STEVE WATSON
& PARTNERS

Job No: 2005/307

Tuesday, 19 June 2007

Pittwater Council
P.O. Box 882
Mona Vale NSW 1660

Attention: Document Management

RE: Construction Certificate No. 05/307/01
Warriewood Aged Care Facility,
6 – 14 Macpherson Street, Warriewood

Please find attached a copy of Construction Certificate 05/307/01 and required attachments issued by Steve Watson & Partners for the above mentioned development in accordance with Section 109C(1)(b) and 81A(2) of the Environmental Planning and Assessment Act 1979.

Please find attached a cheque in the amount of $30.00 payable for the registration of the Construction Certificate.

Can you please forward SWP a receipt for the acknowledgment of the lodgement cheque.

If you have any queries please do not hesitate to contact me on (02) 9283 6555.

Regards,

Andrew Rys
Steve Watson & Partners

S:\Jobs\2005 Jobs\2005-307 Warriewood Valley Retirement Village - 6-14 Macpherson Street, Warriewood\Construction Certificates\20070618 CC attached to council.doc

22/6/07

R. 217944 $30-

BUILDING REGULATIONS CONSULTANTS AND CERTIFIERS
FIRE SAFETY ENGINEERS
LEVEL 5, 432 KENT STREET, SYDNEY NSW 2000
TEL +61 2 9283 6555 | FAX +61 2 9283 8500
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CONSTRUCTION CERTIFICATE

Construction Certificate No. 05/307/01

I, Steve Watson, certify that work completed in accordance with documentation accompanying the application for this certificate (with such modifications verified by me as may be shown on that documentation) will comply with the requirements of this Regulation as are referred to in section 81A (5) of the Environmental Planning and Assessment Act 1979.

Applicant	Name: **Morgan Moore & Associates** Address: **Level 5, 140 Arthur Street,** Suburb: **North Sydney** State: **NSW** Postcode: **2060**
Location of the Property	Address: **6 – 14 Macpherson Street** Suburb: **Warriewood** State: **NSW** Postcode: **2102** Real Property Description: **Lot B, DP 400488; Lot B DP 358765; Lot A DP 400488; Lot A DP 358765; Lot 22 DP 5464**
Building description	**Stage One over site excavation and site remediation (outside 40 m watercourse zone)**
Building Code of Australia Classification	**Class 2, 9c & 9b**
Date of Receipt **Determination**	Date Received: **18th May 2007** **Approved** Date of Determination: **18th June 2007**
Development Consent	Development Consent Number: **N0102/05** Council: **Pittwater Council** Date of Determination: **6th April 2006**

Attachments

1. Plans and specifications endorsed by this certificate
2. Fire safety schedule

STEVE WATSON & PARTNERS
05/307/01
Construction Certificate
Steve Watson Reg # BPB0432

Steve Watson
Accreditation Body: **BPB** Accreditation no: **BPB0432** Date of Endorsement: **Monday, 18 June 2007**

Design documentation approved for Construction Certificate 05/307/01 for Warriewood Retirement Village

Drawing No.	Drawing Title	Revision	Date	Drawn by
0439/DA18	Stage 1 Bulk earthworks & Excavation	A	Oct 2006	Boffa Robertson Group

FIRE SAFETY SCHEDULE

STEVE WATSON & PARTNERS

Warriewood Retirement Village, 6 – 14 Macpherson Street, Warriewood

Existing Fire Safety Schedule

Item No.	Existing Measure	Standard of performance.
1.	Access Panels, doors and hoppers to fire resisting shaft	Not Applicable
2.	Automatic fail safe devices	Not Applicable
3.	Automatic fire detection and alarm system	Not Applicable
4.	Automatic fire suppression system	Not Applicable
5.	Emergency lighting	Not Applicable
6.	Emergency Lifts	Not Applicable
7.	Emergency Warning and intercommunication system	Not Applicable
8.	Exit signs	Not Applicable
9.	Fire control centres and rooms	Not Applicable
10.	Fire dampers	Not Applicable
11.	Fire Doors	Not Applicable
12.	Fire Hydrant systems	Not Applicable
13.	Fire Seals (protecting openings in fire resisting components of the building)	Not Applicable
14.	Fire Shutters	Not Applicable
15.	Fire windows	Not Applicable
16.	Hose reel system	Not Applicable
17.	Light weight construction	Not Applicable
18.	Mechanical air handling systems	Not Applicable
19.	Perimeter vehicle access for emergency vehicles	Not Applicable
20.	Portable fire extinguishers	Not Applicable
21.	Safety curtains in proscenium openings	Not Applicable
22.	Smoke and Heat Vents	Not Applicable
23.	Smoke dampers	Not Applicable
24.	Smoke detectors and heat detectors	Not Applicable
25.	Smoke doors	Not Applicable
26.	Solid-Core doors	Not Applicable
27.	Stand-By Power Systems	Not Applicable
28.	Wall wetting sprinkler and drencher systems	Not Applicable
29.	Warning and operations signs	Not Applicable

Proposed Fire Safety Schedule

Item No.	Proposed Measure	Standard of performance.
1.	Access panels, doors and hoppers to fire resisting shafts	Not Applicable
2.	Automatic Fail Safe Devices	Not Applicable
3.	Automatic Fire Detection and Alarm System *(smoke detection system)*	Not Applicable
4.	Automatic fire suppression systems *(Sprinklers)*	Not Applicable
5.	Emergency Lifts	Not Applicable
6.	Emergency Lighting	Not Applicable
7.	Emergency warning and intercommunication system	Not Applicable
8.	Exit Signs	Not Applicable
9.	Fire control centre / room	Not Applicable
10.	Fire Dampers	Not Applicable
11.	Fire Doors	Not Applicable
12.	Fire Hydrants Systems	Not Applicable
13.	Fire seals protecting opening in fire resisting components of the building	Not Applicable
14.	Fire Shutters	Not Applicable
15.	Fire windows	Not Applicable
16.	Hose Reel System	Not Applicable
17.	Lightweight Construction	Not Applicable
18.	Mechanical Air Handling System *(automatic shut down of air-handling system)*	Not Applicable
19.	Perimeter Vehicle Access for emergency vehicles	Not Applicable
20.	Portable Fire Extinguishers	Not Applicable
21.	Safety curtains in proscenium openings	Not Applicable
22.	Smoke and Heat Vents	Not Applicable
23.	Smoke Dampers	Not Applicable
24.	Smoke detectors and heat detectors *(detectors for the automatic closing operation of fire doors and fire shutters in fire walls)*	Not Applicable
25.	Smoke Doors	Not Applicable
26.	Solid Core Doors	Not Applicable
27.	Stand-by Power Systems	Not Applicable
28.	Wall Wetting Sprinkler and drencher systems	Not Applicable
29.	Warning and Operational signs	Not Applicable

Pittwater Council

ABN 61 340 837 871 Telephone (02) 9970 1111 Facsimile (02) 9970 7150
Postal Address: P.O. Box 882, Mona Vale NSW 1660, DX 9018 Mona Vale

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Business Hours:
8.00am to 6.00pm, Monday to Thursday
8.00am to 5.00pm, Friday

DA No: N0102/05

15 January 2007

Anglican Retirement Village
C/ Connell Wagner
PO Box 538
Neutral Bay
NSW 2089

Dear Sir/Madam

Deferred Commencement Consent for Demolition of existing structures and construction of a SEPP Seniors Living development including 260 self contained dwellings in nine (9) separate buildings, 119 bed Residential Aged Care Facility, ancillary facilities including administration offices, chapel/hall, community centre, café and store, health/fitness centre, child care centre, construction of associated roadwork, carparking and support facilities.

At:

Lot B DP 400488, Lot A DP 400488, Lot 22 DP 5464, Lot B DP 358765, Lot A DP 358765, Pt Lot B DP 345528, Pt Lot 1 DP 208149, Pt Lot 3 DP 579309, Pt Lot 3 DP 942319 and Pt Lot 4 DP 579309
6, 8, 10, 12 and 14 MACPHERSON STREET, WARRIEWOOD and 53C, 53B, 53 and 61 WARRIEWOOD RD, WARRIEWOOD NSW 2102

Please be advised that pursuant to Regulation 95(5) of the Environmental Planning and Assessment Regulation 2000, Council considers the details provided in accordance with deferred commencement Conditions 1, 2 3 and 4 contained in Part 1 of the conditions of Development Consent are satisfactory. The following documentation therefore forms part of the consent documentation:

- Warriewood Retirement Village Water Management Report (Version 4), Prepared by: GHD, Dated: December 2006
- GHD Addenda letter to Pittwater Council dated 5 January 2007 (ref 21/13577/74773) RE: Response to Queries from Cardno Lawson Treloar dated 4 January 2007
- Level 3 Odour Assessment, Warriewood STP, Prepared by Pacific Air & Environment, Dated: 20 September 2006
- Developer Contribution Agreement – Warriewood Sewage Treatment Plant, Prepared by Clayton Utz (ref Legal/102784045.4), Dated: 9 January 2007.

In this regard, the Consent becomes operative from the date of this letter, subject to the conditions listed in Part 2 of the Consent.

Yours faithfully

Lindsay Dyce
MANAGER - PLANNING AND ASSESSMENT

WARRIEWOOD VALLEY ANGLICAN RETIREMENT VILLAGE

Prepared for Anglican Retirement Village

Narrabeen Creek Riparian Restoration
VEGETATION MANAGEMENT PLAN

20 October 2005
05072
QA-2-5[illegible]

Pittendrigh Shinkfield Bruce Pty Ltd
2-14 Mountain Street Ultimo NSW 20[illegible]

PSB

PREAMBLE

This Vegetation Management Plan (VMP) has been prepared by Pittendrigh Shinkfield Bruce Pty Ltd for the riparian corridor restoration of a section of Narrabeen Creek that runs parallel to No.s 6, 8, 10, 12 and 14 Macpherson Street, Warriewood. The VMP is to accompany a development application for a SEPP Seniors Living 2004 development proposed by the Anglican Retirement Village (ARV).

Mark Blanche

B.L.Arch, M.Env.Stud, AAILA, RLA

Associate

:: Environmental Management

Angus Bruce

AssocDipAppSc(Landscape), AAILA, MAIH

Partner

:: Landscape Architecture

:: Landscape Management

Cover page: Warriewood Wetland access pathway meandering through the more elevated areas and ferny vegetation communities within the wetlands – August 2005

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1.00 INTRODUCTION

1.01 Background

Anglican Retirement Villages (ARV) propose to develop a new retirement village on recently acquired land in Warriewood, within the Pittwater LGA. The site is bounded by 6 to 14 Macpherson Road to the south, Brands Lane to the west, and Narrabeen Creek to the north .

The creekline and riparian habitats will be retained within a Corridor Reserve extending 25 metres from the Narrabeen Creek, which will be under the care and control of Pittwater Council (Council). A further native landscape and open space area extends beyond the corridor for an average width of 25m, which will be under the care and control of the landowner.

This Vegetation Management Plan (the Plan) has been prepared to guide the Corridor Reserve restoration process. The objectives of the Plan are to put in place management strategies and actions for the establishment, on-going development and maintenance of a healthy, ecologically productive riparian corridor.

1.02 Council Objectives

The broad aim of this Plan is to meet Council objectives, standards and design guidelines which have been referenced from the following documentation:

- Development Control Plan No. 29 – Warriewood Valley Urban Land Release (2001)
- Landscape Masterplan and Design Guidelines – Warriewood Valley Urban Release Area (2004), and
- Development Control Plan DCP No. 23 – Landscaping and Vegetation Management

More specifically the riparian restoration aims to meet the following objectives:

Natural Environment Guidelines

- Retain, regenerate and promote the planting of local indigenous trees, shrubs and groundcover wherever possible;
- Increase canopy cover, habitat value and improve the natural landscape character of the area;
- Carry the character of the escarpment into the Valley and mitigate any adverse impact on environmentally sensitive areas or impacts of differing land uses, reinforcing the canopied nature of Pittwater and providing native flora and fauna habitat;
- Maximise the restoration, retention and preservation of indigenous trees, shrubs and groundcovers, as well as natural features; and
- Incorporate local species within the restoration that are identified as food sources for native fauna.

Creekline Guidelines

- Incorporate extensive stands of *Casuarina glauca* and groves of *Eucalyptus robusta*, with other native feature trees and indigenous understorey and groundcovers, to comprise a minimum of 40% of the total creekline corridor area;
- In areas of low use, native groundcovers are to be used as an alternative to lawn;
- Protect and where possible incorporate existing significant trees, remnant vegetation and natural features;
- Protect and enhance wildlife corridors and fauna habitats; and
- Provide planting schemes that reinforce the framework of endemic canopy trees, understorey and groundcover species.

2.00 PROJECT OBJECTIVES

2.01 The Role of Riparian Vegetation

Riparian vegetation has a vital role in conserving and improving the health of waterways. Healthy, native riparian vegetation contributes to bank stability, control of erosion and sedimentation and water quality protection. It also provides habitat and a movement corridor for native fauna.

2.02 Restoration Goal

The goal of the restoration works is to create a low maintenance, relatively self-sustaining, ecologically diverse corridor within a highly urbanised environment. The long-term goal of ecological restoration is ultimately the self-perpetuation of plant communities, in this case those which approximate the available understanding of Swamp Sclerophyll Forest on Coastal Plains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Swamp Sclerophyll Forest). The intent is to carry out the restoration to the highest extent practicable.

2.03 Restoration Objectives

The restoration objectives of the project are:

- To enhance the ecological functions of the creek corridor;
- To reinstate local indigenous aquatic and riparian vegetation;
- To provide a diversity of habitats for local aquatic, semi-aquatic and terrestrial native fauna;
- To make provision for a future downstream fauna movement / regional corridor network opportunity; and
- To provide high quality passive recreational and interpretative opportunities for the surrounding community, without compromising ecological values.

2.04 Values of the Project

2.04.01 State, Regional and Local Significance

- Restoration of vegetation communities consistent with the endangered ecological community Swamp Sclerophyll Forest;
- Restoration of vegetation communities consistent with those found within Warriewood Wetland which is described by Benson and Howell (1990) as containing the last significant stand of *Eucalyptus robusta* (Swamp Mahogany) in the Sydney region;
- Reinstatement of Swamp Mahogany, a locally and regionally significant species as listed in DCP No. 25 – Conservation of Biodiversity (Pittwater Council 2000a).

2.04.02 Ecological

- Enhanced local biodiversity and ecological processes;
- Water quality control; and
- Soil erosion control.

2.04.03 Social

- Aesthetic amenity;
- Passive recreation provisions; and
- Interpretative opportunities.

2.04.04 Economic

- Preventing soil erosion and creek degradation;
- Improvement to water quality; and
- Flood mitigation and asset protection.

3.00 PROJECT DESCRIPTION

3.01 Riparian Corridor Framework

Figure 1 shows the development site and specific area covered by this Plan, within the context of the site prior to development. The designated corridor restoration treatments are illustrated on Landscape drawing no. DA01 (Appendix A).

Broadly, the riparian corridor comprises the following components:

3.02 Stream Bank Remediation

The northeastern boundary of the site parallels Narrabeen Creek. The creekline is to be restored by Council, which comprises the re-contouring of the existing creek line and batters, rock armouring of the creek line to reduce the propensity for erosion.

3.03 Stormwater Management

3.03.01 General

A Stormwater Management Plan for the development site incorporates the following general features:

- The entire site is graded towards the existing topographic depression on the site, which will be rehabilitated and upgraded to a Village Lake wetland. This lake will provide the dual functionality of water quality treatment and, by incorporation of the foreshore open space area, detention during larger events;
- Stormwater from all pervious and impervious surfaces will discharge via local on-route treatment strategies to the lake and Narrabeen Creek;
- A "treatment train approach" will be utilised to treat stormwater quality runoff. This will provide primary, secondary and tertiary treatment;
- Infiltration is not proposed as a means to discharge runoff. It is proposed to 'tank' the wetland and bio-retention areas/swales using impermeable membranes or clay layers;
- Rainwater harvesting from roofed areas will supply non-potable toilet, laundry and irrigation demands; and
- Stormwater harvesting from pervious and impervious (non-roof) surfaces areas will supply irrigation demands. It is proposed to capture all stormwater runoff from the sub-surface stormwater system in a stormwater harvesting facility (in the form of large pipes) under the village green.

3.03.02 Stormwater Quantity /Quality

Stormwater quantity and quality management for this catchment will comprise:

- Roof water harvesting using a 30 kl tank for each building for non-potable use (toilet, laundry and irrigation). Top up will be supplied via the Sydney Water potable water supply and optimised to provide assurance of supply while maximising rainwater capture. The rainwater tanks are oversized to manage site runoff. It is proposed that these are located in the underground car-park areas;
- Overflow from the rainwater tanks will be routed to a site sub-surface drainage system which generally drains to the Village Lake wetland;
- Impervious and pervious (at ground) areas will be routed to a number of local bio-retention areas and swales for water quality treatment. Road runoff will be directed to these bio-retention swales potentially located between the road and the footpath. No kerbs are provided on account of a "zero trip hazard policy" facilitating

direct discharge of road runoff. The swales and bio-retention areas will be connected to the sub-surface drainage system at a number of locations;

- The sub-surface drainage system will discharge to the stormwater harvesting facility under the Village Green via a Gross Pollutant Trap (GPT);
- The stormwater harvesting facility under the Village Green will overflow to the Village Lake;
- Further water quality treatment will occur in the Village Lake wetland; and
- The Village Lake wetland will discharge to Narrabeen Creek via a multistage outlet and spillway.

3.04 Riparian Restoration

Restoration aims to reinstate a fully structured riparian community and ground level connectivity for the length of the works.

3.04.01 Regeneration Potential

The vegetation present on the site has been described by (Conacher Travers 2005a, 2005b) as either Disturbed Woodland or Disturbed Land with Scattered Trees. This corresponding to mapping undertaken in 1994 by Benson and Howell (Conacher Travers 2005a).

Specifically the remnant native vegetation within the area covered by this Plan is restricted to scattered canopy species. Based on previous assessments and mapping (Conacher Travers 2005a & 2005b, Benson & Howell 1994), and the site's long history of agricultural use, it is likely that the sites regeneration potential will be very poor.

3.04.02 Restoration Approach

Restoration will be implemented through bush reconstruction to all areas of the 25m wide corridor. This being the most practical approach given the site is likely to be severely depleted of regeneration potential.

Bushland reconstruction involves initial and ongoing control of weeds using bushland regeneration techniques and "*the introduction of locally indigenous plant species, modelled on the diversity and structural characteristics of the original plant community*" (DIPNR 2003).

Reconstruction generally entails the following:

- Soil testing;
- Non-selective mechanical and herbicide weed control;
- Ecological burning of introduced / pastoral grass areas;
- Soil tilling/preparation and amelioration;
- Planting of plants from tree, shrub and ground layers in highly degraded areas; and
- Planting of native grassland areas.

3.05 Community Structure

Two (2) different plant community structures are proposed as follows:

i) Complete reconstruction of all structural layers including tree, shrub and ground stratum, and

ii) Installation of native grassland areas, adjacent pathways and infrastructure to provide safe passage for users of the site and maintenance access where required.

3.06 Plant Selection

Revegetation will comprise those species characteristic of the remnant Swamp Sclerophyll Forest (SSF). This community occurs within and to the north of the site. Species selection is based on both the known diagnostic species for this community, Council's plant list guidelines, and analysis of the nearby Warriewood Wetland and surrounds to identify locally established and resilient communities. A Planting Schedule and summary table of various flora lists is provided in Appendix B.

