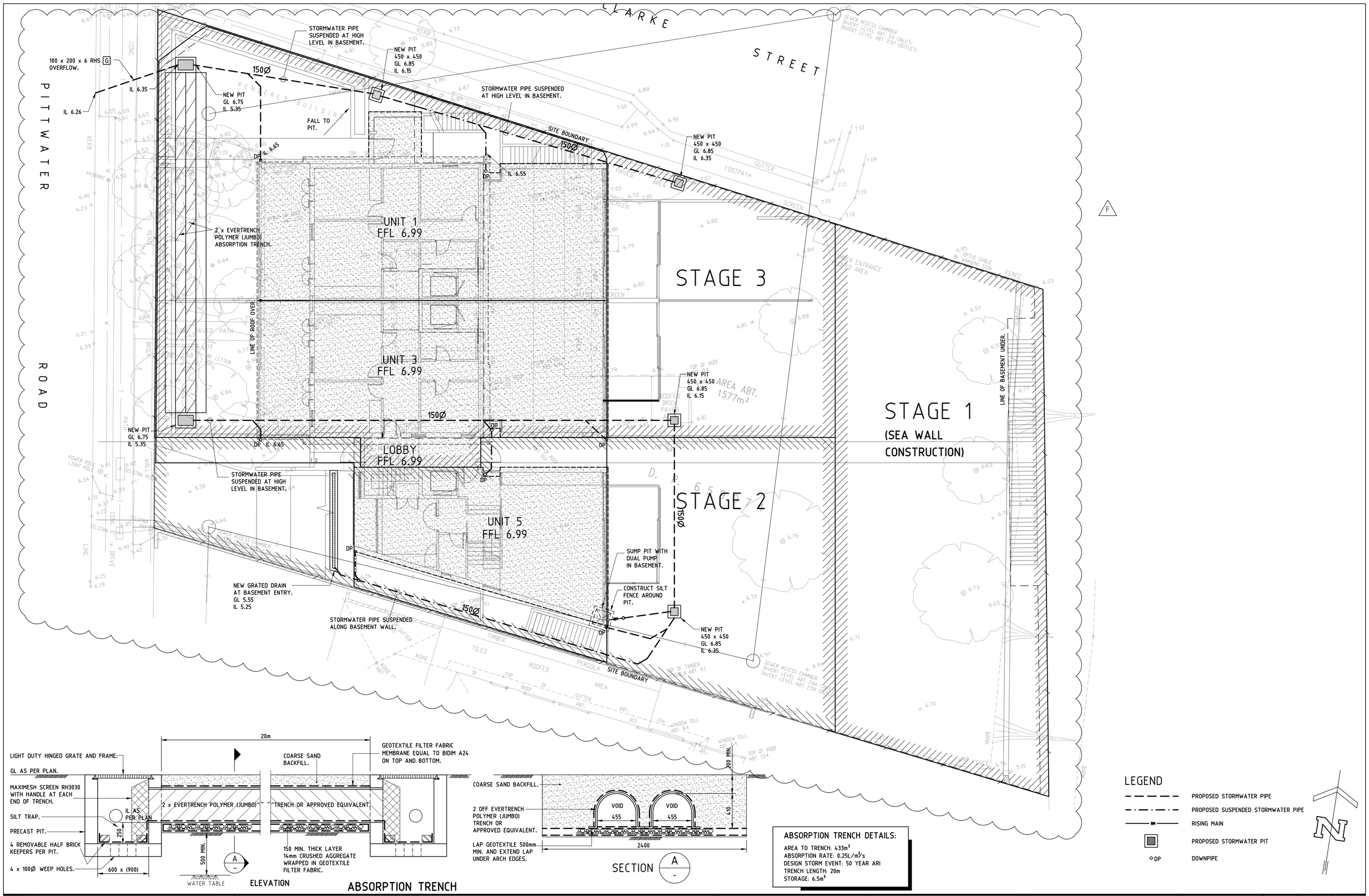
PROJECT ARCHITECT
G BONUS
Arch Reg - 4034

JOB NO
0314

SCALE
1:200 @A1 0 1 2 3 4 6 10 15m

DRAWING NO
DA17

ISSUE
B



ABSORPTION TRENCH DETAILS:

AREA TO TRENCH: 433m²
ABSORPTION RATE: 0.25L/m²/s
DESIGN STORM EVENT: 50 YEAR ARI
TRENCH LENGTH: 20m
STORAGE: 6.5m³

LEGEND

- PROPOSED STORMWATER PIPE
- PROPOSED SUSPENDED STORMWATER PIPE
- RM RISING MAIN
- PROPOSED STORMWATER PIT
- DP DOWNPIPE

N

No.	Date	Description	Ver.	Appr.
A	29.3.07	WIDTH OF ABSORPTION TRENCH REVISED.		SETB
B	6.9.07	LENGTH OF ABSORPTION TRENCH AND STORAGE INCREASED	PHL	SETB
C	4.7.08	BUILDING LAYOUTS REVISED TO SUIT NEW DA		SETB
D	29.08.14	ISSUED FOR CC1		SETB
E	13.09.18	STAGING ADDED		SETB
F	09.04.21	PLAN UPDATED		SETB

Architect
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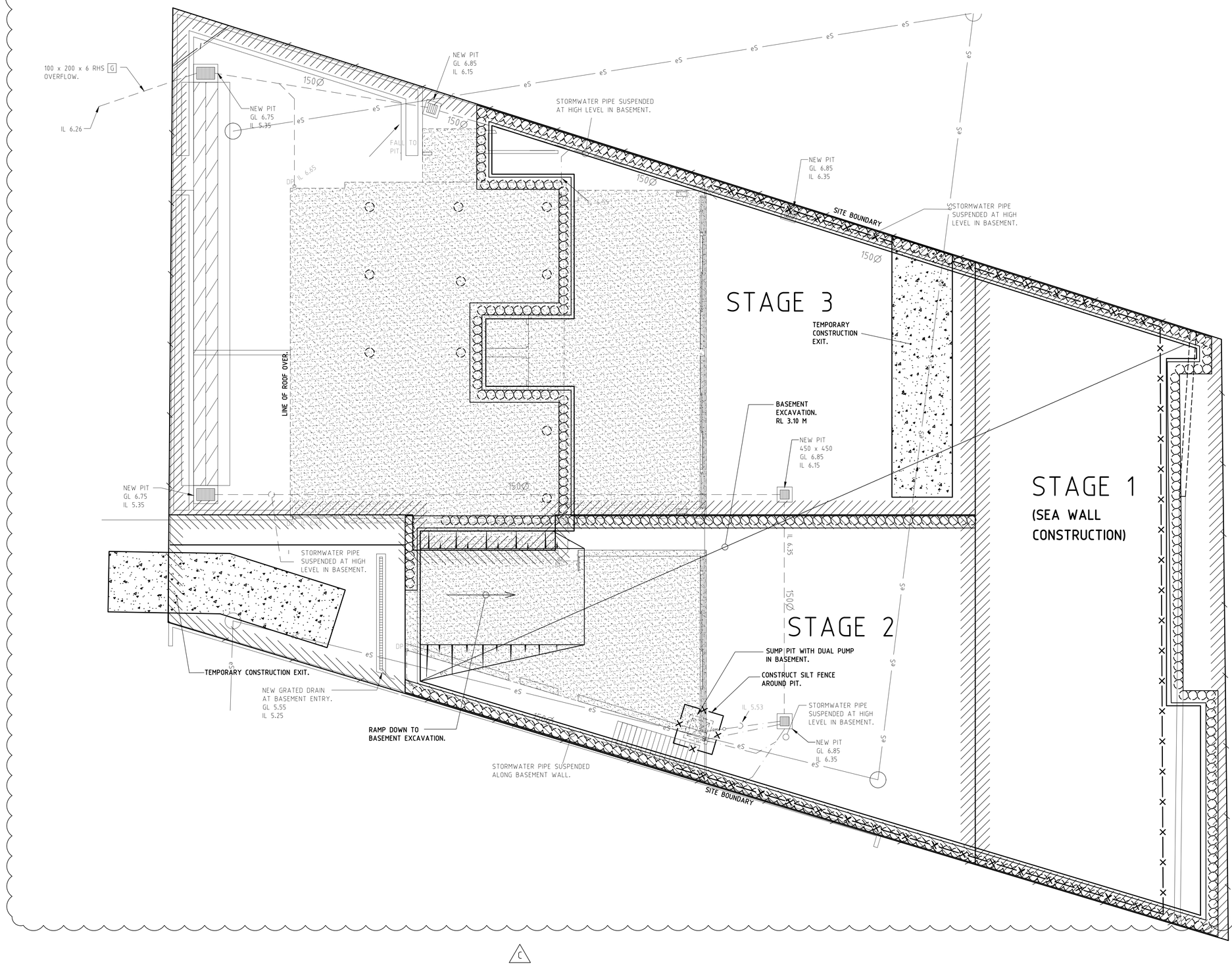
ALTERATIONS AND ADDITIONS
1184-1186 PITTWATER ROAD
NARRABEEN, NSW 2101

STORMWATER MANAGEMENT PLAN

Date	Approved	Verified	Prepared
SEPTEMBER 2006	SETB 18.09.06	PHL 18.09.06	JC 18.09.06
Scale @ A1: 1:100			
Job number: 18-183	Drawing number: SW1		Amendment: F

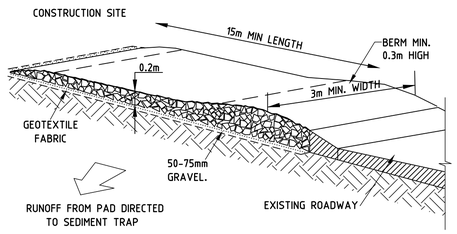


EROSION CONTROL NOTES

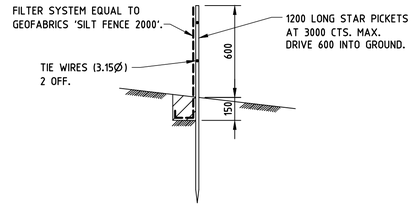
E1 INSTALL SILT FENCES ON LOW SIDE OF SITE AND AS REQUIRED BY LOCAL COUNCIL PRIOR TO COMMENCEMENT OF TOPSOIL STRIPPING.

E2 INSTALL DRAINAGE SYSTEM AND SILT FENCES AROUND PITS AS SOON AS PRACTICABLE.

E3 REINSTATE GRASS COVER AS SOON AS PRACTICABLE.



TEMPORARY CONSTRUCTION ENTRY/EXIT



SILT FENCE DETAIL.

TO BE PLACED AROUND LOW SIDE OF PROPERTY BOUNDARY AND AROUND STORMWATER INLET STRUCTURES TO PREVENT SOIL WASHING OFF SITE.

LEGEND

—×——×— SILT FENCE

N

No.	Date	Description	Ver.	Appr.
A	29.08.14	ISSUED FOR CC1.		
B	13.09.18	STAGING ADDED		SETB
C	09.04.21	PLAN UPDATED		SETB

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ALTERATIONS AND ADDITIONS
1184-1186 PITTWATER ROAD
NARRABEEN, NSW 2101