The proposed revegetation design will comprise a relatively uniform canopy throughout the corridor dominated by *Eucalyptus robusta*, with subdominant species including *E. botryoides*, *Angophora floribunda* and *Casuarina glauca*. Shrub and ground layers will vary in response to elevation and distance from the creekline, and anticipated frequency of flooding as follows:

- Macrophytes instream, where achievable;
- Water tolerant / ephemeral sedges and rushes to the creek verges, referred to as the "littoral understorey";
- Shrub and groundcovers tolerant of infrequent inundation by flood above the 5 year flood level;
- Shrub and groundcovers less tolerant of flood events which will occupy the remaining higher elevated areas; and
- Native grassland without shrub or canopy species immediately bordering pathways adjacent the corridor[1]

3.06.01 Fern Community

An important component of the riparian restoration is the inclusion of fern communities to be installed as scattered groves throughout the corridor. Fern communities were observed as a key lower stratum component within the forested areas of the Warriewood Wetlands, and Swamp Sclerophyll Forest adjacent to the subject site. It is anticipated that this vegetation community was likely to be a more widespread pre-European vegetative component of the valley, and worthy of a strong representation within the proposed Riparian Corridor restoration (refer cover photograph of this Plan).

3.06.02 Canopy Species

While it is acknowledged that Council require the incorporation of extensive stands of *Casuarina glauca* and groves of *Eucalyptus robusta*, the proposed planting schedule incorporates extensive plantings of *Eucalyptus robusta* with *Casuarina glauca* a subdominant canopy species. The basis for this proposal is summarised as follows:

- *Eucalyptus robusta* is a recognised keystone species providing winter food resources for native fauna;
- *Casuarina glauca* has not been found on the site as mature specimens or regenerating;
- *Casuarina glauca*, while beneficial for its rapid growth and weed suppression capabilities once established, can also have a negative impact on the establishment of other native species, particularly within the ground layer, and subsequently reduces species diversity; and
- *Casuarina glauca's* capacity to grow prolifically through suckering from parental root stock resulting in added maintenance expenditure due to invasive growth within areas that are intended to remain as understorey (e.g. native grasslands adjacent pathways), and often damage to pathway and other infrastructure).

Refer Dwg DA01 (Appendix A), and Plant Schedule (Appendix B).

3.07 Plant Procurement

Plant material will be propagated from local genetic stock where possible to ensure its suitability to the site, increase establishment success, and conserve existing gene pools within the Warriewood Valley where possible. To facilitate this process, an indicative species list was forwarded to four local nurseries within both the Warringah and Pittwater Local Government Areas.

[1] Intended to ensure the safety of pathway users from both physical obstructions (ie. Overhanging branches, sharp stems, etc) and crime prevention through environmental design (CPTED).

At the time of drafting this Plan, two of the four nurseries had responded, indicating that a high proportion of the selected plant species, are presently available from local provenance (refer Plant Schedule Appendix B). An initial plant supply contract should be instigated in the first instance, to ensure that existing provenance material is retained for this project, and where necessary:

- Pot up stock to the desirable container sizes; and / or
- Forward order the propagation of species not presently available but able to be supplied in the near future.

At least 10-16 weeks is required to grow plants in modestly sized cells (e.g. 0.035 to 0.093L) from seed and vegetative materials, before they are ready for planting.

Where it is not possible to procure all required species of local provenance, further collection of provenance propagative material should be undertaken during the 2005-2006 flowering / seed bearing season to obtain additional species for later stages of planting to the corridor, and/or replace any failures throughout the plant establishment period.

Where further collection or procurement of plant material is required under the circumstances described above, additional provenance locally endemic species should be sought over and above those specified, with the aim of maximising species diversity within the restoration.

3.08 Soil Testing

As part of the corridor restoration process, a detailed soil testing assessment should be undertaken. Soil amelioration can then be undertaken if necessary and in accordance with specialist recommendations to address soil deficiencies and / or other potentially problematic conditions that will impact on the reinstatement of native vegetation, soil erosion and the like.

3.09 Bushfire Management

The site is not within areas mapped as bushfire prone. Assessment of bushfire hazard, and construction of asset protection zones are not required and therefore not considered within this Plan.

3.10 Required Skills

Experienced Bushland Regeneration Contractors (BRC) should be used for all bushland reconstruction works detailed in this Plan. Generally the following experience is required at a minimum:

- Must demonstrate a minimum (cumulative) 3 years experience working in riparian vegetation communities;
- Must hold a current membership with the Australian Association of Bush Regenerators;
- Demonstrated experience in seed collection and propagation of native flora and hold relevant licences for seed collection and propagation of native flora.

Tender submissions must clearly demonstrate the capacity to undertake such works.

4.00 RESTORATION METHODS

4.01 Overview

A number of tasks in a staged order will be necessary to fulfil the requirements and objectives of this Plan. As outlined in the preceding sections, these include:

- Plant procurement;
- Soil Testing;
- Engagement of suitably qualified bushland regeneration contractors;
- Site preparation;
- Weed control, including primary and secondary weeding;
- Planting program, including primary and supplementary plantings;
- Maintenance and monitoring; and
- Reporting.

4.02 Site Preparation

4.02.01 Soils

A large proportion of the site will be mechanically reshaped as part of the stream remediation works. An understanding of each horizon (A, B and C) that is to be disturbed will be required to ensure that appropriate measures are taken when exposing and replacing subsoils and topsoils. Soil testing should be undertaken within both areas to be disturbed and areas to be retained.

4.02.02 Sediment and Erosion Controls

Stream and restoration works will be undertaken in accordance with an approved Soil and Erosion Control Plan.

Erosion Control

The removal of large areas of weeds may cause instability in some areas of the riparian corridor. Erosion control matting or other temporary erosion control methods (e.g. well anchored/staked hay bales) will be required in areas that become unstable and /or are likely to be subject to erosive forces.

Erosion control matting

Jute matting is designed to hold soil, decrease the risk of erosion and perform the same functions as other mulch products. When properly installed, jute matting will be less readily washed away during flood events, in comparison to products such as leaf or woodchip mulch.

The jute mat should be composed of 100% jute with a normal thickness of 8-13 mm and be installed as per product specifications. This includes: laying the mat perpendicular to the creek line, so that there are no patches of bare ground visible and with a 150mm overlap, overlapping to towards downstream; digging-in the top and upstream-most edge; and pinning-down the mat with at least 3 x 300mm long pins per m^2.

Erosion control matting must be installed to all areas below the 5 year flood line as illustrated in Dwg DA01 (Appendix A).

4.03 Mulch

Mulch is only to be used in higher elevated areas of the riparian zone, above the 5 year flood line. Use mulch to AS 4454, which is free of deleterious and extraneous matter such as soil, weeds, sticks and stones. Mulch is to be placed to the required depth, clear of plant stems, and rake to an even surface flush with the surrounding finished levels. Spread mulch so that after settling, or after rolling, it is:

- Smooth and evenly graded between design surface levels;
- Flush with adjacent finished levels;
- Of the required depths (75mm depth); and
- Sloped towards the base of plant stems in plantation beds, but not in contact with the stem.

It can be expected that mulch will have significantly broken-down after an estimated 12-month period following initial application. It is therefore recommended that, significant weed control is still required, mulch beds are topped-up with a 50mm layer of woodchip/leaf mulch at this stage. This should be accompanied by a topdressing application of a 9-month, slow release, low phosphorous fertiliser to ensure that semi-established plantings do not suffer as a result of potential nitrogen draw-down that may be associated with the application of the 50mm mulch layer at the 12-month period.

4.04 Weed Control

4.04.01 Primary Weeding

Primary weeding involves techniques such as:

- selective hand removal of weeds;
- selective foliage spraying of weeds with herbicides;
- cutting/scraping and painting deep rooted woody weeds and climbers;
- target drilling and injecting certain large exotic trees; and
- burning areas dominated by naturalised grasses.

These selective techniques are focused on avoiding disturbance to any remnant native plants and to soil stored seed banks, which may contain dormant native plant propagules. All weeds should be targeted during the primary weeding phase. A Weed Schedule is provided in Appendix C of this Plan.

Experienced bush regenerators should always implement primary weeding works.

4.04.02 Secondary weeding

Secondary weeding is to be undertaken in areas that have received a primary weeding treatment. It involves the selective removal or treatment of weeds, whilst allowing regenerating or planted native plants to increase in size, abundance and percentage cover. All weeds should be targeted during the follow up weeding phase.

The follow-up bush restoration works should commence no longer than three (3) months after the first exposure to primary weeding and continue to the end of the Plant Establishment Period as a minimum (refer s.4.06).

4.04.03 Maintenance weeding

Maintenance weeding is to be undertaken in areas where revegetation has significantly progressed to the stage where native plants occur at high percentage cover levels. It can be expected that the native vegetation at the site will always require a certain level of bush regeneration maintenance weeding, as weed seeds and vegetative propagules make their way on-site via stormwater during floods, wind and bird droppings. However, the amount of weeding required will decrease significantly as native plants establish and become more resistant to disturbance and weed colonisation.

A reassessment of maintenance weeding requirements should be determined every 2 years after that, over the following 10 to 12 years.

4.04.04 Noxious Weed Species

Under the *Noxious Weeds Act 1993* plants may be declared as noxious weeds by the Minister for Agriculture and their control category specified. Control categories include.

- WI: The presence of the weed must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
- W2: The weed must be fully and continuously suppressed and destroyed.

- W3: The weed must be prevented from spreading and its numbers and distribution reduced.
- W4a: The weed must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property.
- W4b: The weed must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering and fruiting.
- W4c: The weed must not be sold, propagated or knowingly distributed and must be prevented from spreading to an adjoining property.
- W4d: The weed must be fully and continuously suppressed and destroyed unless it is exempt under relevant legislation, such as the *Heritage Act 1977, Environmental Planning and Assessment Act 1979*, or Section 40 of the *Local Government Act 1993*.
- W4e: The weed must be fully and continuously suppressed and destroyed. All reasonable precautions must be taken to ensure produce, soil, livestock, equipment and vehicles are free of the weed before sale or movement from an infested area of the property.
- W4f: The weed must not be sold, propagated or knowingly distributed and any biological control or other control program directed by the local control authority must be implemented.
- W4g: The weed must not be sold, propagated or knowingly distributed

The following noxious weed species are present within the subject site:

W1	*Gymnocornis spilanthoides* Senegal tea plant
W2	*Cestrum parqui* Green cestrum
W2	*Cortaderia jubata* Pampas grass
W2	*Lantana camara* Lantana
W2	*Ricinus communis* Castor oil plant
W2	*Rubus fruticosus* Blackberry
W4a	*Arundo donax* Giant reed
W4a	*Phyllostachyos* spp. Rhizomatous bamboo
W4b	*Acetosa sagittata* Turkey rhubarb
W4b	*Ligustrum lucidum* Broadleaf privet
W4b	*Ligustrum sinense* Narrowleaf privet
W4c	*Anredra cordifolia* Madeira vine
W4c	*Araujia sericifera* Moth vine
W4c	*Asparagus densiflorus* Asparagus fern
W4c	*Ipomea* spp Morning glory
W4f	*Opuntia* spp. Prickly pear

Of particular concern is the presence of Senegal tea plant which occurs within No.10 Macpherson Road. Council have notified the owner of its presence and have provided recommendations for its removal (refer Weed Control Schedule, Appendix C).

4.04.05 Weed Control Considerations

The following should be considered when undertaking weed control:

- Dense areas of woody weeds (e.g. Lantana) be checked for the presence of birds nests, bee hives and possum dreys prior to clearing;
- In the event that any of the above are found, the supporting vegetation is to be left until such a time that replacement habitat has established, or it becomes evident that the habitat is no longer used;
- All native species must be protected from accidental drift of herbicides. Any parts of native foliage accidentally sprayed should be removed from the plant immediately. Contractors administering herbicides must carry secateurs at all times; and
- Any flowering or fruiting structures of weed species are to be carefully removed from the site, this shall include any pieces of branches, stems or other foliage capable of re-growth.

4.05 Ecological Burning

Fire is an essential part of the growth and reproduction of many Australian native plant species and communities. The impacts of fire on riparian and wetland communities is less understood and subsequently it is not intended to use ecological burning as on ongoing management tool, rather to reduce biomass making herbicide and hand weeding treatments easier to effect in areas where naturalised and native grass and herbaceous species co-exist.

The need for ecological burns at the study site, as a one off treatment, during initial weed control programs should be considered an integral tool in the ongoing restoration of the endangered ecological community at the study site, and should be implemented without compromise.

4.05.01 Ecological Burning Regime

Given the level of woody weeds and naturalised grasses present within the site, the following treatments are recommended:

- Woody weed debris should be piled, dried for 3-6 months and burned on-site to assist in stimulating native plant regeneration; and
- Areas of naturalised grasses and other weeds be burned.

4.05.02 Weed Piles

Woody weed debris removed as part of the initial weed clearing works should be piled, let dry for 3-6 months and burnt on-site to assist in stimulating native plant regeneration. This will provide a reasonable indication of whether heat responsive soil stored native plant seeds exist and are capable of germinating. This practice should not be used in areas where soils have been significantly disturbed by cut and fill activities.

Weed burn piles should not be stacked too high, as excessive heat generated by high (>2 metre) piles may adversely affect the viability of the native seed stored in the soil. Unburnt piles should not be left on-site for more than 6 months as they may provide habitat for feral animals.

The Baulkham Hills Rural Fire Service has published guidelines for constructing appropriate cut woody weed ecological burn piles, which provides a useful reference (Appendix D).

4.05.03 Mosaic & Grassland Burning Regimes

Specialised hand held low-pressure gun burners can be used to burn seed crops from perennial and annual grasses such as winter grass and summer grass. This has the potential to be a very practical tool for this site particularly as the location provides fewer constraints with regards to the proximity of residences.

4.06 Planting Program

In any native vegetation revegetation project it is important to consider the restoration of all structural layers of vegetation. Tree, shrub and ground layers will be restored by planting local native material in tubestock containers, supplemented by years of subsequent recruitment from these plantings and natural regeneration from proximate areas.

4.06.01 Staging of Planting

To establish a bushland planting that is low maintenance and reasonably self-reliant in the mid-term a two tiered approach is to be undertaken:

- Canopy and shrub plantings of readily available larger nursery stock and mass plantings of readily available cell and tubestock (from locally collected seeds); and
- Supplementary plantings of those species that are not immediately available, and /or slower to propagate.

Timing should not be critical for the tubestock if some species are introduced at a later stage. Past experience indicates that tubestock outgrow larger size nursery stock within 1-2 years (native shrubs) and 3-5 years (trees).

4.06.02 Tubestock Installation

Trees, shrubs, ground layer herbs, grasses and climbers in a range of cell to tubestock containers should be planted in designated revegetation areas, using the following specifications:

- Appropriate care should be taken to ensure that all cells are planted at the correct depth into the soil, mulch or weed mat layer;
- All tubestock should be watered-in thoroughly after planting to settle any air pockets around the root ball of the plant and to give the plant a good initial supply of water. Further all tubestock should be watered thoroughly on at least 4 to 6 occasions, as a part of post-planting maintenance; and
- Newly planted trees and shrubs should be protected by the installation of tree guards. 750mm x 10-12mm bamboo stakes and 350mm x 450mm tree guard sleeves or equivalent sized alternative should be used. Tree guards offer protection from grazing, against weed competition, frost, high winds and herbicide spray drift during maintenance spraying.

4.07 Planting Establishment Program

After planting works have been completed, treated areas should be maintained by a bush regeneration team, selectively spot spraying and hand weeding from around native plants, watering plants as needed and replacing dead and vandalised plants for an initial period of 24 months. This period of time will constitute the Planting Establishment Period (PEP). The maintenance period should start once all native plant revegetation works have been 100% completed to acceptable standards.

4.07.01 Irrigation

Provision should be made to irrigate newly planted stock in the first 3-6 months after planting (on at least 4-6 occasions, depending on rainfall conditions). Additional irrigation will be required when installing replacement tubestock and transplanting freshly divided plant materials.

4.07.02 Signage

The erection of signs highlighting the importance of the natural regeneration program should be installed.

Signs should be approximately 500mm wide by 500mm high and made of a durable material suitable for display over a period of 24 months.

5.00 ACTION PLAN SUMMARY

Task/Method	VMP Specification	Duration
Site Preparation • Soil testing • Installation of soil and erosion measures, • Subsoil and topsoil amelioration as necessary, • Topsoil preparation: ripping, stabilisation (mulching or matting) • Installation of soil and erosion controls	4.02.01 4.02.02	1 month
Plant Propagation • Letting of plant supply and future plant propagation requirements, including sourcing of native plant material (e.g. collection of seeds & cuttings). • Future plant propagation. • Plant material inspections, including: - Inspection 2 mths prior to delivery, and - Inspection 2 weeks prior to delivery.	3.07	5-6 months
Bush Reconstruction • Primary Weed eradication • Secondary Weed eradication • Planting: - Initial - Secondary planting	4.04.01 4.04.02 4.05	2 months 3 months 1 month As req' d
Plant Establishment Period • Replacement / supplementary plantings • Follow up weeding as required • Irrigation • Supplementation of mulch	4.06	2 years
Maintenance • Regular inspection • Maintenance weeding Repairs, rubbish collection and other ongoing requirements	4.06	Ongoing

6. REFERENCES

Benson D.H. and Howell J. (1998). Vegetation of the Sydney 1:100,000 Scale Map Sheet. National Herbarium of New South Wales, Royal Botanic Gardens, Sydney.

Conacher Travers (2005a). Ecological Impact Assessment Report. No. 6, 8, 10, 12 and 14 McPherson Street, Warriewood, February 2005.

Conacher Travers (2005b). Aquatic Assessment Report. Section of Narrabeen Creek in No. 6, 8, 10, 12 and 14 McPherson Street, Warriewood, February 2005.

Conacher Travers (2005c). Assessment of Impacts on an Endangered Ecological Community, September 2005.