SEDIMENT CONTROL PLAN

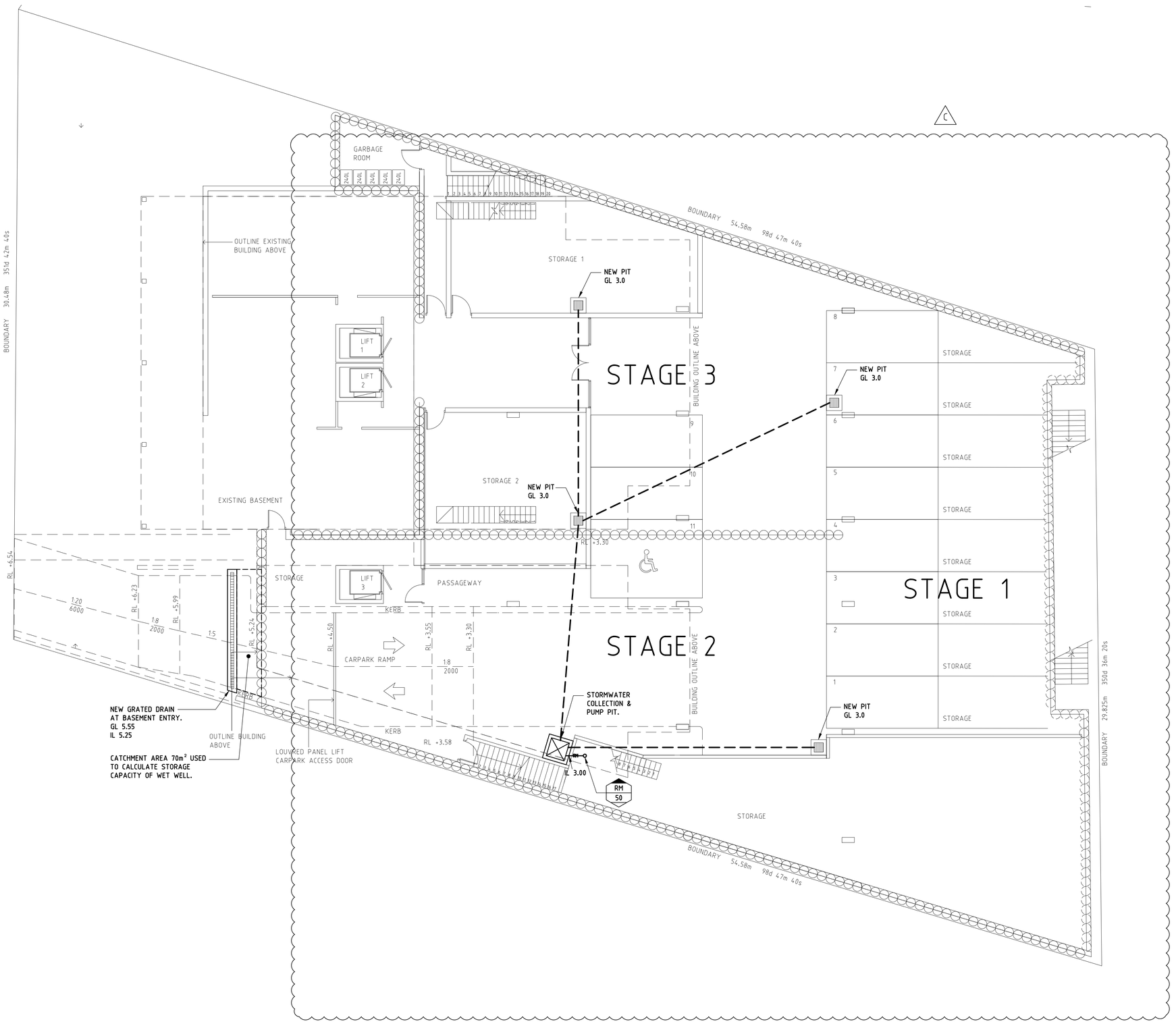
Date	Approved	Verified	Prepared
AUGUST 2014			GM 27.08.14
Scale @ A1: 1:100			

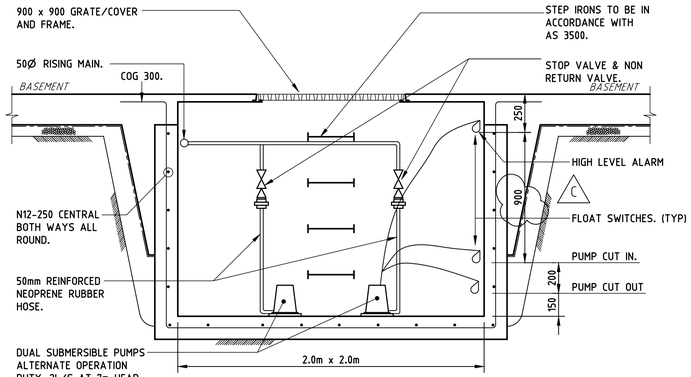
Job number	Drawing number	Amendment
18-183	SW2	C

NOTE:
WET WELL STORAGE CAPACITY
DETERMINED FROM AN ARI OF 10 YEARS
@ A DURATION OF 120 MINUTES AS
STIPULATED BY AS 3500.3:2003 CL 9.36.

LEGEND

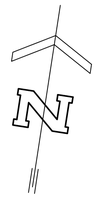
RM —— RISING MAIN.





PUMP PIT DETAIL

2mx2mx1.5m DEEP



No.	Date	Description	Ver.	Appr.
A	29.08.14	ISSUED FOR CC1.		
B	13.09.18	STAGING ADDED. PUMP PIT RELOCATED		SETB
C	09.04.21	PLAN UPDATED		SETB

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ALTERATIONS AND ADDITIONS
1184-1186 PITTWATER ROAD
NARRABEEN, NSW 2101

BASEMENT STORMWATER DRAINAGE PLAN

Date	Approved	Verified	Prepared
AUGUST 2014			GM 27.08.14
Scale @ A1: 1:100			
Job number: 18-183	Drawing number: SW3		Amendment: C

Appendix B
Calculations

Woolacott Hale Corlett & Jumikis
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2a Broughton Road
Artarmon 2064

Telephone (02) 9413 1399
Facsimile (02) 9413 1132

Woolacotts.
CONSULTING ENGINEERS

Job Narrabeen - mix development Date 10/9/07

Aim

Prepare stormwater management plan

Ref:

1. WSUD : Basic procedures for source control of stormwater . John R Argue
2. Australian rainfall and runoff

Summary :

1. Trench design to cater 50 years ARI storm event
2. Roof catchment, time of concentration (t_c) = 5 min.
3. Absorption trench : Everglas Jumbo x 2.
4. k_h = 0.25 L/m²/s

Designed PHL | Job No 06-172 | Sheet No 1

Hydrological Design:

					Equivalent impervious Area				
Catchment Ref.	ARI (yr)	I (mm/h)	Area (m^2)	imperv. (%)	C^1_{10}	C_{10}	F_y	C_y	Q (L/s)
A	5	166	164	1	0.607	0.9	0.95	0.855	6.47
B	5	166	164	1	0.607	0.9	0.95	0.855	6.47
C	5	166	60	1	0.607	0.9	0.95	0.855	2.37
D	5	166	58.5	1	0.607	0.9	0.95	0.855	2.31
E	5	166	80	1	0.607	0.9	0.95	0.855	3.15
A	20	211	164	1	0.607	0.9	1.05	0.945	9.08
B	20	211	164	1	0.607	0.9	1.05	0.945	9.08
C	20	211	60	1	0.607	0.9	1.05	0.945	3.32
D	20	211	58.5	1	0.607	0.9	1.05	0.945	3.24
E	20	211	80	1	0.607	0.9	1.05	0.945	4.43
A	100	270	164	1	0.607	0.9	1.2	1.08	13.28
B	100	270	164	1	0.607	0.9	1.2	1.08	13.28
C	100	270	60	1	0.607	0.9	1.2	1.08	4.86
D	100	270	58.5	1	0.607	0.9	1.2	1.08	4.74
E	100	270	80	1	0.607	0.9	1.2	1.08	6.48

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Woolacotts.
CONSULTING ENGINEERS

Job Narrabeen mix - development Date 10/9/07

Absorption trench design:

$$\frac{V}{L} = e_s b H + 60 k_h t (b_i + \frac{H}{2}) U \quad -①$$

From geotech report:

Soil : sand $U = 1.0$

Infiltration rate (k_h) = $0.25 L/m^2/s = 2.5 \times 10^{-4} m/s$

Eveglas Large size : $H = 410$ mm

$b = 455$ mm.

Site time of concentration (t_c) = 5 min.

Try 2 Eveglas ... size with 2400 mm drainage materials at bottom.

$\therefore b_m = 0.91$ m.
$b_i = 2.4$ m.
$L = 20$ m.

Rainfall (mm/h)	duration (min)	V_{in} (m^3)	Available volume (V) Refer to eqn. ①
236	5	9	15
158	15	18	22
116	30	26	33
95	45	32	43
82	60	37	54
75	75	42	65
64	90	43	75

Since available volume is greater than total inflow volume.

∴ use 2 Eveglas Jumbo trench, each 20m long.

and 2.4m filter material under the trench.

Designed PHL | Job No 06172 | Sheet No 2

EVERHARD INDUSTRIES Everything Water

EVERHARD WASTEWATER

Everhard Industries offers the complete Septic System Range for any situation including septic tanks, collection wells, grease traps and greywater recycling units.
Click here to view Septic System process

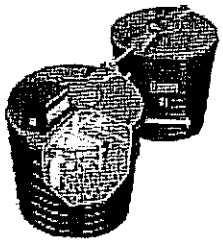
Also in our range is the Aqua-nova® Wastewater Treatment System, an effective environmentally friendly wastewater treatment process.

Click here for more information.

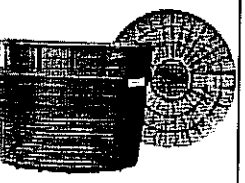
SEARCH FOR A PRODUCT

GO

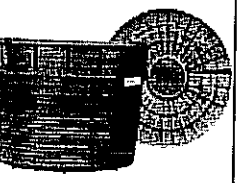
Wastewater
scroll to view range



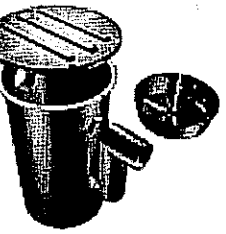
Aqua-nova® Wastewater Treatment System



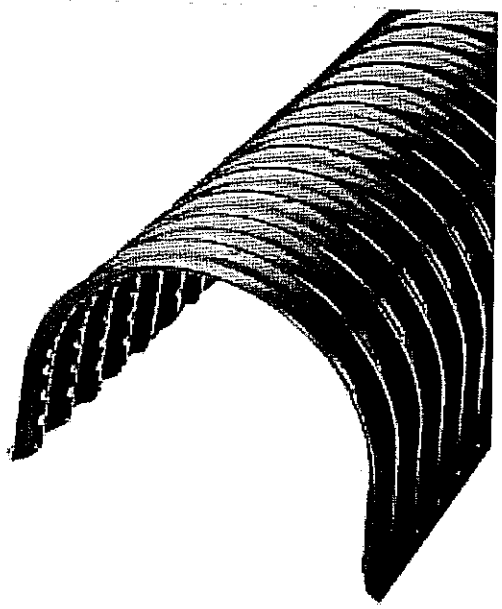
Septic Tanks



Collection Wells



Domestic Grease Traps



DESCRIPTION: Evertrench® Sull
Part No.0

Evertrench® Polymer Trench Liner is widely r the best systems available for the disposal of septic tank in unsewered areas.

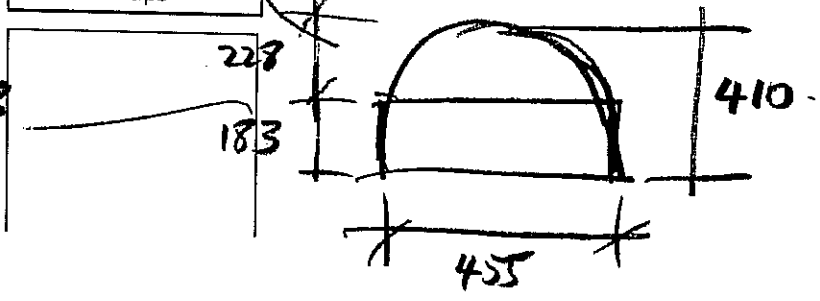
With Evertrench®, family health is protected I and efficient disposal of wastewater from kitcl and showers, laundry tubs and septic systems