Department of Infrastructure, Planning and Natural Resources, (2003). *Bringing the Bush Back to Western Sydney.*

APPENDICES

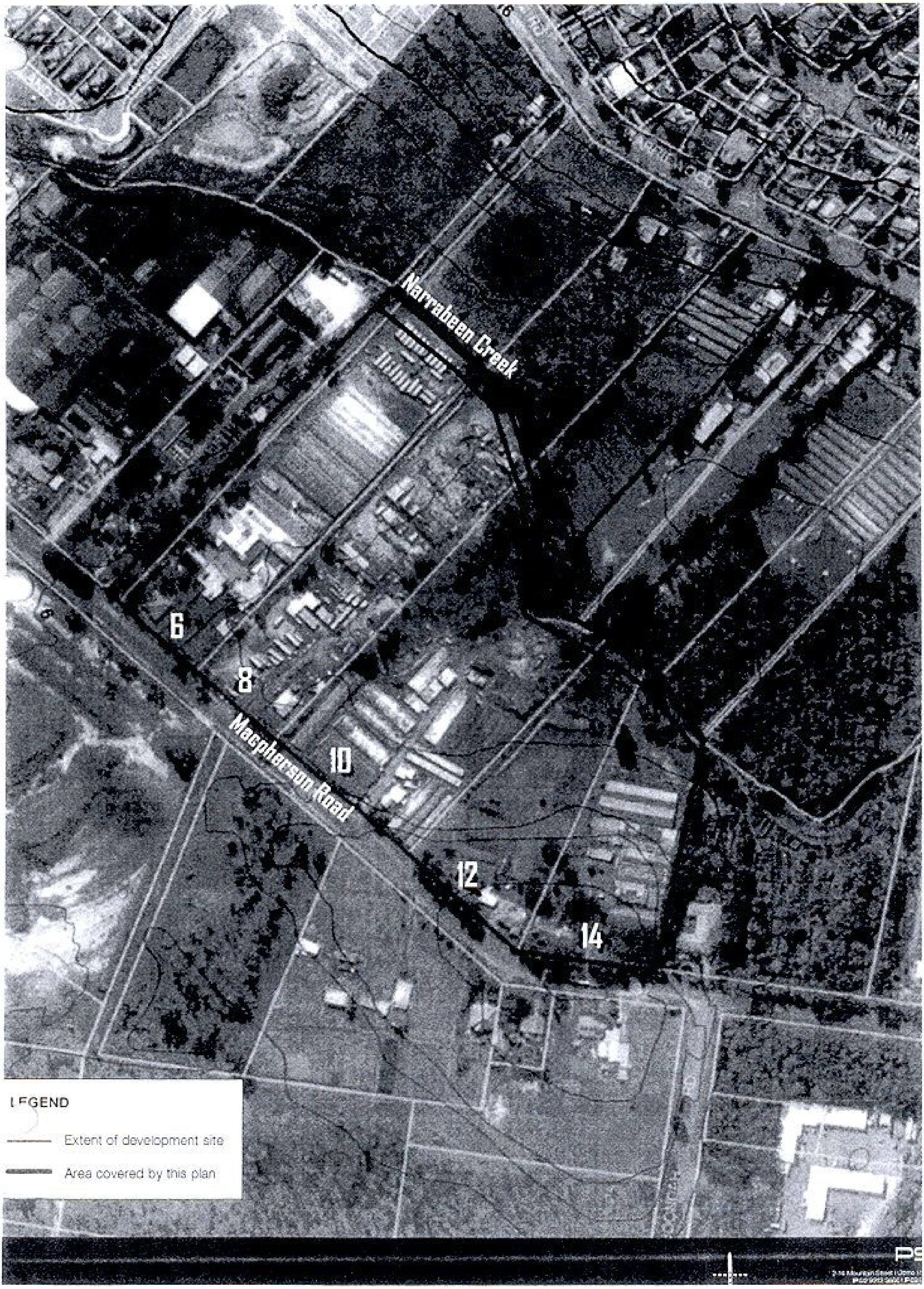
APPENDIX A. FIGURES

APPENDIX B. PLANT SCHEDULES

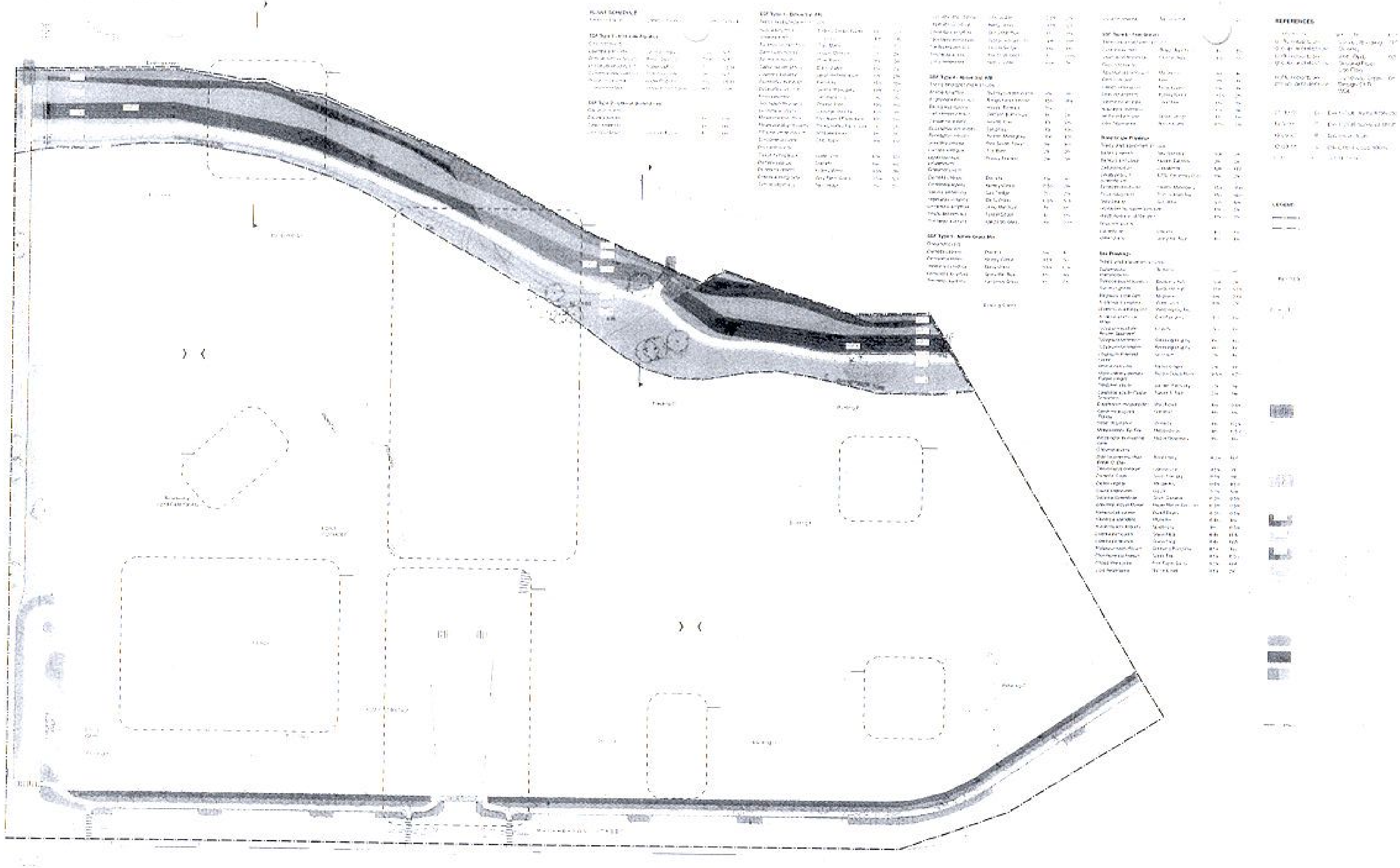
APPENDIX C. WEED CONTROL

APPENDIX D. PILE BURN GUIDELINES

APPENDIX A. FIGURES



Narrabeen Creek
6
8
10
Macpherson Road
12
14
LEGEND
Extent of development site
Area covered by this plan



Amended DA Plan

Warriewood Retirement Village

Anglican Retirement Villages

Scale 1:500@A1

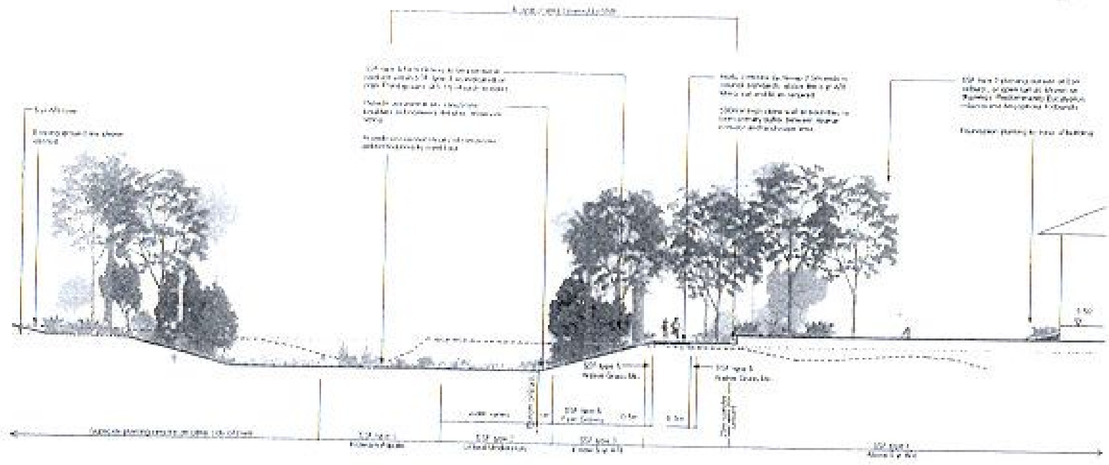
Project No. 05029

DA

REFERENCES

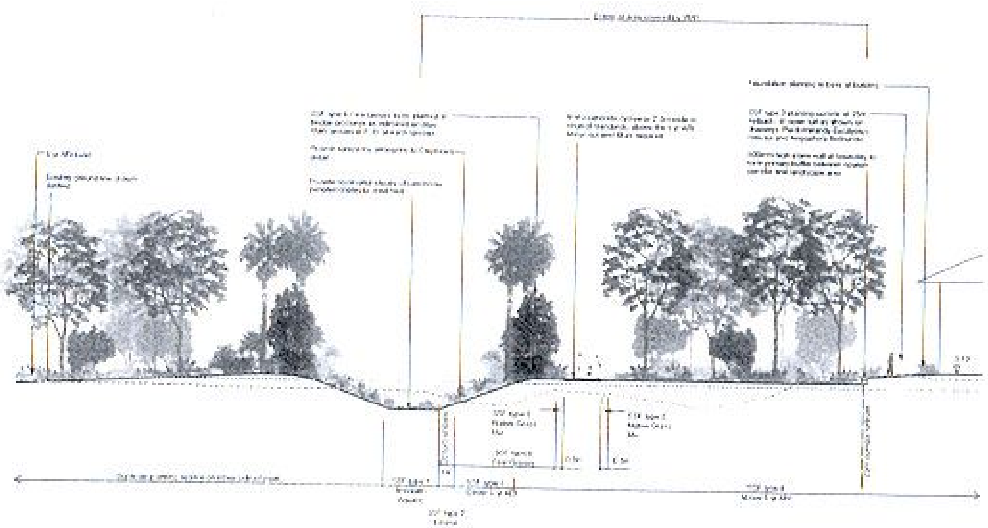
Consultant	Drawing No	Date of Issue
bella robertson group architecture	Survey Building Overlay	11.08.05
bella robertson group architecture	A05 Op B Ground Floor Site Plan	02.10.17
bella robertson group architecture	Cycleway Drawn Design WS	05.10.18

Date	Rev	Amendments
20.10.05	D	DA ISSUE 100% FOR COUNCIL
18.10.05	C	DA ISSUE 100% AMENDED
18.08.05	B	DA Issue 100%
10.09.05	A	DA Client Issue 100%

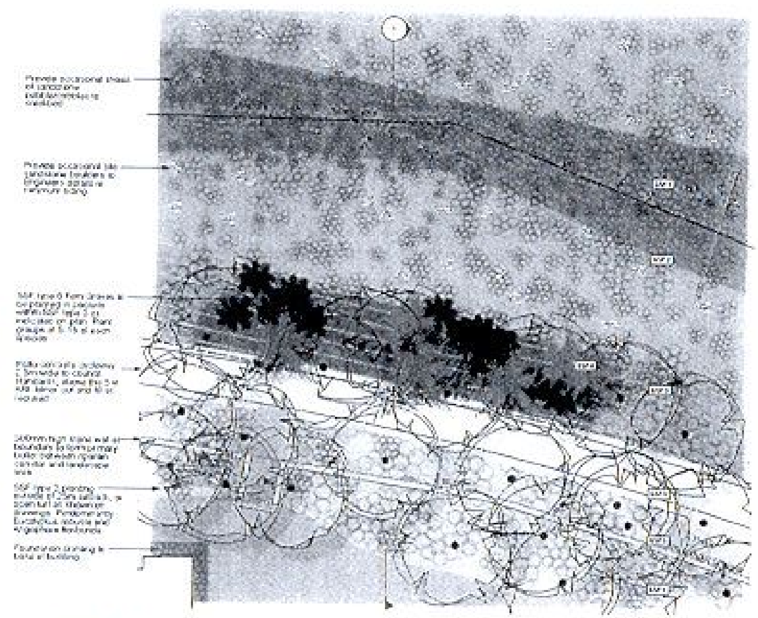


1 Riparian Corridor

Native Trees



2 Riparian Corridor



3 Detailed Planting Plan

Riparian Corridor Features

Amended DA Sections

Warriewood Retirement Village

Retirement Villages

PSB

DA02D

APPENDIX B. PLANT SCHEDULES

PLANT SCHEDULE

INDICATIVE SPECIES SUMMARY LIST

PLANT SCHEDULE: Warriewood Valley Anglican Retirement Village

SSF TYPE 1 (INSTREAM AQUATICS)

Groundlayer	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Baumea articulata	500	4	25	tube	not listed
Baumea rubiginosa				tube	HS in 3mths
Bolboschoenus fluviatilis	500	4	25	tube	HS in 3mths
Philydrum lanuginosum	500	4	10	tube	TN
Schoenoplectus validus	500	4	20	tube	TN
Triglochin procera	500	4	10	tube	HS in 3mths
Villarsia exaltata	500	4	10	tube	HS in 3mths
Subtotal			100		

SSF TYPE 2 (LITTORAL UNDESTOREY)

Groundlayer	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Baumea juncea	500	4	30	tube	forward order
Carex appressa	500	4	35	tube	TN
Juncus usitatus	500	4	35	tube	TN, HS
Subtotal			100		

SSF TYPE 3 (FULL RECONSTRUCTION — below 5 yr ARI)

Canopy	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Eucalyptus botryoides	5000	0.04	20	tree tube	TN, HS
Eucalyptus robusta	5000	0.04	40	tree tube	TN, HS
Livistona australis	5000	0.04	10	tree tube	HS
Melaleuca styphelioides	5000	0.04	20	tree tube	TN, HS
Schizomeria ovata	5000	0.04	10	tree tube	TN
			100		
Midstratum					
Acmena smithii	3000	0.11	20	tree tube	HS
Callicoma serratifolia	3000	0.11	20	tree tube	TN
Ficus coronata	3000	0.11	20	tree tube	HS
Glochidion ferdinandi	3000	0.11	20	tree tube	HS
Melaleuca linariifolia	3000	0.11	20	tree tube	HS
			100		
Shrub Layer					
Acacia longifolia	1000	1	25	tube	HS
Backhousia myrtifolia	1000	1	15	tube	HS in 3mths
Banksia spinulosa	1000	1	15	tube	HS in 3mths
Bauera rubioides	1000	1	10	tube	TN now, HS 3mths
Dodonea triquetra	1000	1	25	tube	Not listed
Pittosporum revolutum	1000	1	10	tube	HS
			100		
Groundlayer					
Cissus hypoglauca	1000	1	1	hiko	HS in 6mths
Viola hederacea	1000	2	1	hiko	TN
Pandorea pandorana	1000	1	1	hiko	TN, HS
Dianella caerula	350	6	10	hiko	TN, HS
Dichondra repens	350	2	1	hiko	TN
Entolasia marginata	350	6	10	hiko	not listed
Gahnia sieberiana	1000	1	10	hiko	HS in 5mths

SSF TYPE 3 (FULL RECONSTRUCTION — below 5 yr ARI)

Groundlayer cont'd

Glycine clandinestina	1000	1	1	hiko	HS in 6mths
Imperata cylindrica	350	6	15	hiko	not listed
Lomandra longifolia	350	4	20	hiko	TN, HS
Restio tetraphyllus	1000	2	10	hiko	not listed
Themeda australis	350	4	20	hiko	HS in 3mths
Subtotal			100		

SSF TYPE 4 (FULL RECONSTRUCTION — above 5 yr ARI)

Canopy	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Angophora floribunda	5000	0.04	20	tree tube	HS
Casuarina glauca	5000	0.04	20	tree tube	TN
Eucalyptus botryoides	5000	0.04	20	tree tube	TN, HS
Eucalyptus robusta	5000	0.04	40	tree tube	TN, HS
			100		
Shrub Layer					
Acacia longifolia	1000	1	20	tube	not listed
Banksia spinulosa	1000	1	20	tube	forward order
Callistemon citrinus	1000	1	15	tube	TN, HS
Grevillea sericea	1000	1	15	tube	TN, HS
Kunzea ambigua	1000	1	15	tube	TN, HS
Leptospermum juniperinum		1	15	tube	TN
			100		
Groundlayer					
Dianella caerula	350	6	15	hiko	TN, HS
Dichondra repens	350	2	2.5	hiko	TN
Entolasia marginata	350	6	10	hiko	not listed
Gahnia sieberiana	1000	1	7.5	hiko	HS in 5mths
Imperata cylindrica	350	6	10	hiko	not listed
Lomandra longifolia	350	4	20	hiko	TN, HS
Restio tetraphyllus	1000	2	15	hiko	not listed
Themeda australis	1000	4	20	hiko	HS in 3mths
Subtotal			100		

SSF TYPE 5 (NATIVE GRASS MIX)

Groundlayer	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Dianella caerula	350	4	20	hiko	TN, HS
Imperata cylindrica	350	6	20	hiko	not listed
Lomandra longifolia	350	4	20	hiko	TN, HS
Themeda australis	350	4	20	hiko	HS in 3mths
Dichondra repens	1000	1	10	hiko	TN
Viola hederacea	1000	1	10	hiko	TN, HS
Subtotal			100		

SSF TYPE 6 (FERN GROVES)

Canopy / Midstratum	Spacing mm	Plants/ m^2	% mix	Container size	Availability
Glochidion ferdinandi	4000	0.0625	50	tree tube	HS
Cyathea australis	4000	0.0625	50		forward order
			100		

Groundlayer

Viola hederacea	1000	2	2.5	tube	TN, HS
Dichondra repens	350	2	2.5	tube	TN
Adiantum aethiopicum	350	2	5	tube	forward order
Blechnum spp.	350	2	20	tube	forward order
Gleichenia dicarpa	350	2	10	tube	forward order
Restio tetraphyllus	1000	2	20	tube	forward order
Hypolepis muelleria	1000	2	20	tube	forward order
Calochlaena dubia	1000	2	20	tube	forward order
Subtotal			100		

Availability Key
Not listed: not listed on indicative list sent to nurseries
Forward order: able to be propagated but not available
TN: Toolijooa Nursery
HS: Harvest Seeds

Warriewood Valley – Indicative Plant Summary List

Warriewood Valley Landscape M/Plan (50m public)	Warriewood Valley Landscape M/Plan (25m private)	Warriewood Valley DCP Lower Creekline	Warriewood Valley DCP Upper Creekline	TSCA Swamp Sclerophyll Forest
TREES				
		Acacia decurrens	*Acacia decurrens*	
Angophora costata	*Angophora costata*		*Angophora costata*	
Angophora floribunda	*Angophora floribunda*	*Angophora floribunda*	*Angophora floribunda*	
	Banksia integrifolia			
Callitris rhomboidea		*Callitris rhomboidea*	*Callitris rhomboidea*	
Casuarina glauca	*Casuarina glauca*	*Casuarina glauca*	*Casuarina glauca*	*Casuarina glauca*
Ceratopetalum apetalum	*Ceratopetalum apetalum*	*Ceratopetalum apetalum*	*Ceratopetalum apetalum*	
Eucalyptus botryoides	*Eucalyptus botryoides*	*Eucalyptus botryoides*	*Eucalyptus botryoides*	*Eucalyptus botryoides*
	Eucalyptus punctata			
Eucalyptus robusta	*Eucalyptus robusta*	*Eucalyptus robusta*	*Eucalyptus robusta*	*Eucalyptus robusta*
	Ficus rubiginosa	*Ficus rubiginosa*	*Ficus rubiginosa*	
	Glochidion ferdinandi	*Glochidion ferdinandi*	*Glochidion ferdinandi*	*Glochidion ferdinandi*
Livistona australis	*Livistona australis*	*Livistona australis*	*Livistona australis*	*Livistona australis*
				Melaleuca biconvexa
				Melaleuca quinquenervia
				Melaleuca sieberi
				Melaleuca styphelioides
	Schizomeria ovata			
Syncarpia glomulifera	*Syncarpia glomulifera*	*Syncarpia glomulifera*	*Syncarpia glomulifera*	
		Syzygium paniculatum	*Syzygium paniculatum*	
Tristaniopsis laurina	*Tristaniopsis laurina*	*Tristaniopsis laurina*	*Tristaniopsis laurina*	