Evertrench® Sullage Trench Sizes

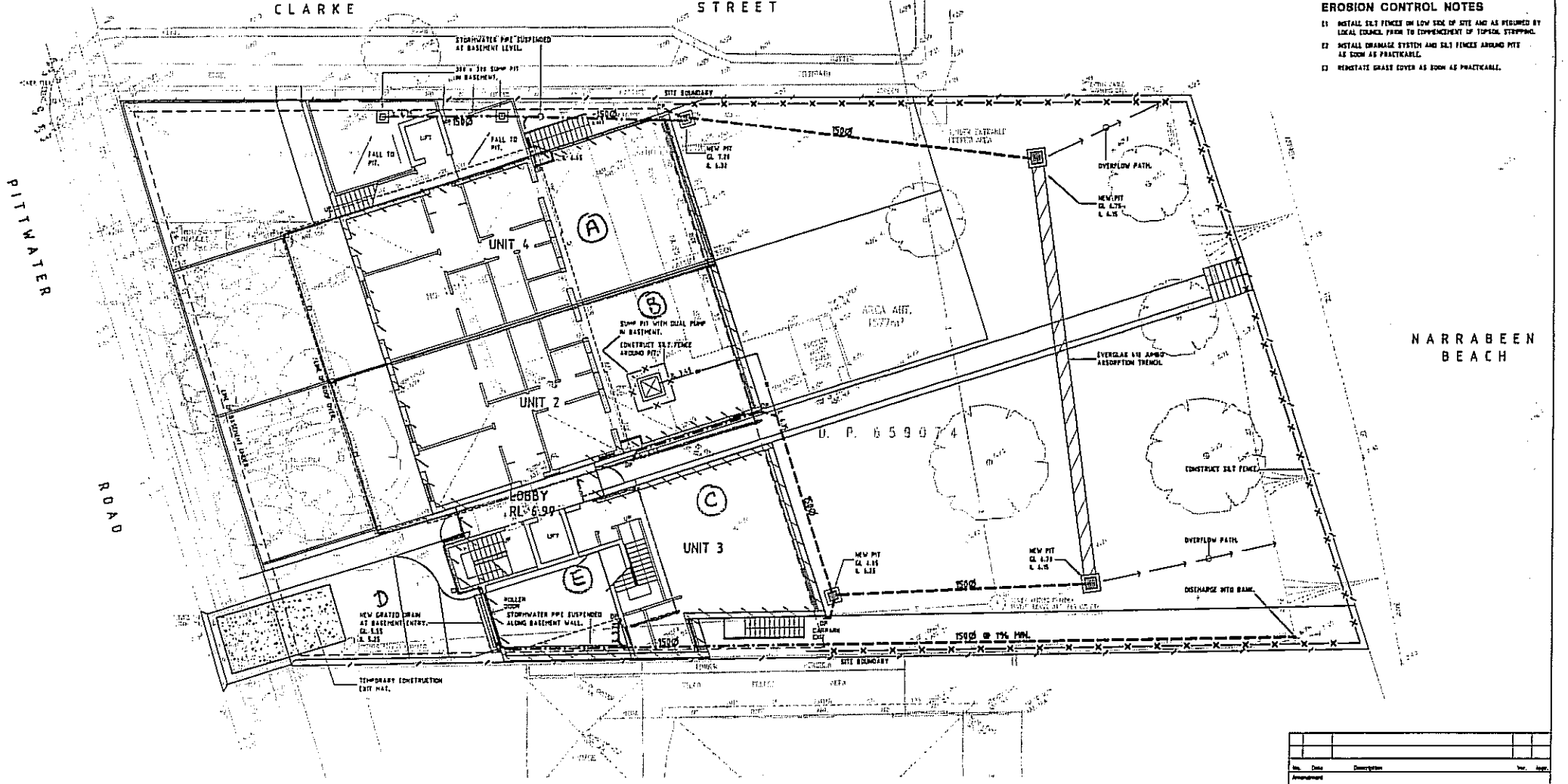
- 82010 – 230x1500mm Small
- 82020 – 350x1500mm Large
- 82030 – 410x1500mm Jumbo

End Caps, Spreader Bars and Geotextile Rolls

*This product was also known as Everglas Sq

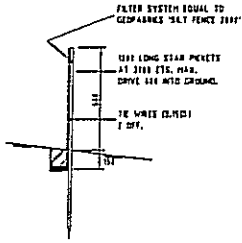


A = 0.081 + 0.083
= 0.164 m²
× 20 = 3.3 m².



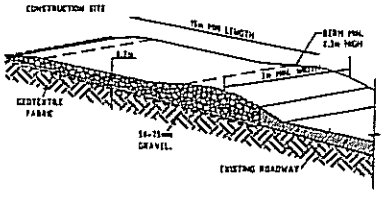
EROSION CONTROL NOTES

1. INSTALL SILT FENCES ON LOW SIDE OF SITE AND AS REQUIRED BY LOCAL COUNCIL PRIOR TO COMMENCEMENT OF TOPSOIL STRIPPING.
2. INSTALL DRAINAGE SYSTEM AND SILT FENCES AROUND PITS AS SOON AS PRACTICABLE.
3. REINSTATE GRASS COVER AS SOON AS PRACTICABLE.

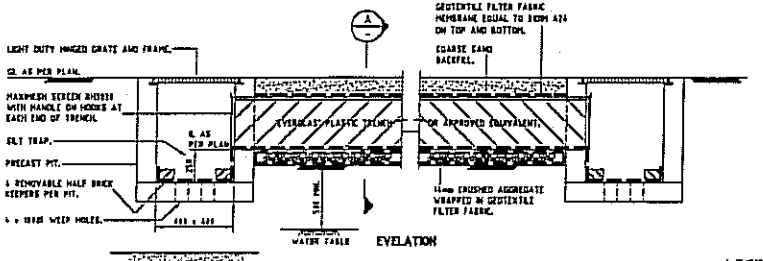


SILT FENCE

TO BE PLACED AROUND LOW SIDE OF PROPERTY BOUNDARY AND AROUND STORMWATER INLET STRUCTURES TO PREVENT SOIL WASHING OFF SITE.