Warriewood Valley Landscape M/Plan (50m public)	Warriewood Valley Landscape M/Plan (25m private)	Warriewood Valley DCP Lower Creekline	Warriewood Valley DCP Upper Creekline	TSCA Swamp Sclerophyll Forest
SHRUBS / SMALL TREES				
Acacia elongata		*Acacia elongata*	*Acacia elongata*	
Acacia implexa		*Acacia implexa*	*Acacia implexa*	
				Acacia irrorata
Acacia longifolia		*Acacia longifolia*	*Acacia longifolia*	*Acacia longifolia*
Acacia suaevolens	*Acacia suaevolens*	*Acacia suaevolens*	*Acacia suaevolens*	
Acmena smithii	*Acmena smithii*	*Acmena smithii*	*Acmena smithii*	*Acmena smithii*
Backhousia myrtifolia		*Backhousia myrtifolia*	*Backhousia myrtifolia*	
Banksia spinulosa	*Banksia spinulosa*			*Banksia spinulosa*
Bauera rubioides	*Bauera rubioides*	*Bauera rubioides*	*Bauera rubioides*	
				Breynia oblongifolia
	Callicoma serratifolia	*Callicoma serratifolia*	*Callicoma serratifolia*	
Callistemon citrinus		*Callistemon citrinus*	*Callistemon citrinus*	
Callistemon linearis		*Callistemon linearis*	*Callistemon linearis*	
				Callistemon salignus
Ceratopetalum gummiferum	*Ceratopetalum gummiferum*	*Ceratopetalum gummiferum*	*Ceratopetalum gummiferum*	
	Cyathea australis	*Cyathea australis*	*Cyathea australis*	
				Dodonea triquetra
	Ficus coronata	*Ficus coronata*	*Ficus coronata*	*Ficus coronata*
Goodenia paniculata		*Goodenia paniculata*	*Goodenia paniculata*	
	Grevillea sericea			
Kunzea ambigua			*Kunzea ambigua*	
Leptospermum juniperinum		*Leptospermum juniperinum*	*Leptospermum juniperinum*	
	Macrozamia communis			
Melaleuca ericifolia	*Melaleuca ericifolia*	*Melaleuca ericifolia*	*Melaleuca ericifolia*	*Melaleuca ericifolia*
	Melaleuca linariifolia	*Melaleuca linariifolia*	*Melaleuca linariifolia*	*Melaleuca linariifolia*
Pittosporum revolutum		*Pittosporum revolutum*	*Pittosporum revolutum*	
Pultenea villosa			*Pultenea villosa*	

Warriewood Valley Landscape M/Plan (50m public)	Warriewood Valley Landscape M/Plan (25m private)	Warriewood Valley DCP Lower Creekline	Warriewood Valley DCP Upper Creekline	TSCA Swamp Sclerophyll Forest
AQUATIC PLANTS				
Alisma plantago-aquatica		*Alisma plantago-aquatica*		
Baumea articulata		*Baumea articulata*		
Baumea juncea		*Baumea juncea*		*Baumea juncea*
Baumea rubiginosa		*Baumea rubiginosa*		
Bolboschoenus caldwellii		*Bolboschoenus caldwellii*		
Bolboschoenus fluviatilis		*Bolboschoenus fluviatilis*		
Eleocharis sphacelata		*Eleocharis sphacelata*		
Philydrum lanuginosum		*Philydrum lanuginosum*		
Phragmites australis		*Phragmites australis*		*Phragmites australis*
Schoenoplectus validus		*Schoenoplectus validus*		
Triglochin procera		*Triglochin procera*		*Triglochin procera*
				Typha orientalis
				Villarsia exaltata
LITTORAL PLANTS				
		Alternanthera denticulata	*Alternanthera denticulata*	
Carex appressa		*Carex appressa*	*Carex appressa*	
Cyperus brevifolius		*Cyperus brevifolius*	*Cyperus brevifolius*	
Isachne globosa		*Isachne globosa*	*Isachne globosa*	*Isachne globosa*
Juncus kraussii		*Juncus kraussii*	*Juncus kraussii*	
Juncus usitatus		*Juncus usitatus*	*Juncus usitatus*	
Philydrum lanuginosum		*Philydrum lanuginosum*	*Philydrum lanuginosum*	
EPHEMERAL				
Carex appressa		*Carex appressa*	*Carex appressa*	*Carex appressa*
Dianella caerulea		*Dianella caerulea*	*Dianella caerulea*	
				Gahnia clarkei
Gahnia sieberana	*Gahnia sieberana*	*Gahnia sieberana*	*Gahnia sieberana*	*Gahnia sieberana*
Isolepis nodosa		*Isolepis nodosa*	*Isolepis nodosa*	
Juncus usitatus	*Juncus spp.*	*Juncus usitatus*	*Juncus usitatus*	
Lomandra longifolia	*Lomandra longifolia*	*Lomandra longifolia*	*Lomandra longifolia*	

Warriewood Valley Landscape M/Plan (50m public)	Warriewood Valley Landscape M/Plan (25m private)	Warriewood Valley DCP Lower Creekline	Warriewood Valley DCP Upper Creekline	TSCA Swamp Sclerophyll Forest
GRASSES & GROUNDCOVERS				
				Blechnum camfieldii
				Blechnum indicum
				Calochlaena dubia
	Cissus hypoglauca			
		Dichondra repens	*Dichondra repens*	
				Entolasia marginata
				Entolasia stricta
		Gleichenia dicarpa	*Gleichenia dicarpa*	
		Glycine clandinestina	*Glycine clandinestina*	
		Hardenbergia violacea	*Hardenbergia violacea*	
				Hypolepis muelleri
		Isolepis nodosa	*Isolepis nodosa*	
		Kennedia rubicunda	*Kennedia rubicunda*	
		Pandorea pandorana	*Pandorea pandorana*	
		Pteridium esculentum	*Pteridium esculentum*	*Pteridium esculentum*
	Themeda australis			*Themeda australis*
	Xanthorrhoea spp.			
				Viola hederacea

APPENDIX C. WEED CONTROL SCHEDULE

Trees / Shrubs	Control Methods
Salix babylonica Weeping willow	• Mechanical removal best, ensuring all root system is removed; • Cut stump with Triclopyr + picloram (1L in 60L diesel), need to treat all stems; • Stem injection with Glyphosate 360g/L (undiluted) 1-2mL per cut.
Cinnamomum camphora Camphor laurel	• Cut stump application with Triclopyr + picloram (1L in 60L diesel) or Triclopyr 600g/L (1L in 60L diesel); • Stem injection with Glyphosate 360g/L undiluted on basal diameters 25-60cm, and 1:1 if less than 25cm
Erythrina spp. Coral trees	• Stem injection with Glyphosate 360g/L undiluted on basal diameters 25-60cm, and 1:1 if less than 25cm
Lantana camara Lantana	***W2 weed that must be fully and continuously suppressed and destroyed*** • Slashing, burning, and manual removal; • Cut stump application with Triclopyr + picloram (1L in 60L diesel) or Triclopyr 600g/L (1L in 60L diesel); • Foliage spray with Glyphosate 360g/L (1L in 100L of water), Glyphosate + metsulfuron (l measured pack in 100L of water), Metsulfuron methyl (10g in 100L).
Ligustrum sinense & Ligustrum lucidum Privet	***W2 weed that must be fully and continuously suppressed and destroyed*** • Manually remove small plants and seedlings; • Cut stump application with Triclopyr + picloram (1L in 30L of diesel), Triclopyr (1L in 12L of diesel); • Stem injection with Glyphosate (undiluted 1-2mL per cut); • Foliage spray with Metsulfuron methyl (10g in 100L of water) or Glyphosate + metsulfuron (l measured pack in 100L of water)
Rubus fruticosus Blackberry	***W2 weed that must be fully and continuously suppressed and destroyed*** • Foliage spray with Metsulfuron methyl (10g in 100L of water), Glyphosate + metsulfuron (l measured pack in 100L of water), Triclopyr + picloram (350mL or 500mL in 100L of water), Triclopyr (170mL in 100L of water) or Glyphosate 360g/L 1 to 1.3L in 100L of water)
Cestrum parqui Green cestrum	***W2 weed that must be fully and continuously suppressed and destroyed*** • Scrape stem application with Glyphosate 360g/L (undiluted); • Foliage spray to active growth with Triclopyr + picloram (500mL in 100L of water), Picloram + 2,4-D (650mL in 100L of water), Amitrole + ammonium thiocyanate (1.1L in 100L of water), and Triclopyr (170 in 100L of water)

APPENDIX C. WEED CONTROL SCHEDULE

Shrubs	Control Methods
Ricinus communis Castor oil plant	*W2 weed that must be fully and continuously suppressed and destroyed* • Physical removal of mature plants; • Cut stump application with Triclopyr (1L in 60L of diesel); • Foliage spray at young seedling stage with 2,4-D Amine 500g/L (4.2L per hectare).
Senna pendula Senna	• Young seedlings can be manually removed. Seed pods should be collected and removed from site; • Chemical stem injection / cut stump with Glyphosate 360g/L (1to 1.5 parts water)
Ground Stratum	
Cortaderia jubata Pampas grass	*W2 weed that must be fully and continuously suppressed and destroyed* • Mechanical removal where possible; • Foliar application when actively growing with Glyphosate 360g/L (1 or 1.3 in 100L of water)
Arundo donax Giant reed	*W4a weed that must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property* • Physical removal of small infestations is possible; • Cut stump application with Glyphosate 360g/L (undiluted); • Foliage spray with Glyphosate 360g/L (300mL in 15L of water).
Phyllostachyos spp. Rhizomatous bamboo	*W4a weed that must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property* • Physical removal will give best results; • There are no herbicides registered for this plant.
Vines	
Acetosa sagittata Turkey rhubarb	*W4a weed that must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property* • Grub out single plants, prevent plants from seeding; • Stem scrape with Glyphosate 360g/L (undiluted); • Foliage spray with Glyphosate (1L in 100L of water).
Anredra cordifolia Madeira vine	*W4b weed that must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering and fruiting* • Small seedlings and tubers can be manually removed, bagged and composted; • Spot spray for seedling control with Glyphosate 360g/L (1.0L in 75L of water / add a surfactant); • Foliage spray with Fluroxypyr (500mL in 100L of water); • Stem scrape application with Glyphosate 360g/L (undiluted).

APPENDIX C. WEED CONTROL SCHEDULE

Vines	Control Methods
Araujia sericifera Moth vine	***W4a weed that must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property*** • Physical removal of young plants; • Bag and remove fruit; • Spot spray for seedling control with Glyphosate 360g/L (1.0L in 50L of water); • Stem scrape application with Glyphosate 360g/L (400mL in 600mL of water)
Ipomea spp. Morning glory	***W4a weed that must not be sold, propagated or knowingly distributed and be prevented from growing within 3 metres of the boundary of a property*** • Small seedlings can be manually removed; • Vines and runners can be collected and disposed of; • Spot spray for seedling control with Glyphosate 360g/L (1.0L in 50L of water); • Stem scrape application with Glyphosate 360g/L (400mL in 600mL of water).
Asparagus densiflorus Asparagus fern	***W4a weed that must not be sold, propagated or knowingly distributed and must be prevented from spreading to an adjoining property*** • Mechanically or manually remove rhizomes where practical; • Spot spray with Glyphosate 360g/L (300mL in 15L of water /add surfactant), repeat treatments required; • Cut-stump or stem-scrape application with Glyphosate 360g/L (400mL in 600mL of water); • Spot spray with Metsulfuron methyl (1-2g in 10L of water), best results between flowering and berries forming.
Aquatics	
Senegal Tea Plant (*Gymnocoronis spilanthoides*)	***W1 weed that must not be notified to the local control authority and must be fully and continuously suppressed and destroyed.*** Council have requested the following guidelines for controlling this species: • The area containing Senegal tea plant is to be pegged off to avoid accidental spread; • The area containing Senegal tea plant is to be excavated and moved off site and buried at a suitable location, or used as backfill providing it is deep buried (up to *4metres* below surface); • Regrowth can be treated by foliage spray of Metsulfuron methyl (10g in 100L water) but only when located within terrestrial environments. An off-label permit will be required from the Dept. of Agriculture for use of this herbicide over or near water; • New and very small infestations can be cleared by hand and deep buried.

APPENDIX D. PILE BURN GUIDELINES

N.S.W. RURAL FIRE SERVICE
BAULKHAM HILLS DISTRICT

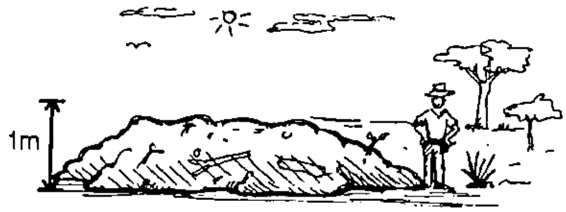
Cnr Angus and Annangrove Rds Kenthurst Ph: 9654 1244 Fax: 9654 2268
P.O. Box 75 Castle Hill NSW 2154 Email: fire@bhsc.nsw.gov.au

PILE BURN CONSTRUCTION GUIDELINES

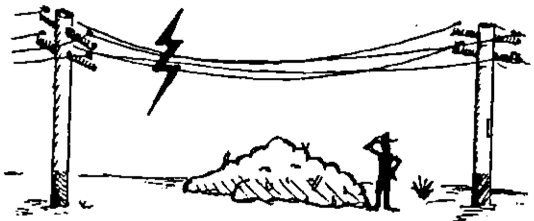
WRONG

WRONG: Pile burns are not bon-fires, they don't need to be high. This pile will be too hot. Pile Burns must be constructed from natural vegetation only, not household or building rubbish.

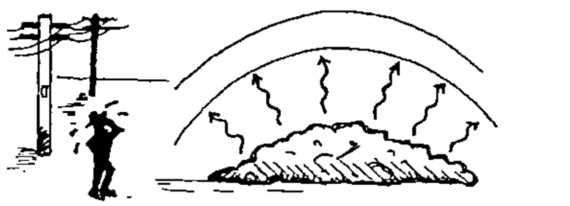
RIGHT



Make the pile wide and long rather than high. This will spread the heat & give better native plant regeneration results.

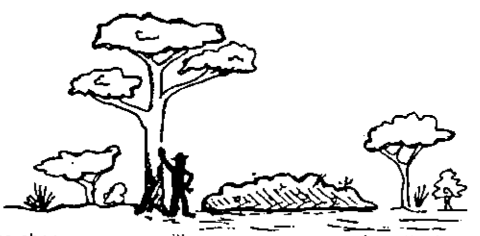


WRONG: Never construct piles under or near power lines. Smoke and ash can cause power lines to arc, and the heat will damage the lines.

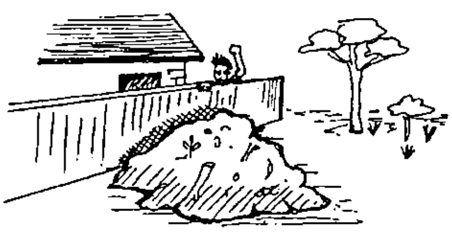


Give power lines a wide berth. Consider the radiant heat and smoke the burn will generate.

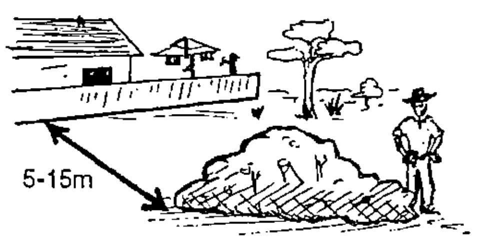
WRONG: Don't pile vegetation around the base of trees or directly under low canopy. Don't plant new trees near piles that are planned for burning.



Try to choose a space with open canopy away from the base of trees. Wait until the piles have been burnt or removed before planting



WRONG: Avoid piling vegetation close to neighbouring residents.



Stay away from fences & property boundaries. Consider local residents and their needs. Maintain a clear area between piles and any other combustible material.

N.S.W. RURAL FIRE SERVICE
BAULKHAM HILLS DISTRICT

Cnr Angus and Annangrove Rds Kenthurst Ph: 9654 1244 Fax: 9654 2268
P.O. Box 75 Castle Hill NSW 2154 Email: fire@bhsc.nsw.gov.au

PILE BURN CONSTRUCTION GUIDELINES

The following are some guidelines to assist in the construction of vegetation piles for burning. These guidelines are set to provide a procedure for construction of vegetation piles in order to allow safe and efficient burning.

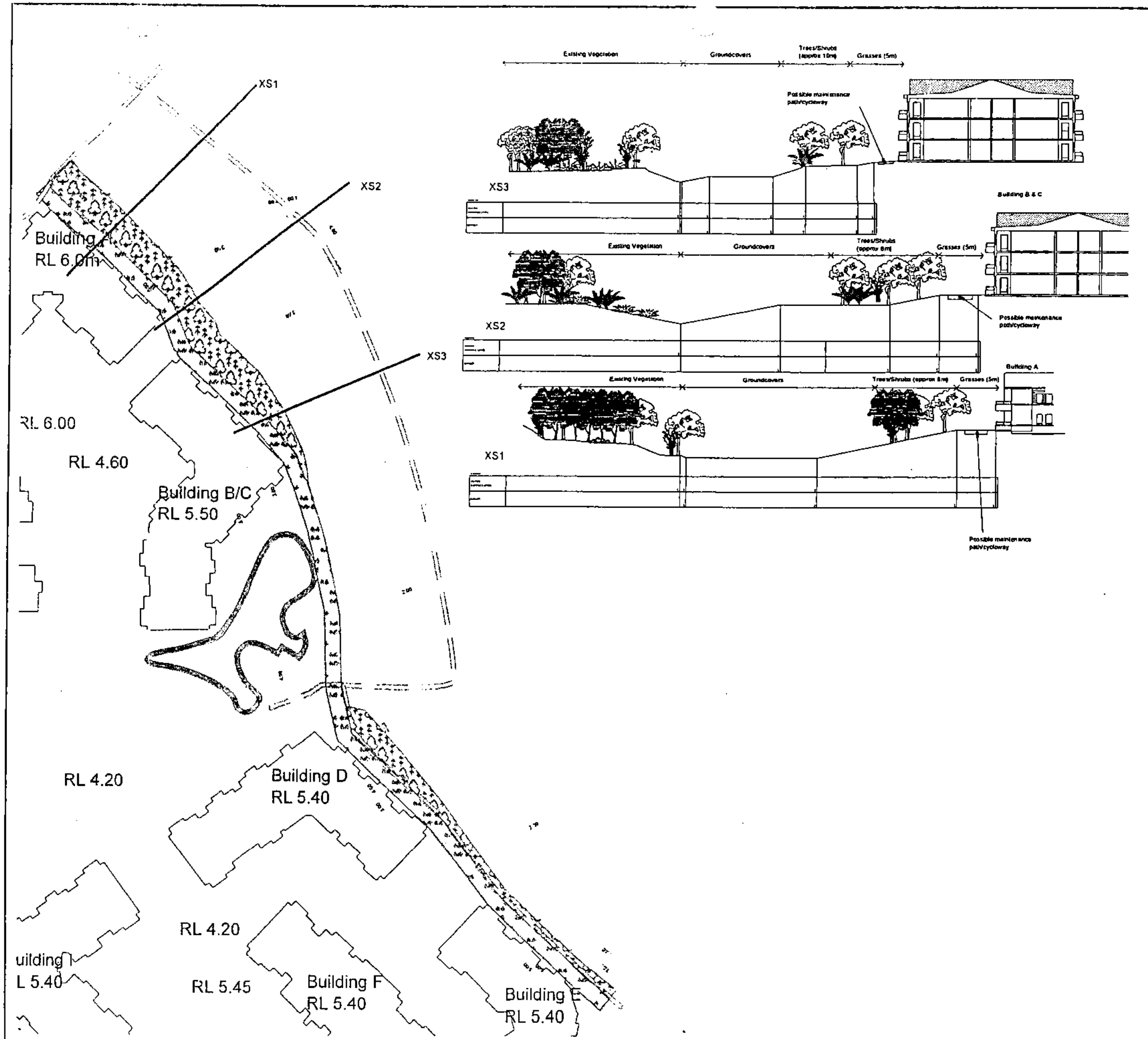
- Material that is to be burnt must only be natural vegetation, not household or building materials such as plastics, wooden pallets or cardboard boxes.
- All vegetation to be burnt should be 4.5 metres clear of any log, stump or other flammable material.
- Construct long and wide piles rather than excessively high piles. A good rule of thumb is to not exceed 1.5 metres high.
- Locate the piles away from overhanging branches that may ignite.
- Locate the piles away from any overhead power lines or telephone cables.
- Locate the piles away from tennis courts, houses, outdoor furniture, and fences - especially the brushwood variety.
- If practical, place vegetation in an area where it will receive direct sunlight to allow the pile to dry out.
- Try not to construct lots of small piles as these are time consuming to burn.