TEMPORARY CONSTRUCTION EXIT MAT



SECTION A

ABSORPTION TRENCH DETAILS:

AREA TO TRENCH 4.32m²
ABSORPTION RATE: 8.3L/m²/d
TRENCH LENGTH 7m
STORAGE: 1.0m³

ABSORPTION TRENCH

LEGEND

- PROPOSED STORMWATER PIPE
- PROPOSED SUSPENDED STORMWATER PIPE
- EXIST MAIN
- SILT FENCE
- PROPOSED STORMWATER PIT
- DP DOWNPIPE

No.	Date	Description	Ver.	Appr.
Amendment				

Woolacotts. Consulting Engineers
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24 Brougham Rd.
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Facsimile (02) 9413 1132.
e-mail info@woolacotts.com.au

Project

PROPOSED MIXED-USE DEVELOPMENT
PITTWATER ROAD, NARRABEEN for
BEACH PROPERTY TRUST

Client

BONUS + ASSOCIATES ARCHITECTS
597 DARLING STREET
ROZELLE - NSW 2039

Drawing Title

STORMWATER MANAGEMENT &
EROSION SEDIMENT CONTROL PLAN

Approved	Verified	Prepared	Date	Scale
			SEPTEMBER 2006	1:100

Job number	Drawing number	Amendment
06-172	SW1	

Woolacott Hale Corlett & Jumikis
Consulting Engineers Pty Ltd
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2a Broughton Road
Artarmon 2064

Telephone (02) 9413 1399
Facsimile (02) 9413 1132

Woolacotts.
CONSULTING ENGINEERS

Job Narrabeen Date 5 Sept 07

Absorption Trench:

Length = 20m

Trench width = 2.4m (infiltration area)

Area for absorption = 48m²

Absorption rate = 0.25L/m²/s

↳ 12 L/s

Roof catchment = 435m²
= catchment of trench)

$$Q_{50} = \frac{1.0 \times I \times 433}{3600}$$

Dur (min)	I (mm/hr)	Qin (L/s)	Vin (m³)	Vout (m³)	ΔV
5	236	28.4	8.5	3.6	4.9
10	186	22.4	13.4	7.2	6.2
15	158	9.0	17.1	10.8	6.3
20	140	16.8	20.2	14.4	5.8
25	126	15.2	22.7	18.0	4.7
30	116	14.0	25.1	21.6	3.5
45	95	11.4			
60	82	9.9			
90	64	7.7			
120	53	6.4			

Storage volume required
= 6.3m³

Designed ..... Job No ..... Sheet No .....

Appendix C
Geotechnical Investigations

GEOTECHNIQUE
PTY LTD

Member of
Australian Contaminated
Land Consultants Association Inc

Quality System
Quality
Endorsed
Company

ABN 64 002 841 063

Job No: 11201/2
Our Ref: 11201/2-AB
5 March 2007

Beach Property Trust
c/- Bonus & Associates Architects
Level 1
597 Darling Street
ROZELLE NSW 2039
Email: tim.west@bonusarch.com

Attention: Mr T West

Dear Sir

re: **Proposed Mixed Development**
1184-1186 Pittwater Road, corner of Clarke Street, Narrabeen
Infiltration Assessment

Geotechnique Pty Ltd carried out permeability tests at the above site in February 2007 and provided an estimate of infiltration rate or absorption capacity of sub-surface soil for design of an On-site Stormwater Detention (OSD) system (refer Geotechnique Pty Ltd Report No 11201/2-AA dated 21 February 2007.

The proposed development at the site comprises an approximately 3.0m deep basement excavation and the absorption capacity recommended in Report No 11201/2-AA was based on our understanding that the OSD would be located beneath the basement level, at depths of about 3.0m to 6.0m from existing ground surface.

However, we now understand from Mr S Branch of Woolacotts Consulting Engineers that the OSD will be located within 1.0m from existing ground surface. This letter provides a revised estimate of absorption capacity of sub-surface soil if the OSD is located within a depth of 1.0m from existing ground surface and should be read in conjunction with Report No 110201/1-AA.

Sub-surface soil to a depth of 6.0m is predominantly sand. The sand is very loose to loose to a depth of about 3.5m and medium dense to dense at depths exceeding 3.5m. Therefore, for design of an OSD to a depth of 1.0m, an absorption capacity of 0.25L/m^2/s is recommended. We reiterate that the appropriate absorption capacity for an OSD at depths of 3.0m to 6.0m is 0.02L/m^2/s.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Associate

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GEOTECHNIQUE
PTY LTD

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Land Consultants Association Inc

Quality
Endorsed
Company

Job No: 11201/2
Our Ref: 11201/2-AA
21 February 2007

Beach Property Trust
c/- Bonus & Associates Architects
Level 1
597 Darling Street
ROZELLE NSW 2039

Attention: Mr T West

Dear Sir

re: **Proposed Mixed Development**
1184-1186 Pittwater Road, corner of Clarke Street, Narrabeen
Infiltration Assessment

This letter report presents the results of permeability testing at the above site. The tests were commissioned by Mr R Wiggins of Beach Property Trust in a facsimile dated 8 February 2007 and carried out in general accordance with the Geotechnique Pty Ltd proposal (ER.pb/Q11201-2) dated 6 February 2007.

It is understood that the proposed development will include demolition of the existing residence and construction of a two-three storey mixed-use building with a single basement car park to RL3.8. The basement excavation is understood to be about 3.0m deep.

Geotechnique Pty Ltd completed a geotechnical investigation at the above site in 2006 and provided a report detailing sub-surface conditions and recommendations on design of excavations, retaining walls, floor slabs and footings (refer Geotechnique Pty Ltd Report No 11201/1-AA dated 18 September 2006).

However, it is now understood that the proposed development also includes construction of an On-site Stormwater Detention (OSD) system. Consequently, permeability testing was required to assess the water absorption capacity of soils across the site.

An Engineering Geologist from this company conducted permeability tests in three boreholes. Two tests were carried out in boreholes BH1 and BH2 drilled during the previous geotechnical investigation (refer Report No 11201/1-AA). Standpipes were installed in these two boreholes for groundwater monitoring and were therefore available for permeability testing. The third test was carried out in borehole BH101, which was drilled during this present investigation. The log for BH101 is attached. Approximate borehole locations are indicated on the attached Drawing No 11201/2-1.