If you are planning to burn the piles yourself you will need to contact Baulkham Hills District Emergency Management Centre on 9654 1244, in regards to burning regulations.

For further information on pile burns or hazard reductions you can pick up a number of brochures at the Emergency Management Centre.

Appendix K

Concept Creek Line Landscape Plan



FIGURE

LEGEND

Types of Revegetation

Cycleway

Ground covers (with 1 tree per 70m2)

Grassed

Trees and shrubs

North

CLIENT	ARV		
PROJECT	Warriewood Water Management Report		
TITLE	Concept Landscape Plan for Interim Creek Rehabilitation		
GHD		DRAWN HR	REVISION DRAFT
		CHECKED	SCALE NOT TO SCALE
DWG REF 21/13577/MI-001		DATE 06/12/2006	SIZE A3

Appendix L

Modelling and detailed results using MUSIC

WARRIEWOOD RETIREMENT VILLAGE
DAILY TOILET FLUSHING WATER USAGES

19/05/2006
5005

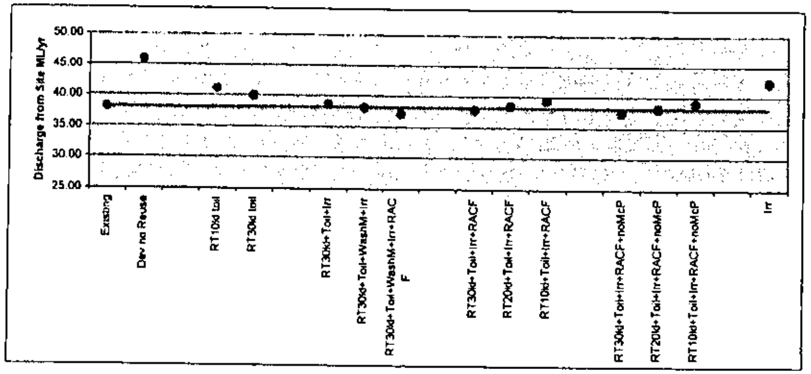
Building	A	B & C	D	E	F	G	H	I	J
Total No. of units	22	42	36	30	30	33	30	24	12
1-bed units	2	4	1	0	0	2	0	4	1
No. of person in all 1-bed units	2	4	1	0	0	2	0	4	1
2-bed units	8	13	7	8	10	13	10	4	2
No. of persons in all 2-bed units	16	26	14	16	20	26	20	8	4
3-bed units	12	25	28	22	20	18	20	16	9
No. of persons in all 3-bed units	24	50	56	44	40	36	40	32	18
Total No. of persons in all units	42	80	71	60	60	64	60	44	23
No. of toilet flushing per person per day	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush	4 half flush & 3 full flush
Quantity of water each half flush	3 litres	3 litres	3 litres	3 litres	3 litres	3 litres	3 litres	3 litres	3 litres
Quantity of water each full flush	6 litres	6 litres	6 litres	6 litres	6 litres	6 litres	6 litres	6 litres	6 litres
Flushing water used per person per day	30 litres	30 litres	30 litres	30 litres	30 litres	30 litres	30 litres	30 litres	30 litres
Total quantity of flushing water used in each building daily	1260 litres	2400 litres	2130 litres	1800 litres	1800 litres	1920 litres	1800 litres	1320 litres	690 litres

Total Daily Toilet Flushing Water usage	**15,120 litres**

Note:-
Average number of residents in each 1-bed unit assumed to be (1)
Average number of residents in each 2-bed unit assumed to be (2)
Average number of residents in each 3-bed unit assumed to be (2)

ARV: Water Balance Simulations

Option	Raintank kl	StormTank kl	Comments	Internal Reuse	Irrigation	Discharge from site ML/yr	Delta ML/yr	File
Existing				Existing		37.87		c:\Projects\Music\ARV\ARV 20 06 06 dev toil RACF 30klRT withIRR.xls
Dev no Reuse				Developed no reuse		45.76	7.89	c:\Projects\Music\ARV\ARV 20 06 06 dev toil 10klRT noIRR.xls
RT10kl toil	10			GDK Toilet only (excl RACF)	none	41.02	3.16	c:\Projects\Music\ARV\ARV 20 06.06 dev toil 10klRT noIRR.xls
RT30kl toil	30			GDK Toilet only (excl RACF)	none	39.76	1.89	c:\Projects\Music\ARV\ARV 20 06.06 dev toil 30klRT noIRR.xls
RT30kl+Toil+Irr	30	30		GDK Toilet only (excl RACF)	Taylor Brammer (seas dist)	38.50	0.63	c:\Projects\Music\ARV\ARV 20.06.06 dev toil 30klRT withIRR.xls
RT30kl+Toil+WashM+Irr	30	30		GDK Toilet (excl RACF) + WashM	Taylor Brammer (seas dist)	37.87	0.00	c:\Projects\Music\ARV\ARV 20 06.06 dev toil washm 30klRT withIRR.xls
RT30kl+Toil+WashM+Irr+RACF	30	30		GDK Toilet + WashM	Taylor Brammer (seas dist)	36.92	-0.95	c:\Projects\Music\ARV\ARV 20.06.06 dev toil washm RACF 30klRT withIRR.xls
RT30kl+Toil+Irr+RACF	30	30		GDK Toilet	Taylor Brammer (seas dist)	37.55	-0.32	c:\Projects\Music\ARV\ARV 20.06.06 dev toil RACF 30klRT withIRR.xls
RT20kl+Toil+Irr+RACF	20	30		GDK Toilet	Taylor Brammer (seas dist)	38.18	0.32	c:\Projects\Music\ARV\ARV 20.06 06 dev toil RACF 20klRT withIRR.xls
RT10kl+Toil+Irr+RACF	10	30		GDK Toilet	Taylor Brammer (seas dist)	39.13	1.26	c:\Projects\Music\ARV\ARV 20 06.06 dev toil RACF 10klRT withIRR.xls
RT30kl+Toil+Irr+RACF+noMcP	30	30	no McPherson Inflow (0.32)	GDK Toilet	Taylor Brammer (seas dist)	37.24	-0.63	c:\Projects\Music\ARV\ARV 20.06 06 dev toil RACF 30klRT withIRR noMcP.xls
RT20kl+Toil+Irr+RACF+noMcP	20	30	no McPherson Inflow (0.32)	GDK Toilet	Taylor Brammer (seas dist)	37.87	0.00	c:\Projects\Music\ARV\ARV 20.06 06 dev toil RACF 20klRT withIRR noMcP.xls
RT10kl+Toil+Irr+RACF+noMcP	10	30	no McPherson Inflow (0.32)	GDK Toilet	Taylor Brammer (seas dist)	38.82	0.95	c:\Projects\Music\ARV\ARV 20 06 06 dev toil RACF 10klRT withIRR noMcP.xls
Irr	na	50		na	Taylor Brammer (seas dist)	42.29	4.42	c:\Projects\Music\ARV\ARV 20 06 06 dev withIRR.xls

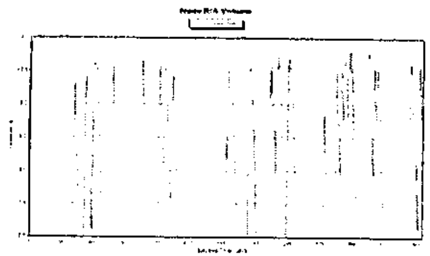


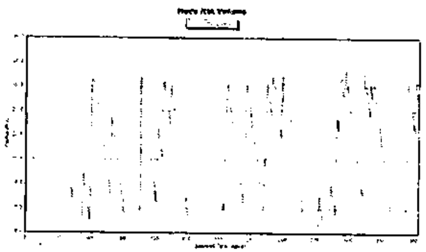
Averge Year = 1987

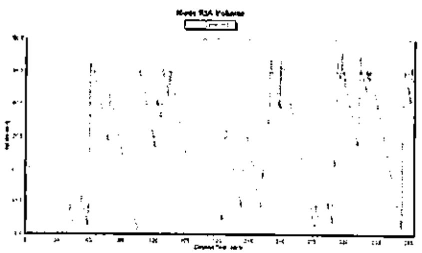
10kL Tank

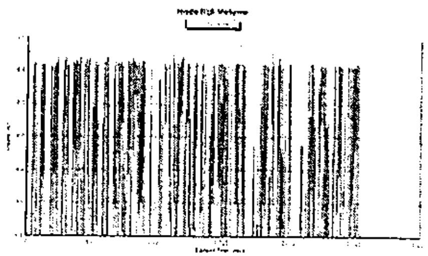
30kL Tank

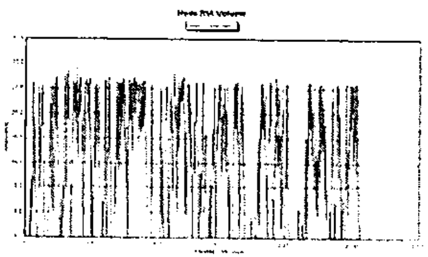
50kL Tank

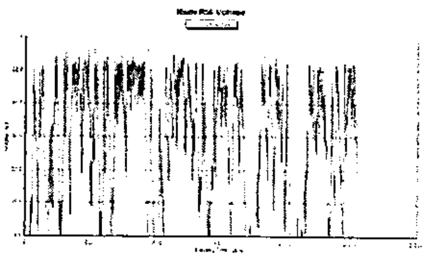












GHD

Client : event Project Management
Title : Warriewood ARV
Job No : 21/13577/10

www.ghd.com.au
ndeeks@ghd.com.au
Tel. +61 2 9239 7262 Fax. +61 2 9239 7197
10 Bond St, Sydney

MUSIC RESULTS
ARV20.06.06 dev toil RACF 30+kIRT noIRR no McP - Receiving Node - Flow-Based Sub-Sample Statistics

Existing:

Existing - Receiving Node - Flow-Based Sub-Sample Statistics

Inflow	mean	standard deviation	median	maximum	minimum	10 percentile	90 percentile
Flow (cubic metres/sec)	0.002	0.007	0.000	0.120	0.000	0.000	0.003
TSS Concentration (mg/L)	16.100	18.000	4.300	55.300	4.300	4.300	49.100
Log [TSS] (mg/L)	0.947	0.451	0.633	1.740	0.633	0.633	1.690
TP Concentration (mg/L)	0.113	0.033	0.092	0.206	0.092	0.092	0.175
Log [TP] (mg/L)	-0.963	0.111	-1.030	-0.686	-1.030	-1.030	-0.757
TN Concentration (mg/L)	1.650	0.314	1.850	1.920	1.040	1.120	1.850
Log [TN] (mg/L)	0.209	0.094	0.268	0.284	0.016	0.048	0.268
TSS Load (kg/Day)	6.910	33.700	0.139	567.000	0.000	0.003	13.800
TP Load (kg/Day)	0.027	0.125	0.002	2.120	0.000	0.000	0.050
TN Load (kg/Day)	0.239	1.110	0.041	19.100	0.000	0.001	0.358
Gross Pollutant Load (kg/Day)	2.230	4.330	0.000	28.200	0.000	0.000	9.690

Developed:

ARV20.06.06 dev toil RACF 30+kIRT noIRR no McP - Receiving Node - Flow-Based Sub-Sample Statistics

Inflow	mean	standard deviation	median	maximum	minimum	10 percentile	90 percentile
Flow (cubic metres/sec)	0.003	9.42E-03	5.80E-04	0.125	4.31E-06	6.67E-05	7.61E-03
TSS Concentration (mg/L)	6.020	0.145	6.01	10.2	6.01	6.01	6.03
Log [TSS] (mg/L)	0.780	7.98E-03	0.779	1.01	0.779	0.779	0.78
TP Concentration (mg/L)	0.090	4.64E-04	9.03E-02	0.102	9.01E-02	9.01E-02	9.05E-02
Log [TP] (mg/L)	-1.040	2.13E-03	-1.04	-0.991	-1.05	-1.05	-1.04
TN Concentration (mg/L)	1.300	2.49E-02	1.3	1.31	1.1	1.29	1.31
Log [TN] (mg/L)	0.113	8.78E-03	0.115	0.117	4.06E-02	0.11	0.116
TSS Load (kg/Day)	1.840	5.78	0.301	111	2.24E-03	3.47E-02	3.96
TP Load (kg/Day)	0.027	7.59E-02	4.51E-03	1.1	3.36E-05	5.21E-04	5.94E-02
TN Load (kg/Day)	0.368	0.96	6.53E-02	11.9	4.83E-04	7.53E-03	0.837
Gross Pollutant Load (kg/Day)	0.000	0	0	0	0	0	0

Appendix M

Swamp Mahogany Impact Assessment

ANNE CLEMENTS & ASSOCIATES PTY. LIMITED
(ABN 41 077 242 365, ACN 077-160-939)
Environmental and Botanical Consultants
PO Box 1623, North Sydney 2059
Phone: (02) 9955 9733, Facsimile: (02) 9957 4343
Email: mail@acabotanic.com

22 June 2006

Assessment of Impact:
6–14 Macpherson Street, Warriewood

Prepared by:
Dr AnneMarie Clements
Emma Laxton
Tony Rodd
Jane Rodd

Prepared for:
Craig Fyall
event Project Management
PO Box 6180
Frenchs Forest NSW 2086
Phone: (02) 9452 8300
Fax: (02) 9452 8388

Contents

1.0 Introduction

This document assesses the hydrological impact of the development of 6-14 Macpherson Street, Warriewood on the *Eucalyptus robusta* (Swamp Mahogany) located along Narrabeen Creek.

2.0 *Eucalyptus robusta*

Eucalyptus robusta is a dominant species of the Open-forest form of Coastal Swamp Forest Complex (map unit 27a) mapped by Benson and Howell (1994) in the south-east of the Site and extending off site adjoining Narrabeen Creek. The Coastal Swamp Forest Complex includes Reedland dominated by Phragmites australis and *Typha orientalis.*

Eucalyptus robusta is a characteristic tree species of the Endangered Ecological Community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. *Eucalytpus robusta* is the dominant tree canopy species of the identified Swamp Sclerophyll Forest in the Warriewood Wetlands. Warriewood Wetlands is located approximately 440 m south of the Site on Fern Creek, one of the three major creeks in the approximately 9 km^2 of the Warriewood Valley catchment.

In the Final Determination for the Swamp Sclerophyll Forest, it is stated in paragraph 1 that:

> *The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a). ... The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil.*

Changing the soil moisture content and frequency of inundation is likely to change the composition of the Swamp Sclerophyll Forest adjoining Narrabeen Creek.

As a swamp, coastal lagoon and river species, *Eucalyptus robusta* is subject to periodic flooding (King and Skolmen 1990). At Myall Lakes, *E. robusta* stands were found to be inundated by freshwater to a depth of 0.45 m during times of high lake height, generally over wet winters (Clements unpublished data).

Clemens and Pearson (1977) found that within 80 days of waterlogging plants of *Eucalyptus robusta* developed:

- symptoms of leaf chlorosis (abnormal yellow colour of a plant);
- epinasty, which is increased growth on the upper surface of a leaf causing it to bend downwards;
- premature abscission, that is shedding from the plant, usually leaf drop;
- reduction of stem elongation (shorter internodes);
- stem hypertrophy, which is excessive growth of the stem due to an increase in cell size;

- formation of aerenchyma. Aerenchyma is an air-filled tissue found mainly in roots of plants, which allows exchange of gases between the shoot and the root. It contains large air-filled cavities, which provide a low-resistance internal pathway for the exchange of gases such as oxygen and ethylene between the plant parts above the water and the submerged tissues; and
- adventitious roots, which are roots arising from the shoot system.

Dunn *et al.* (1994) found that the species exhibits a moderate salt tolerance. Salt and waterlogging has been found to significantly reduce seedling growth (Marcar 1993). Plant and leaf morphology is affected by salt (Sun and Dickinson 1993).

The pattern of occurrence of *Eucalyptus robusta* is clearly illustrated in Warriewood Wetland with *Eucalyptus robusta* not occurring in the frequently waterlogged areas. In the more waterlogged areas there are reed beds with sections of open water.

Eucalyptus robusta provides food for the Grey-headed Flying Fox (*Pteropus poliocephalus*), Koalas (*Phascolarctos cinereus*) and insects (Benson and McDougall 1998), and habitat for squirrel gliders (*Petaurus norfolcensis*) (Smith and Murray 2003) and occasionally the Regent Honeyeater (*Xanthomyza phrygia*).

By assessing impacts of the proposal on the key species *Eucalyptus robusta* of endangered ecological community Swamp Sclerophyll Forest, the effects on the community can be assessed.

2.1 *Eucalyptus robusta* on and to the north of the Site

From assessing the vegetation on the Site, *Eucalyptus robusta*, the fern species *Hypolepis muelleri* and the reed *Phragmites australis* characteristic of the endangered ecological community were recorded on the flood plain adjoining Narrabeen Creek and adjoining cut channel in the north of the Site (Table 1, Figure 1).

Tree and Landscape Consultants (2005) prepared an Arboricultural Assessment Report for the Site. A total of 125 trees were identified, their height and diameter at breast height recorded, and each assessed in terms of Safe Useful Life Expectancy (SULE), condition, age class and vigour.

Of the total 125 trees identified on the Site (Tree and Landscape Consultants 2005), 47 were identified as *Eucalyptus robusta* (Figure 2).

Of the 47 *E. robusta* on the Site, there were:
- two in the south-east (trees 7 and 11);
- eight in the south-west (trees 45-48, 50, 52-54);
- 21 in the central north (trees 65-69, 77-86, 88-94); and
- 16 in the north of the Site (trees 57, 59-64, 66, 70, 72-76, 97-98).

3.0 The proposal

A retirement village is proposed on the Site. Narrabeen Creek bounds the Site to the north. A riparian corridor of approximately 25 m width adjoining the southern bank of Narrabeen Creek and is proposed as part of the development.

Part of development in the Warriewood Valley requires rehabilitation of Narrabeen Creek. The proposed ultimate creek rehabilitation adjacent to the retirement village site has the following key rehabilitation design parameters (GHD 2006, Appendix 1):

- Creek invert to be maintained at current invert levels;
- Creek profile is required to convey the 100-year ARI event within a 50m wide corridor;
- Flood levels for the 100-year ARI event are not permitted to exceed current flood levels;
- A pinch-point will be provided upstream of the swamp mahogany area, to throttle 100-year discharges; and
- Creek rehabilitation adjacent to the swamp mahogany will only occur on the southern bank. The northern bank will be the existing landform within the swamp mahogany area.

3.1 *Eucalyptus robusta* to be retained on and to the north of the Site

The *Eucalyptus robusta* identified on and to the north of the Site are located in the following areas on the proposed landscape masterplan (Figure 3):

Trees	**Location in relation to the proposed development**	**Potentially retained**
Two trees 7 and 11	south-east of the Site adjoining Macpherson Street	Yes
Eight trees 45-48, 50, 52-54	south-west of the Site	Trees adjoining the boundary may be retained.
Twenty-one trees 65-69, 77-86, 88-94	central north of the site outside the proposed riparian corridor (trees) and fringing the proposed detention basin.	Yes. The detention basin has been designed so that most of the trees of *E. robusta* are retained.
Sixteen trees 57, 59-64, 66, 70, 72-76, 97-98	north of the Site within the proposed riparian corridor	Yes

The creekline and riparian habitats in the corridor are to be conserved and enhanced under a Vegetation Management Plan (PSB 2005). The planting of local native species of the endangered ecological community Swamp Sclerophyll Forest shall form part of the restoration of the creekline.

3.2 Water management

The Water Management Report for the Site by GHD (2005) is designed to mitigate the hydrological impacts of the development. Water management strategies include:

- A detention facility on the site, to throttle runoff peaks;
- A range of water quality management strategies to manage pollutants; and
- Water re-use strategies to manage runoff quantities.

3.2.1 Potential changes in inundation and duration

From the water balance assessment for the site (in isolation) for the pre- and post-development scenarios, there is a decrease in average runoff from the proposed retirement village of 8% (GHD 2006, Appendix 1).

GHD (2006, Appendix 1) undertook a daily simulation model (using measured daily average rainfall) for the entire Warriewood Valley with the retirement village site occupying only 3% of the Warriewood catchment, The modeling results represent daily average inundation and hence does not fully represent peak events. It was found at the following cross-sectional locations (Figures 1A and 1B of Appendix B of GHD 2006, Appendix 1) that:

- At cross-section 378.73, post development mean daily flood levels are expected to be reduced by the rehabilitation of Narrabeen Creek. This is likely on account of increased flow area provided by the rehabilitated creek cross-section compared with the predevelopment (existing) scenario. Mean daily flow levels of 2 m and more are expected to occur 40% of the time under existing conditions, while in the post development scenario these levels are only expected 5% of the time.
- At cross-section 378.73 a further simulation, which included a low (0.1 m) weir or riffle in the channel, was undertaken. The result shows that the inclusion of weir or riffle effectively mitigates the drop in post development mean daily water levels by raising flow levels to similar levels as per the existing scenario.
- At cross-section 298.30, which is nearer to the downstream end of the ARV site and at the end of the Narrabeen Creek rehabilitation works, pre and post-development mean daily flow levels compare favourably; and

Comparing the mean daily flow levels to the topographic levels shows depths of inundation are not expected to change significantly in the areas containing Swamp Mahogany. However, flood peaks within one day, on account of shorter duration storms, would be expected to result in short periods with increased levels of inundation.

4.0 Expected outcomes

The effects of the proposal, based on GHD (2006) modelling (Appendix 1), is to decrease the existing depths of inundation of the area containing Swamp Mahogany within the creek corridor on and to the north of the Site and shorten duration of the period of inundation. The resultant hydrological changes from the development proposal on the Site are not likely to lead to death or decline of *Eucalyptus robusta*.

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Marcar N.E. (1993)
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Arboricultural Assessment Report. 6-14 Macpherson Street Warriewood 2102. Prepared for Pittendrigh Shinkfield Bruce; dated 8 September 2005.

Figures

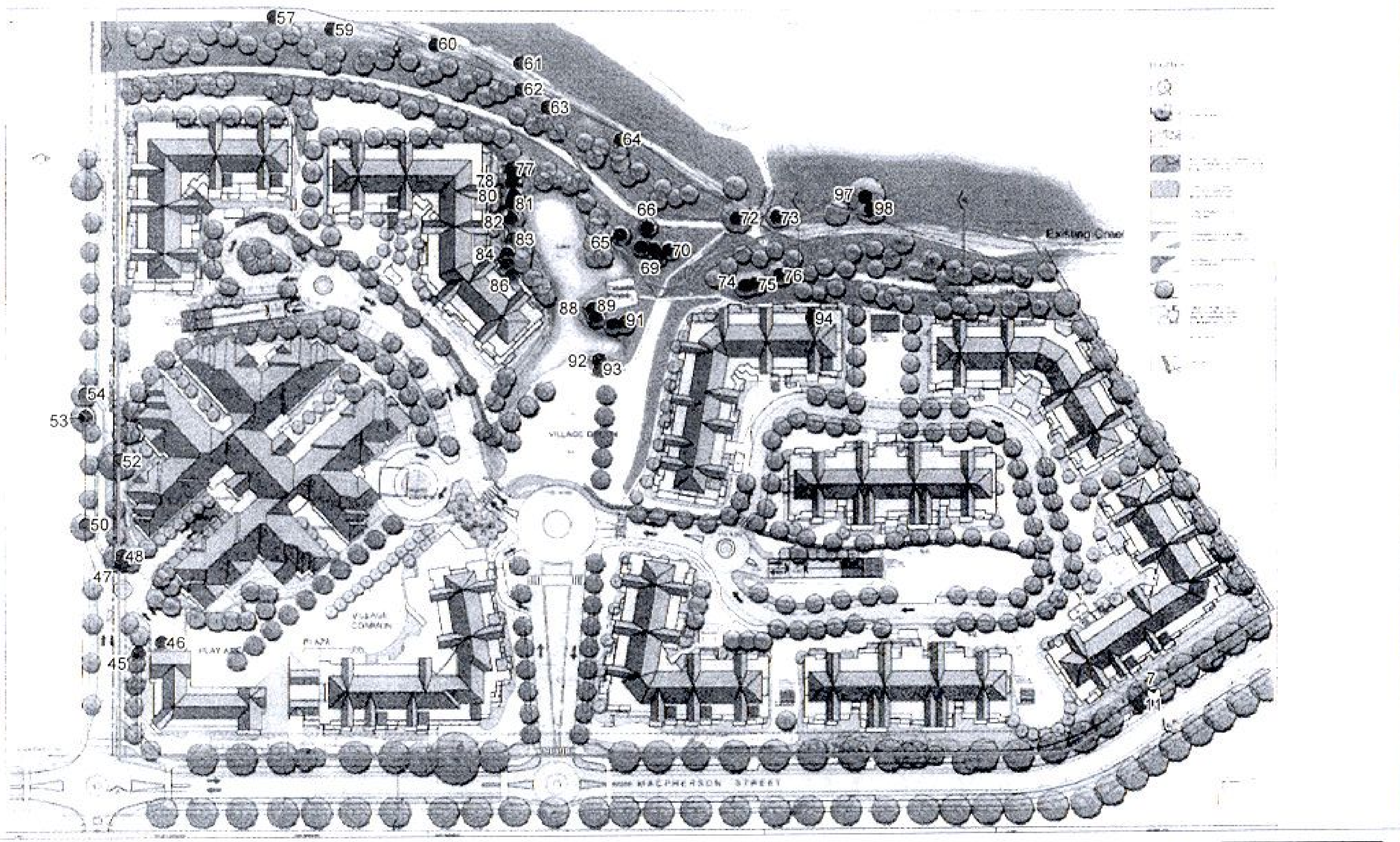
Site boundary

Quadrat location

Spot location

Figure 1
Sampling locations of the current survey

Figure 2.
Eucalyptus robusta recorded on the Site by Tree and Landscape Consultants (2005)



Site boundary

Eucalyptus robusta

Figure 3.
Locations of Eucalyptus robusta in relation to the proposed development

Table 1 — Species recorded on the Site

Notes: 1. asterisk (*) before botanical name signifies exotic species; hash (#) signifies non-local or planted native species.

2. In the quadrat, frequency is represented by the number 1, 2, 3 or 4 (number of 10 m x 10 m subquadrats in which the species is present.

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
1. Pteridophytes													
Davalliaceae													
* Nephrolepis cordifolia	Fishbone Fern			X									
Dennstaedtiaceae													
Hypolepis muelleri													4
Pteridium esculentum	Bracken			X									
2. Gymnosperms													
Cupressaceae													
* Cupressus macrocarpa	Monterey Cypress									X	X		
* Juniperus virginiana	Pencil Cedar									X	X		
* Platycladus orientalis cv. (unidentified)								X					
Pinaceae													
* Pinus patula	Mexican Pine, Spreading-leaved Pine									X			
* Pinus radiata	Monterey Pine, Radiata Pine									X	X		
3. Dicotyledons													
Apiaceae													
* Hydrocotyle bonariensis	Beach Pennywort	X											1
Apocynaceae													
* Nerium oleander	Oleander									X	X		
Araliaceae													
# Schefflera actinophylla	Queensland Umbrella Tree		X				X		X				
* Schefflera arboricola	Miniature Umbrella Tree		X										

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
Asclepiadaceae													
* Araujia sericifera	Moth Vine, Cruel Plant												1
Asteraceae													
* Ageratina adenophora	Crofton Weed					X	X						2
* Aster subulatus	Wild Aster						X						
* Bidens pilosa	Farmer's Friend, Cobblers Pegs, Beggar	X	X	X	X		X		X			X	
* Cirsium vulgare	Black Thistle, Spear Thistle						X						
* Conyza albida	Tall Fleabane	X	X	X	X	X	X	X	X			X	1
* Crassocephalum crepidioides				X									
* Hypochaeris radicata	Catsear, False Dandelion		X						X				
* Senecio madagascariensis	Fireweed, Madagascar Ragwort	X											
* Tagetes minuta	Stinking Roger			X			X						
Bignoniaceae													
Pandorea pandorana	Wonga Vine							X					
* Radermachera sinica			X										
Caprifoliaceae													
* Abelia x grandiflora	Glossy Abelia										X		
* Lonicera japonica	Japanese Honeysuckle						X				X		2
Caryophyllaceae													
* Polycarpon tetraphyllum	Four-leaf Allseed							X					
Casuarinaceae													
Casuarina glauca	Swamp Oak, Swamp She-oak		X									X	
Convolvulaceae													
* Ipomoea indica	Blue Morning Glory			X	X	X	X				X		4
Euphorbiaceae													
Omalanthus populifolius	Bleeding heart, Native Poplar							X					
Fabaceae Caesalpinioideae													
* Senna pendula var. glabrata		X		X	X								3
Fabaceae Faboideae													
* Erythrina crista-galli	Cockspur Coral Tree				X								4

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
* Wisteria sinensis	Chinese Wisteria			X	X								
Fabaceae Mimosoideae													
# Acacia saligna	Golden Wreath Wattle												
Malvaceae													
* Hibiscus (rosa-sinensis hybrid) cv. Miss Haw			X										
* Hibiscus syriacus	Hibiscus		X										
* Sida rhombifolia	Paddy's Lucerne				X		X						
Melastomataceae													
* Tibouchina sp. (unidentified)			X										
Moraceae													
* Ficus benjamina	Weeping Fig		X					X	X			X	
* Ficus elastica	Rubber Tree										X		
Ficus rubiginosa	Port Jackson Fig, Rusty Fig												
* Morus alba	Mulberry						X					X	
Myrtaceae													
Angophora floribunda	Rough-barked Apple			X									
Eucalyptus botryoides	Bangalay									X			
Eucalyptus haemastoma	Broad-leaved Scribbly Gum									X			
Eucalyptus microcarpa	Western Grey Box									X			
# Eucalyptus nicholii	Narrow-leaved Black Peppermint										X		
Eucalyptus robusta	Swamp Mahogany						X	X			X		4
Eucalyptus saligna	Sydney Blue Gum	X	X										
Eucalyptus tereticornis	Forest Red Gum									X	X		
Lophostemon confertus	Brush Box										X		
Syzygium australe	Brush Cherry		X										
Oleaceae													
* Ligustrum lucidum	Broad-leaved Privet					X						X	
* Ligustrum sinense	Small-Leaved Privet, Chinese Privet					X						X	
Onagraceae													
* Ludwigia peruviana					X	X							1
* Oenothera sp.	Evening-primrose						X						

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
Phytolaccaceae													
* Phytolacca octandra	Inkweed			X									
Pittosporaceae													
Pittosporum undulatum	Pittosporum									X			
Plantaginaceae													
* Plantago lanceolata	Plantain, Ribwort				X								
Platanaceae													
* Platanus x acerifolia	London Plane										X		
Polygonaceae													
* Acetosa sagittata	Rambling Dock, Turkey Rhubarb			X			X						
Persicaria hydropiper	Water Pepper		X	X		X							
Proteaceae													
Banksia integrifolia	Coast Banksia												
Grevillea robusta	Silky Oak		X										
Ranunculaceae													
* Ranunculus repens	Creeping Buttercup						X						
Rosaceae													
* Prunus persica	Peach				X								
* Rubus discolor	Blackberry			X									
Salicaceae													
* Populus x canadensis	Hybrid Poplar		X	X								X	
* Salix babylonica	Weeping Willow				X		X						
* Salix matsudana cv. Tortuosa	Contorted Willow											X	
Solanaceae													
* Cestrum parqui	Green Cestrum				X	X	X						1
* Solanum nigrum	Blackberry Nightshade							X					2
Urticaceae													
* Parietaria judaica	Wall Pellitory, Kirribilli Curse, Stickywee				X				X				

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
Verbenaceae													
* Citharexylum spinosum	Fiddlewood		X										
* Lantana camara	Lantana						X						2
* Verbena bonariensis	Purpletop		X				X						
4. Monocotyledons													
Alliaceae													
* Agapanthus praecox subsp. orientalis	Agapanthus			X									
Araceae													
* Monstera deliciosa	Fruit-salad Plant, Guembe;		X						X				
* Zantedeschia aethiopica	Arum Lily, Calla Lily												1
Arecaceae													
Archontophoenix cunninghamiana	Bangalow Palm, Piccabeen Palm								X		X		
* Dypsis sp. (unidentified)									X				
* Phoenix canariensis	Canary Island Date		X										
* Syagrus romanzoffiana	Cocos Palm, Queen Palm	X	X						X		X		
* Washingtonia robusta	Mexican Washingtonia, Cotton Palm										X		
Asparagaceae													
* Asparagus aethiopicus	Asparagus Fern			X	X			X			X		
* Asparagus falcatus				X									
Commelinaceae													
Commelina cyanea	Blue Spiderwort	X											1
Cyperaceae													
Carex appressa	Tall Sedge	X											1
* Cyperus eragrostis	Drain Flat-sedge, Umbrella Sedge	X			X			X					
Musaceae													
* Musa acuminata	Banana											X	
Poaceae													
* Arundo donax	Giant Reed						X						
* Bromus catharticus	Prairie Grass							X					
* Cortaderia selloana	Pampas Grass						X						

Botanical name	Common name	Sampling location											
		A	B	C	D	E	F	G	H	I	J	K	Q1
Cynodon dactylon	Couch, Bermuda Grass	X	X										
* Digitaria sanguinalis	A Summer Grass, Crab Grass							X					
* Ehrharta erecta	Panic Veldgrass						X	X					
* Paspalum dilatatum	Paspalum	X	X	X					X				
* Paspalum urvillei	Vasey Grass	X	X										
* Pennisetum clandestinum	Kikuyu								X				2
Phragmites australis	Common Reed		X	X									3
* Setaria gracilis	Slender Pigeon Grass						X						
* Sporobolus indicus	Parramatta Grass							X					
* Stenotaphrum secundatum	Buffalo Grass								X				
Zingiberaceae													
* Hedychium coronarium	White Ginger, Ginger Lily						X						
* Hedychium gardnerianum	Yellow Ginger, Ginger Lily			X									

Appendix 1.

GHD (2006) ARV Warriewood - Swamp Mahogany Impact; Briefing to Ecologist.
Memorandum dated 31 May 2006.

Pittwater Council

ABN 61 340 837 871 Telephone (02) 9970 1111 Facsimile (02) 9970 7150
Postal Address: P.O. Box 882, Mona Vale NSW 1660, DX 9018 Mona Vale

pittwaterlga.com.au e-mail: pittwater_council@pittwater.nsw.gov.au

MORGAN MOORE & ASSOC.

14 MAY 2007

MMA	
FILE	

Ross McWhirter, Project Leader - Warriewood Infrastructure
8am to 5pm Mon - Fri
Phone 9970 1207 Mobile 0419 629 007

11 May 2007

Morgan Moore and Associates Pty Ltd
Level 5
140 Arthur Street
NORTH SYDNEY NSW 2060

Attention: - Richard Abbott

Dear Sir,

Re: DA N0102/05 - Partial Construction Certificate

Reference is made to your letter dated 9 May 2007 concerning condition C3 of Consent No. N0102/05.

Council confirms that it does not require condition C3 of Consent No N0102/05 to be satisfied prior to the release of a partial Construction Certificate for "Early Works" being site clearing, remediation and bulk earthworks only. However, this condition must be satisfied prior to the release of all remaining Construction Certificates for the development.

Yours faithfully

James Payne
MANAGER - URBAN INFRASTRUCTURE

TRANSPORT AND TRAFFIC PLANNING ASSOCIATES

A division of Moayole Pty Ltd ACN 060 653 125
ABN 44 068 653 125

8 February 2007
Misc 04/07

Mr Lee Thomson
Event Project Management
PO Box 6180
FRENCHS FOREST 2086

(Facsimile 9452 8388)

Dear Lee

Construction Traffic Management Plan,
6-14 McPherson Street, Warriewood

I have reviewed the revised truck access/egress routes and confirm that this does not alter my earlier assessment of the TMP and confirm that these amendments are satisfactory.

I trust that this information is suitable to your requirements. However, should any further assistance be required, please do not hesitate to contact me.

Yours faithfully

Andrew Morse
Senior Traffic Consultant
Transport and Traffic Planning Associates

Transportation, Traffic and Design Consultants

Suite 603 Level 6 282 Victoria Avenue PO Box 1160 Chatswood NSW 2067 ph (02) 9411 5660 Fax (02) 9904 6622
Email ttpa@ttpa.com.au

ALLAMS
LANDWORKS P/L
DEMOLITION – EXCAVATION – PLANT HIRE
Office [illegible] Fax [illegible] - Mobiles [illegible]
15 [illegible] Street, Strathfield NSW [illegible] ABN [illegible]
Demolition Licence [illegible]

6/02/2007

TRAFFIC MANAGEMENT PLAN FOR 6-14 MACPHERSON ST, WARRIEWOOD

Amendment to Construction Traffic Management Plan dated 25/01/2007.

1. Route 2 Terry Hills and Camelia, exit site turn left onto MacPherson St follow to Warriewood Road then right onto Pittwater Road, this will eliminate any traffic on Mona Vale Rd as directed by Pittwater Councils conditions of consent.