Permeability testing in BH101 was carried out using the Falling Head test method (Reference: Australian Standard AS1547) and involved the following:

- Drilling the borehole (BH101) using handheld equipment. This borehole was terminated in fine to medium grained sand at about 3.0m from the existing ground surface.
- Screening the borehole with PVC to prevent wall collapse.

- Saturating the soil surrounding the borehole by filling and refilling the borehole several times.
- After saturation of soil is achieved, the borehole is filled with water and the rate of water level drop in the borehole is measured with time. The measurements were repeated several times until similar falling rates were obtained in two consecutive tests.

Permeability tests in boreholes BH1 and BH2 were carried out using the Rising Head test method (Reference: Australian Standard AS1547) and involved the following:

- Measuring depths to groundwater levels in both boreholes. The depths to groundwater level in BH1 and BH2 were 5.8m and 6.0m from ground surface, respectively.
- Pumping water from the boreholes to lower the groundwater level.
- After pumping was terminated, the rate of water level recovery in the boreholes was measured with time. The measurements were repeated several times until similar rates were obtained in two consecutive tests.

Results of field work are summarised as follows:

- The boreholes indicate that the sub-surface profile at the site comprises a sequence of topsoil/fill, underlain by fine to medium grained sand to depths exceeding 8.5m. It is also our assessment that the sand to depths of about 6.0m is similar in grain size and density.
- The depth to groundwater level across the site is about 6.0m from existing ground surface.
- The depth of excavation for OSD system construction is anticipated to be less than 6.0m. For design of OSD in sand to a depth of about 6.0m, we recommend an indicative permeability value of 10^{-5}m/s.
- Based on indicative permeability, the absorption capacity of sand to a depth of about 6.0m is estimated to be about 0.02L/m^2/s. This means an absorption pit measuring 5.0m long, 5.0m wide and 1.0m deep would be able to infiltrate about 60m^3 of water per day and that the sand at the site has good drainage capacity.
- For depth < 1m from surface 0.25 L/m^2/s

It is also understood that the council requires the following information from the permeability testing:

- The infiltration rate that can be maintained long-term.
- The minimum distance any infiltration system should be located clear of the property boundaries.
- Whether the use of infiltration is likely to cause seepage problems to the proposed structure or to any adjoining properties.

The above issues are addressed as follows.

- As sub-surface soils are sandy and stormwater is expected to contain insignificant amounts of clayey materials (resulting in blocking of voids in sand), the change in absorption rate in the long-term is expected to be insignificant. Therefore, the long-term infiltration rate will be similar to that indicated above.
- As the sub-surface material is predominantly sandy and the depth to groundwater table is assessed to be about 6.0m from existing ground surface, water in the absorption pit is anticipated to infiltrate both horizontally and vertically. Due to the nature of the sand (no clay layers) and high permeability value, horizontal migration of water from the absorption pit, before reaching the groundwater table, is anticipated to be less than 6.0m. Therefore, we suggest that the absorption pit is located at least 5.0m away from site boundaries. It might be preferable for the absorption pit to be located beneath the floor slab, which is to be constructed at a depth of about 3.0m

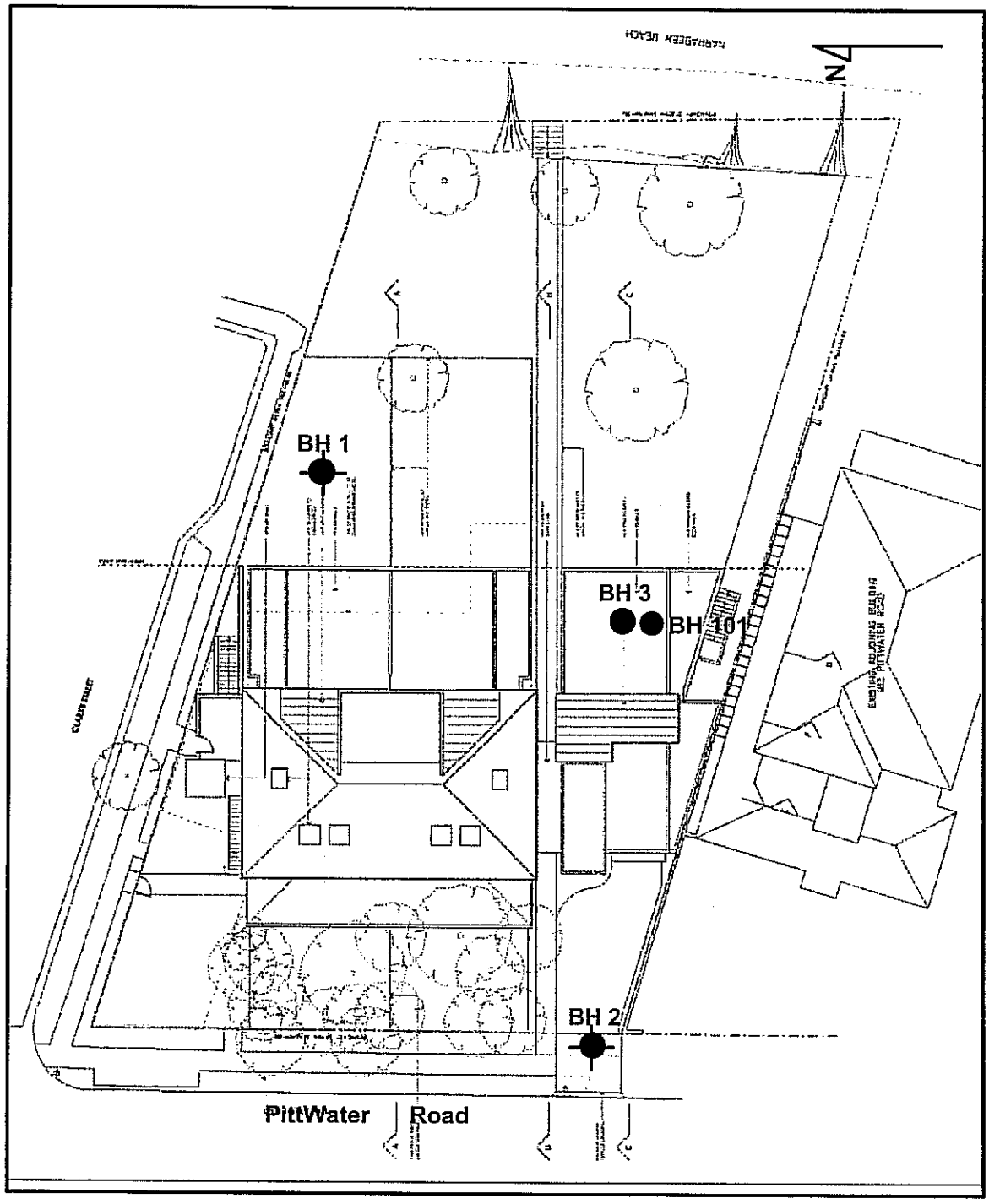
- Assuming that the absorption pit is located at least 5.0m away from the site boundaries, horizontal migration of water from the absorption pit is not expected to reach site boundaries or structures in the neighbouring properties. Likewise, high permeability of the sub-surface soils is anticipated to prevent ponding of water beneath the basement slabs. Therefore, it is unlikely that water flows from the absorption pit will adversely impact the stability of proposed structures, if designed in accordance with recommendations presented in Report No 11201/1-AA, and existing structures in adjoining properties.