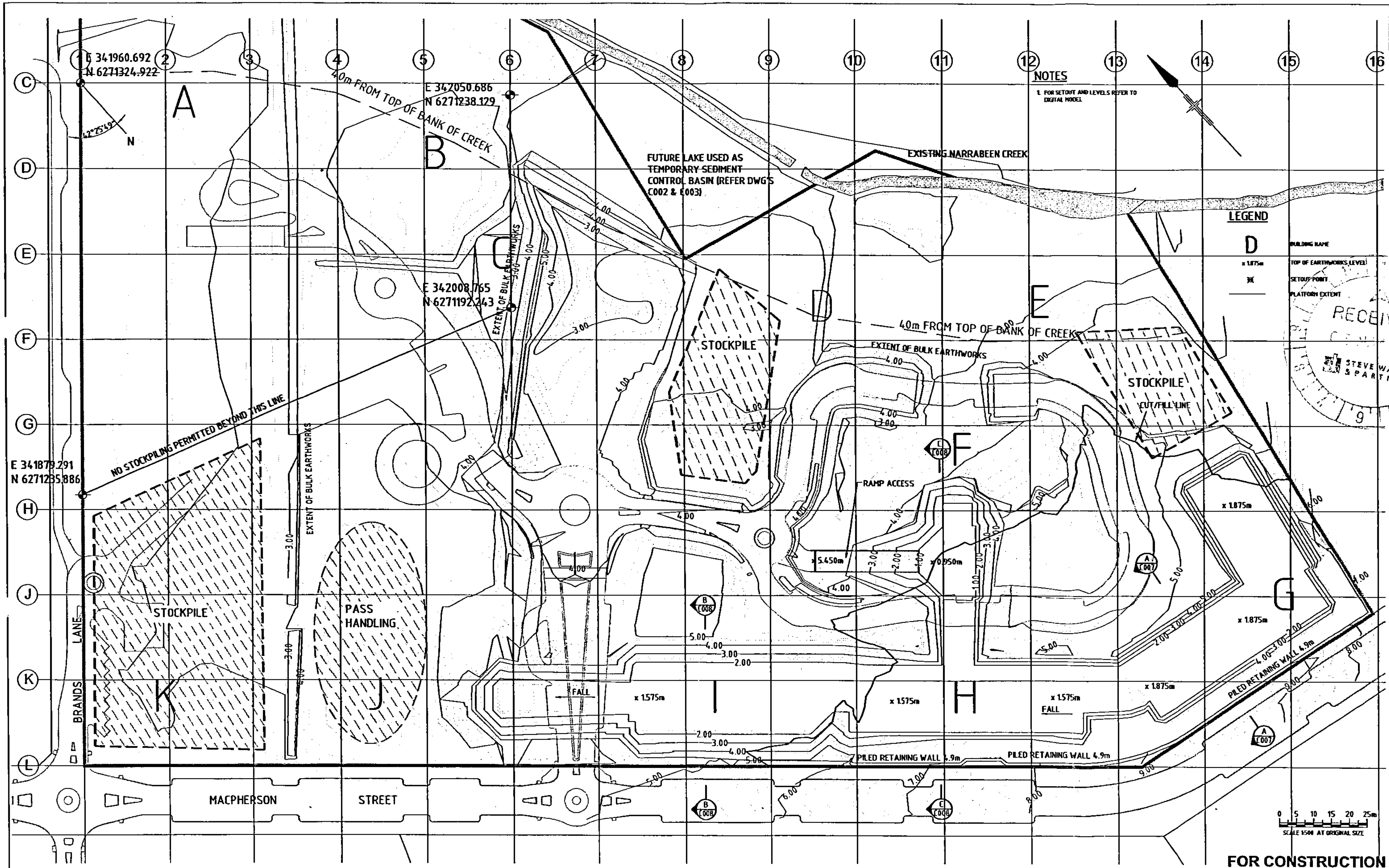
2. 2 Semi Trailers to operate between 2 and 4 trips per day, depending on need.

3. The following quantities will be removed from site;
    a. Bricks 15m2
    b. Concrete 20m2
    c. Timber 135m2
    d. Plasterboard 135m2
    e. Metals 35m2
    f. Asbestos 10m2
    g. Glass 30m2

Yours Sincerely

for [signature]

Romy Allam
Director



FOR CONSTRUCTION

No	Revision	Drawn	Checked	Approved	Date
0	FOR CONSTRUCTION	LSM			19.12.06

Note: * indicates signatures on original issue of drawing or last revision of drawing

ANGLICAN RETIREMENT VILLAGES
DIOCESE OF SYDNEY

GHD CLIENTS | PEOPLE | PERFORMANCE

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Drafting Check AP | Design Check GS
Approved
Date 19.12.06
Scale AS SHOWN

This Drawing must not be used for Construction unless signed as Approved

Client: ANGLICAN RETIREMENT VILLAGES
Project: WARRIEWOOD BROOK
Title: BULK EARTHWORKS CONTRACT PROPOSED EARTHWORKS WITH CONTOURS
Original Size: A1 Drawing No: 21-13577-C006 Rev: 0

Plot Date: 20 December 2006 - 1:53 PM Cad File No: G:\Projects\21-13577-CADD-DRAWINGS\CIVIL\21-13577-C006.dwg

NOTES

1. ALL EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH DEPARTMENT OF HOUSINGS SOIL AND CONSTRUCTION MANAGING URBAN STORMWATER MARCH 2004 (BLUE BOOK).
WORKS SHALL BE UNDERTAKEN IN THE FOLLOWING SEQUENCE:
 1 INSTALL ALL SILT FENCING.
 2 CONSTRUCT DIVERSION DRAINS.
 3 INSTALL OTHER EROSION AND SEDIMENT CONTROLS.
 4 STRIP AND STOCKPILE TOPSOIL AND CARRY OUT BULK EARTHWORKS.
 5 TOPSOIL AND REHABILITATE BULK EARTHWORK AREAS IMMEDIATELY UPON COMPLETION.
 6 UNDERTAKE REMAINING SITE WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS.
 7 REHABILITATE THE REMAINING SITE.
 8 REMOVE SOIL AND WATER MANAGEMENT WORKS ONCE UPSTREAM SURFACES ARE STABILISED TO THE SATISFACTION OF THE SUPERINTENDENT AND COUNCIL.

2. THIS ORDER MAY BE CHANGED SUBJECT TO FIELD CONDITIONS BUT ANY SUCH CHANGE MUST ACHIEVE ALL ENVIRONMENTAL AND CONSTRUCTION GOALS.

EROSION CONTROL MEASURES

3. CONTROLS AFFECTED BY WORKS ARE TO BE RE-ESTABLISHED PRIOR TO THE COMPLETION OF EACH DAYS WORK.

4. THE CONTRACTOR IS TO STABILISE TOPSOIL STOCKPILES AND ALL DISTURBED AREAS AS SOON AS THEY REACH FINAL LEVELS.

5. WHERE SURFACE SLOPES ARE STEEPER THAN 6H:1V FURTHER STABILISATION WILL NEED TO BE PROVIDED.

6. DUST CONTROL MEASURES SHALL BE IMPLEMENTED CONTINUOUSLY DURING CONSTRUCTION WORKS TO THE SATISFACTION OF THE SUPERINTENDENT AND COUNCIL.

7. TOPSOIL SHALL BE RESPREAD AND STABILISED AS SOON AS POSSIBLE. DISTURBED AREAS SHALL BE LEFT WITH A SCARIFIED SURFACE TO ENCOURAGE WATER INFILTRATION AND ASSIST KEYING IN TOPSOIL.

8. THE CONTRACTOR SHALL TEMPORARILY REHABILITATE ANY DISTURBED AREAS WITHIN 20 DAYS. WHERE FINAL SHAPING HAS OCCURRED THE CONTRACTOR SHALL PROVIDE FINAL REHABILITATION WITHIN 20 DAYS.

SEDIMENT CONTROL MEASURES

9. SEDIMENT TRAPS AND BASINS ARE TO BE MAINTAINED SUCH THAT:
(A) SEDIMENT IS REMOVED SUCH THAT NO LESS THAN 70% OF THE DESIGN CAPACITY REMAINS AT ANY ONE TIME.
(B) MATERIALS ARE REPLACED OR REPAIRED AS REQUIRED TO ENSURE SERVICEABILITY OF BOTH THE ELEMENT AND THE TRAP OR BASIN.

10. PERMANENT DRAINAGE STRUCTURES INCLUDING PIPES AND PITS ARE TO BE HANDED OVER IN A CLEAN CONDITION AT THE COMPLETION OF THE CONTRACT MAINTENANCE PERIOD.

11. FOLLOWING COMPLETION AND RESTORATION OF SITE: REMOVE ALL MATERIALS AND FILL DIVERSION DRAINS, WATERWAYS, SEDIMENT TRAPS, AND SEDIMENT BASINS AND COMPACT IN ACCORDANCE WITH COUNCIL SPECIFICATION TO MATCH LEVELS OF THE PREVIOUSLY COMPLETED WORKS. PROVIDE 100mm TOPSOIL AND HYDROSEED OVER DISTUBED AREAS (EXCEPT PROPOSED ROADS).

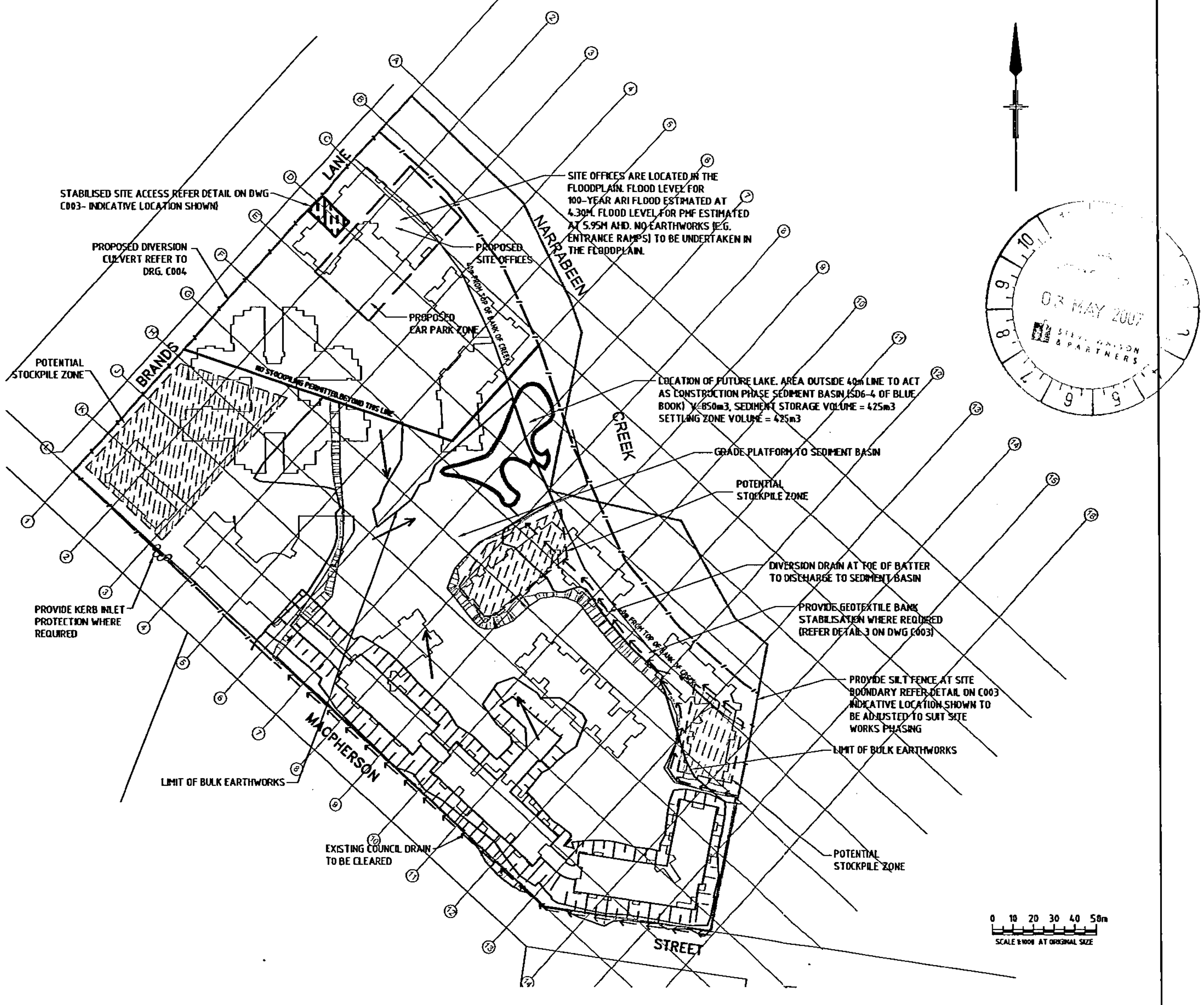
12. ACCESS POINT TO ALLOW MACHINE ENTRY / EXIT ARE TO INCLUDE A ROUNDED DIVERSION BANK 0.3m HIGH WITH 1H:1V BATTERS TO DIVERT RUNOFF TO SEDIMENT FENCES EITHER SIDE OF ENTRY.

13. TEMPORARY KERB INLET SEDIMENT TRAPS TO BE PROVIDED TO ALL EXISTING KERB INLETS IN THIS VICINITY.

14. THE CONTRACTOR SHALL MAINTAIN A LOG BOOK DETAILING
- RECORDS OF ALL RAINFALL
- CONDITION OF SOIL AND WATER MANAGEMENT STRUCTURES
- ANY APPLICATION OF FLOCCULATING AGENTS TO SEDIMENT BASIN
- VOLUMES OF ALL WATER DISCHARGED FROM SEDIMENT BASINS - ANY ADDITIONAL REMEDIAL WORKS REQUIRED
THE LOG BOOK SHALL BE MAINTAINED ON A WEEKLY BASIS AND BE MADE AVAILABLE TO ANY AUTHORISED PERSON UPON REQUEST. THE ORIGINAL LOG BOOK SHALL BE ISSUED TO THE PROJECT MANAGER AT THE COMPLETION OF THE WORKS.

15. THE CONTRACTOR SHALL AT ALL TIMES RESTRICT CONSTRUCTION EQUIPMENT MOVEMENT TO THE ESSENTIAL CONSTRUCTION AREAS. THE CONTRACTOR SHALL NOT EXTEND LAND DISTURBANCE BEYOND 2m FROM THE EDGE OF ANY ESSENTIAL CONSTRUCTION ACTIVITY.

16. ALL WATER REMOVED FROM EXCAVATIONS TO BE DISCHARGED THROUGH THE SEDIMENT BASIN.



LEGEND

—/—/—	SILT FENCE
→ → → —	DIVERSION DRAIN (REFER DWG C003)
↗	FLOW LINES

FOR CONSTRUCTION

No	Revision	Drawn	Checked	Approved	Date
0	FOR CONSTRUCTION	LSM			19.12.06

Note: * indicates signatures on original issue of drawing or last revision of drawing

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DIOCESE OF SYDNEY

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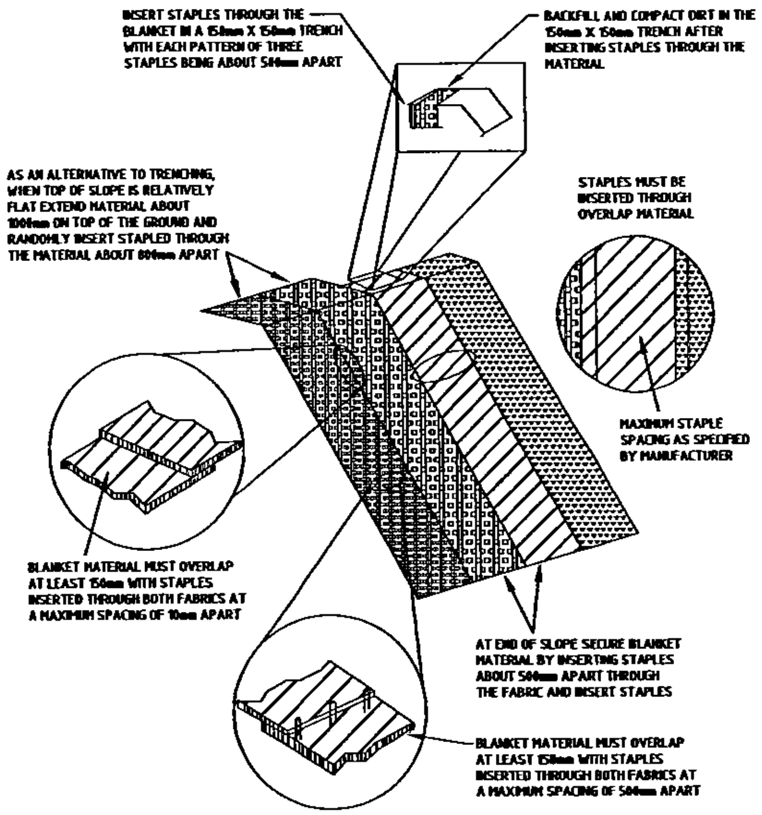
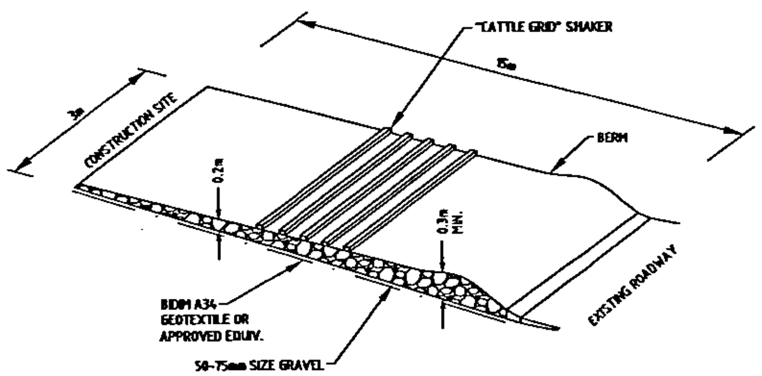
Client: ANGLICAN RETIREMENT VILLAGES
Project: WARRIEWOOD BROOK
Title: BULK EARTHWORKS CONTRACT SEDIMENT & EROSION CONTROL PLAN
Original Size: A1 Drawing No: 21-13577-C002 Rev: 0

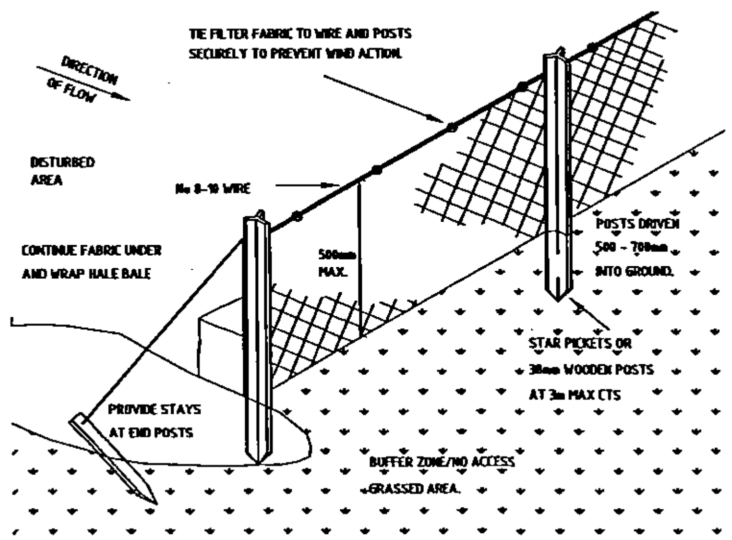
Plot Date: 20 December 2006 - 1:52 PM Cad File No: G:\Projects\21\13577\CAD\DRAWINGS\CIVIL\21-13577-C002.dwg



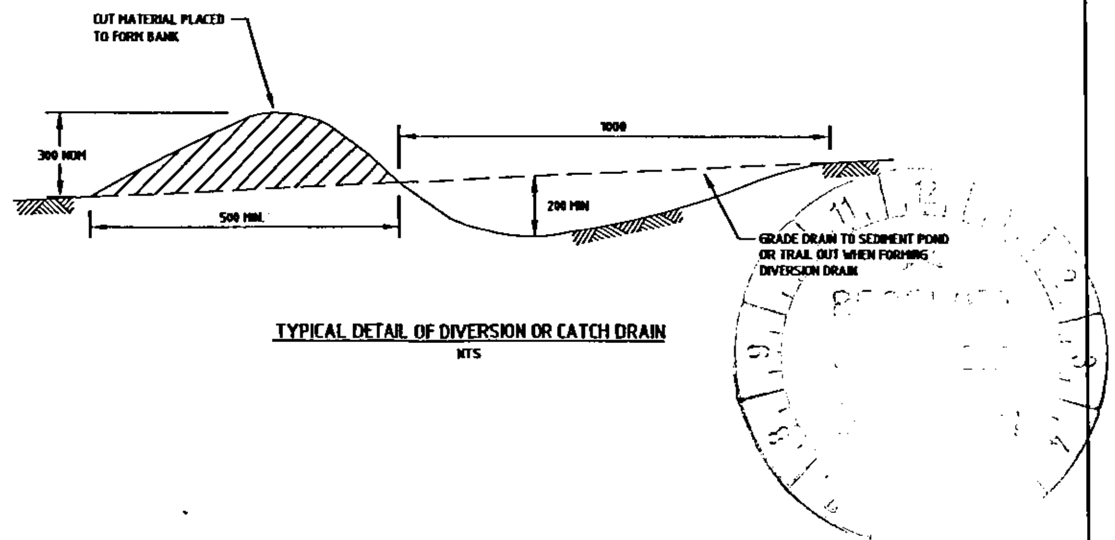
DETAIL 3-BANK STABILISATION (WHERE REQUIRED)
NTS