Should you have any questions relating to this report, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Associate

Encl Location Plan – Drawing No 11201/2-1
Borehole Log for BH101



0 7 14

Scale 1:350

LEGEND

Boreholes With Groundwater Monitoring Well

Borehole

PREPARED BY:

GEOTECHNIQUE PTY LTD
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Bonus & Associates Architects
Proposed Mixed Development
1184-1186 Pittwater Road,
Narrabeen

Borehole & Monitoring Well Location Plan

Drawing No: 11201/2-1
Job No: 11201/2
Drawn By: ZM
Scale: 1: 350
Date: 20/02/2007
Checked By: IJ

GEOTECHNIQUE
PTY LTD

engineering log - borehole

Client : Bonus & Associates Architects
Project : Proposed Development
Location : 1184-1186 Pittwater Road, Narrabeen

Job No. : 11201/2
Borehole No. : 101
Date : 13/02/07
Logged/Typed/Checked by: ZM/jb/

drill model and mounting : Hand Auger **slope :** 90° **deg.** **R.L. surface :**

hole diameter : 75 **mm** **bearing :** **deg.** **datum :**

method	groundwater	samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Hand Auger	DRY			0			TOPSOIL/FILL; Sand, fine grained, brown, with roots and root fibres and ceramic fragments	D			
							SAND; fine to medium grained, pale yellow, brown	M	L		
				0.5							
				1							
				1.5							
				2							
				2.5							
				3			Borehole No. 101 terminated at 3.0m				
				3.5							
				4							
				4.5							

EXPLANATORY NOTES

Introduction
These notes have been provided to simplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments section. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods
The methods of description and classification of soils and rocks used in this report are based on AS1726 - 1993 "Geotechnical Site Investigations". In general, descriptions cover the following properties; strength or density, colour, structure, soil or rock type, and inclusions. Identification and classification of soil and rock involves, to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, ¬ualified by the grading or other particles present (e.g. sandy clay) on .e following basis:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT), as below:

Relative Density	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-MPQ)
Very Loose	Less than 5	Less than 2
Loose	5 – 10	2 – 5
Medium Dense	10 – 30	5 – 15
Dense	30 – 50	15 – 25
Very Dense	>50	>25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering, strength, defects and other minor components. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling
Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. 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.

Field Investigation Methods
The following is a brief summary of investigation methods currently carried out by this Company and comments on their use and application.

Hand Auger Drilling
The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits
These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure to accommodate the poorly compacted backfill.

Large Diameter Auger (e.g. Pengo)
The hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers
The hole is advanced by using 90mm-115mm diameter continuous spiral flight augers, which are 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 are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively lower reliability due to remoulding, mixing or softening of samples by groundwater, resulting in uncertainties of the original sample depth.

The spiral augers are usually advanced by using a V-bit through the soil profile to refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of recovered rock fragments and through observation of the drilling penetration resistance.

Non-core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the feel and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (e.g. SPT and U_{50}) samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances, a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in AS1289 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blow counts for each 150mm of, say 4, 6 and 7 blows as;

  N = 13
  4,6,7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm as;

  15, 30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test method is used to obtain samples in 50mm diameter thin walled sample tubes in clays. In these circumstances, the test results are shown on the bore logs in brackets.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in AS1289 6.5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in MPa *
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows per 300mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c=(12 \text{ to } 18)C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values, to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (DCP)
Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows per successive 100mm increment of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) AS1289 6.3.2 and the Perth Sand Penetrometer AS1289 6.3.3. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS1289 Test P3.2).

Laboratory Testing
Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs
The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Groundwater
Where groundwater levels are measured in boreholes, there are several potential problems:

- In low permeability soils groundwater, although present, may enter the hole slowly or perhaps not at all during the investigation period
- 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 due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report
- the use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if water observations are to be made

More reliable measurements can be achieved by installing standpipes that are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be advisable in low permeability soils, or where there may be interference from a perched water table or surface water.

Engineering Reports
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, perhaps a three-storey building, the information and interpretation may not be relevant if the design proposal is changed, say to a twenty-storey building. If this occurs, the Company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company 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.

  Changes in policy or interpretation of policy by statutory authorities.

- The actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies
In the event that conditions encountered on-site during construction appear to vary from those that were expected from the information contained in the report, the Company requests immediate notification. Most problems are much more easily resolved when conditions are exposed rather than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes
Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institute of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes; it is recommended that all information, including the written report and discussion, be made available.

In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purposes, at a nominal charge.

Site Inspection
The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site.

Review of Design
Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.