TYPICAL STABILISED SITE ACCESS
NTS



TYPICAL SILT FENCE
NTS



TYPICAL DETAIL OF DIVERSION OR CATCH DRAIN
NTS

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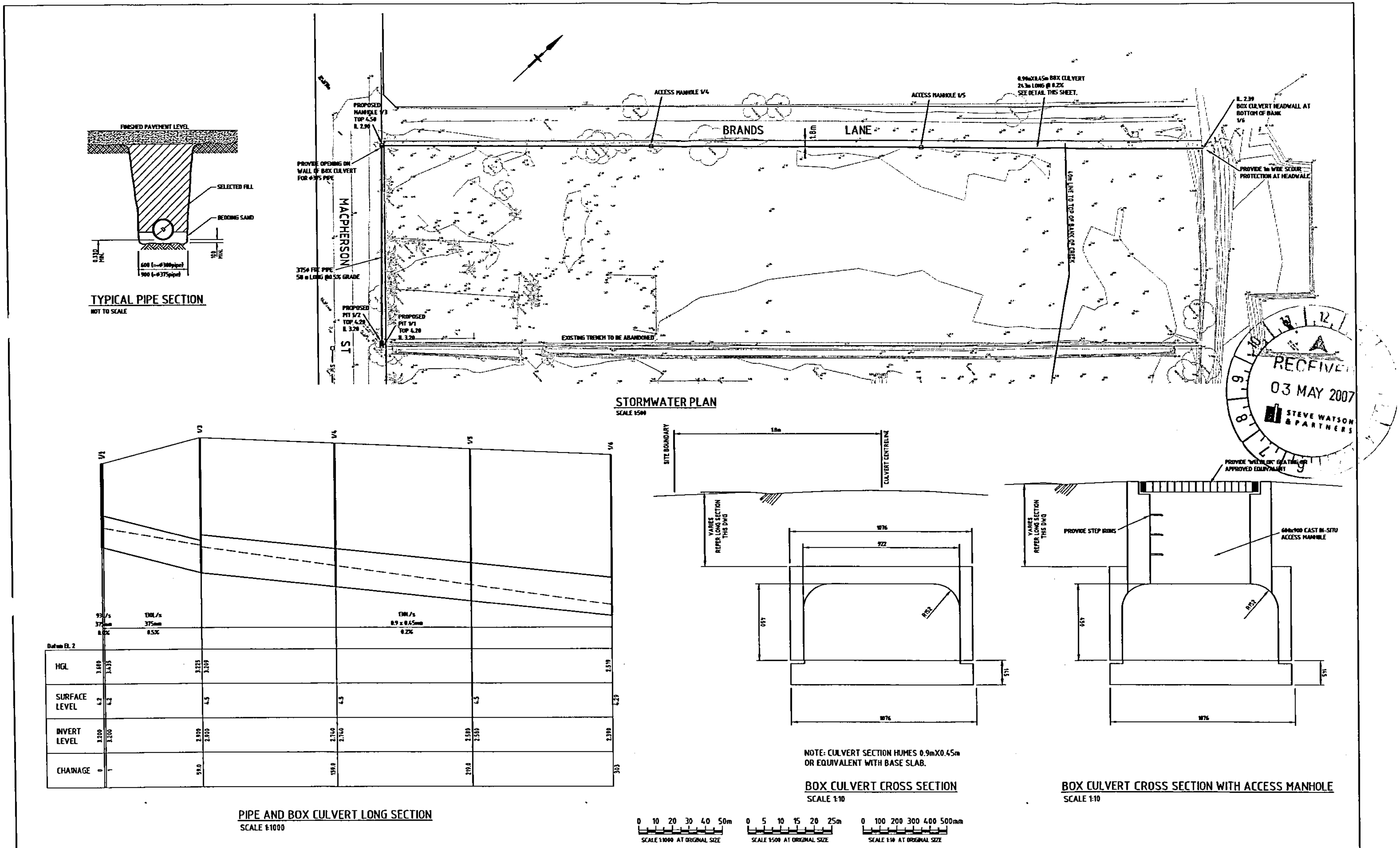
Project: WARRIEWOOD BROOK
Title: BULK EARTHWORKS CONTRACT
SEDIMENT & EROSION CONTROL DETAILS

Original Size: A1 Drawing No: 21-13577-C003 Rev: 0

Plot Date: 20 December 2006 - 1:52 PM Cad File No: G:\Projects\21\13577\CADD\DRAWINGS\CIVIL\21-13577-C003.dwg



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Approved
Date 19.12.06
Scale AS SHOWN

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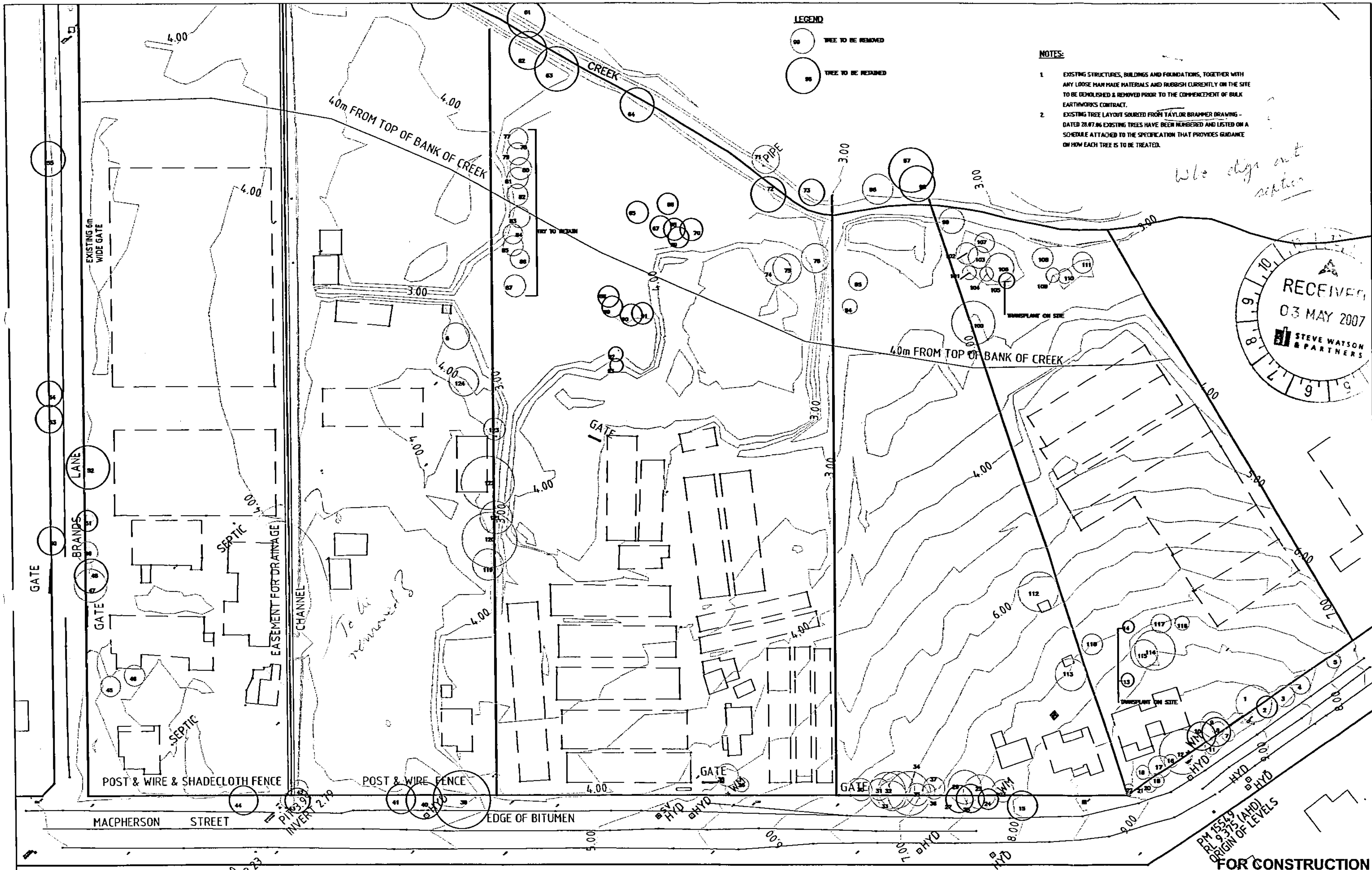
Client: ANGLICAN RETIREMENT VILLAGES
Project: WARRIEWOOD BROOK
Title: BULK EARTHWORKS CONTRACT
STORMWATER BYPASS PLAN & LONG SECTION

Original Size A1 Drawing No: 21-13577-C004 Rev: 0

Plot Date: 20 December 2006 - 1:52 PM Cad File No: G:\Projects\21\13577\CADD DRAWINGS\CIVIL\21-13577-C004.dwg



LEGEND

TREE TO BE REMOVED

TREE TO BE RETAINED

NOTES:

1. EXISTING STRUCTURES, BUILDINGS AND FOUNDATIONS, TOGETHER WITH ANY LOOSE MAN MADE MATERIALS AND RUBBISH CURRENTLY ON THE SITE TO BE DEMOLISHED & REMOVED PRIOR TO THE COMMENCEMENT OF BULK EARTHWORKS CONTRACT.
2. EXISTING TREE LAYOUT SOURCED FROM TAYLOR BRAMMER DRAWING - DATED 28.07.06 EXISTING TREES HAVE BEEN NUMBERED AND LISTED ON A SCHEDULE ATTACHED TO THE SPECIFICATION THAT PROVIDES GUIDANCE ON HOW EACH TREE IS TO BE TREATED.

FOR CONSTRUCTION

No	Revision	Drawn	Checked	Approved	Date
0	EXISTING TREE LAYOUT ADDED & SCALE CHANGED	AL	AL		2/1/07
0	FOR CONSTRUCTION	LSM			19.12.06

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Client: ANGLICAN RETIREMENT VILLAGES
Project: WARRIEWOOD BROOK
Title: BULK EARTHWORKS CONTRACT
SITE LAYOUT: EXISTING FEATURES

Original Size: A1 | Drawing No: 21-13577-C005 | Rev: 0

Plot Date: 2 January 2007 - 1:35 PM Cad File No: G:\Projects\21\13577\CADD\DRAWINGS\CIVIL\21-13577-C005.dwg

Pittwater Council

ABN 61 340 837 871 Telephone (02) 9970 1111 Facsimile (02) 9970 7150
Postal Address: P.O. Box 882, Mona Vale NSW 1660, DX 9018 Mona Vale

www.pittwaterlga.com.au e-mail: pittwater_council@pittwater.nsw.gov.au

Ross McWhirter, Project Leader - Warriewood Infrastructure
8am to 5pm Mon - Fri
Phone 9970 1207 Mobile 0419 629 007

31 January 2007

RECEIVED BY event
0 1 FEB 2007
PROJECT MANAGEMENT

Event Project Management
PO Box 6180
FRENCHS FOREST NSW 2086

Attention: - Andrew Graham

Dear Sir,

Re: DA N0102/05 - Partial Construction Certificate

Reference is made to your email dated 31 January 2007 concerning conditions C20, C21, C22 and C23 of Consent No. N0102/05.

Council confirms that it does not require conditions C20, C21, C22 and C23 of Consent No. N0102/05 to be satisfied prior to the release of a partial Construction Certificate for land remediation and bulk earthworks only. However, the forementioned conditions must be satisfied prior to the release of all remaining Construction Certificates for the development.

Yours faithfully

James Payne
MANAGER - URBAN INFRASTRUCTURE

CLIENTS PEOPLE PERFORMANCE

Anglican Retirement Villages

Warriewood Retirement Village

Water Management Report

December 2006

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Water Management Report: Document Status

Version	Date	Purpose	Development Footprint
1	February 2005	Prepared for Development Application	SK19 Rev B
2	October 2005	Re-submission for DA (in response to comments received 11 April 2005 see Appendix B)	SK19 Rev F
2.A	December 2005	Addendum to October 2005 document (in response to consolidated comments received 25 November 2005 see Appendix C)	SK19 Rev G
3	May 2006	Re-submission for DA. In particular: • WMR 2, Addendum A of 07/12/05 has been integrated into this report • Councils Deferred Commencements Consent Conditions (Part 1, Pittwater Council Report to Development Unit, 19 January 2006) are addressed (Appendix D)	SK19 Rev G
4	December 2006	Re-submission for DA. In particular: • Issues presented in the Agenda for the Council meeting 18/10/2006 are addressed; • Further flood modelling for the interim creek scenario is included	SK19 Rev G

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L	Modelling and detailed results using MUSIC
M	Swamp Mahogany Impact Assessment
N	PSD and SSR simulations using DRAINS
O	Creek Rehabilitation HECRAS Results
P	Narrabeen Creek Concept Design Cross-Sections
Q	Cardno Lawson Treloar 100-year and PMF simulation results Reports
R	Assessment of Flood Impacts at the Warriewood STP
S	Flood Maps showing the PMF and 100-year ARI flood levels and flood depths for the Ultimate and Interim scenarios
T	Water Quality Monitoring Report

1. Introduction

1.1 Purpose of Report

Anglican Retirement Villages (ARV) is currently planning the development of land in the Warriewood Valley (see Figure 1), encompassing a number of sectors, buffer areas and sub-sectors as tabulated below (see Appendix A for Sectors, Buffer areas and Sub-sectors). For the ARV site, a Rezoning Application will not be required. This Water Management Report (WMR) thus provides information for the Development Application stage. Requirements for the Construction Certificate and Handover will be dealt with at a later time.

Table 1 Sectors, Buffer areas and Sub-sectors

Site	Sector	Buffer Area	Sub-sector
14 Macpherson Street	3	na	na
12 to 8 Macpherson Street	4	2	102
6 Macpherson Street	C	2	102

The land has been rezoned for development as part of the Warriewood Valley Urban Land Release. The process of development of each buffer area/sector generally comprises five administrative and approval stages:

- Rezoning Application;
- Development Application;
- Construction Certification;
- Certificate; and
- Handover.

Water quantity and quality management requirements for developments in the Warriewood Valley are identified in the Warriewood Valley Urban Land Release, Water Management Specification (WMS), adopted by Pittwater Council in February 2001. This requires that the Applicant provide a single WMR at each stage of the process listed above. Also required are Status Reports during the construction period.

The WMS lists the water management requirements at each stage of the development approval process, and each report should be an updated version of the previous report. The WMS also provides a water management checklist for each stage, which needs to be included in each report.

1.2 Report Structure

This report is structured so that:

- Section 2: describes the site and provides background information;
- Section 3: provides a description of the proposed stormwater management strategy;
- Section 4: assesses water cycle impacts;
- Section 5: details proposed works in the Narrabeen Corridor
- Section 6: details water quality monitoring and results;
- Section 7: provides a water quality assessment; and
- Section 8: provides a summary of the report.

1.3 Key Documentation

Key documents of relevance to this investigation are:

- Warriewood Valley Urban Land Release, Water Management Specification; Revised Version, Pittwater Council, February 2001 (WMS);
- DCP 30, Development Control Plan 30 Pittwater Flood Risk Management, Pittwater Council, December 2002;
- Flood Risk Management Policy for Pittwater, Pittwater Council, December 2002;
- Warriewood Valley Urban Release Area, Landscape Masterplan and Design Guidelines, September 2004;
- Warriewood Valley Flood Study, Flood Study Report (April 2005) and Addendum 1 (July 2005); and
- Warriewood Due Diligence, Stormwater Management, Water, Sewer, Geotechnical & Contamination Assessment, GHD February 2004.

Apart from these documents there are a number of other documents of relevance to development in the Warriewood Valley, which have been referenced.

1.4 WMR Status

The WMR document status and versions of this report are provided at the start of this report (before the Table of Contents). A number of key changes (Table 2) and amendments have been made to the analysis approach reported in this document, in response to:

- The assessment and comments received from Council on Version 1 of the WMR on 11 April 2005 (refer to Appendix B for comments and response to comments); and
- Assessment and comments received from Council on Version 2 of the WMR in the form of consolidated comments received from Event Project Management (refer to Appendix C for comments and response to comments);

- Councils Deferred Commencement Consent Conditions as reported in the Pittwater Council Report to Development Unit, 19 January 2006, Part 1 (refer to Appendix D for requirements); and
- Councils Agenda tabled at the meeting of 18/10/2006, which documents a response to Version 3 of the WMR (refer to Appendix E for requirements).

Table 2 Key changes to WMR Analysis Methods

Item and Topic	Change
1. Site configurations	A number of key site configuration amendments have been made, in response to various Council comments: • Buildings have been marginally moved resulting in SK19 Rev G (Appendix H shows the proposed development footprint) Most repositioning was relatively minor and as a direct response to Council's discussions; and • Site platform levels and some ground levels have been altered to better manage the conveyance of PMF flows across the site, in response to flood modelling; • Floor levels of individual buildings have been raised; and • Internal roads have been reconfigured.
2. Site Water Balance	Version 1 report used a spreadsheet approach to calculate the site water balance and MUSIC to simulate water quality. In this report both water quantity and quality are simulated using the MUSIC model. Infiltration to groundwater is not proposed as a stormwater runoff management strategy. This approach was adopted due to the requirements for underground car parking, which limits opportunities for infiltration across the site and could introduce the risk of seepage into the basements. In addition infiltration was found to be problematic in other areas of the Warriewood Valley. Site water demands have been reduced, and the MUSIC model re-simulated.
3. Flood Modelling	The Version 1 report relied on Mike 11 modelling to simulate the effects of the proposed development on local flood levels and to determine flood levels across the site, in response to the 100-year ARI and PMF events. Since then Council's 2-D SOBEK model has been utilised to simulate the 100-year ARI and PMF events. Further simulations have included: • Optimisation and simulation of landform for ultimate development; • Optimisation and simulation of the landform for interim conditions; and • Assessment of off-site impacts;

1.5 WMR Checklist

The relevant checklist as required by the WMS for the DA stage is provided in Appendix F.

FIGURE 1

LEGEND

ARV Site

North

CLIENT
ARV

PROJECT
Warriewood Water Management Report

TITLE
Locality Plan

GHD	DRAWN	REVISION
	CHECKED	SCALE SEE SCALE BAR
DWG NO	DATE	SIZE A4

2. Site Description

2.1 Location and Description

Buffer Area 2 of the Warriewood Valley Urban Land Release area is located between Warriewood Road to the north and Macpherson Street to south, and is bisected by Narrabeen Creek. Referring to Figure 1, the ARV site within the buffer area, is located south of Narrabeen Creek and is bounded on the north-west by Brands Lane and on the south-east by an adjacent allotment (Lot 4) off Macpherson Street. It includes five properties along the south bank of Narrabeen Creek. The lots that define the subject study site are No 14, 12, 10, 8, and 6 Macpherson Street. The total site area is 6.65 ha.

2.2 Site Boundaries

Two plans of the site boundaries are provided in Appendix G. Referring to the plans the following is noted:

- The ARV lot boundary follows, what we understand from the surveyors Summit Geomatic, to be a historical creek centreline; and
- The existing creek line location follows a slightly different alignment for most of the reach adjacent to the site, except at 10 Macpherson Street where significant differences are encountered.

From the above it can be seen that there are some differences in defining the northern boundary of the ARV site. The implications are that in the interim scenario (see discussion in Section 5.2.2) rehabilitation is required on the southern bank of the creek up to the existing creek centreline. In areas where the creek centreline falls outside the ARV site, land access may be problematic.

We understand that negotiations are presently underway, and ARV has advised us that they are negotiating access to the creek for the purposes of construction, on the southern bank up to the existing creek centreline, as it currently exists.

2.3 Topography

The ARV site is approximately 600m upstream of the Warriewood Wetlands, and as such is characterised by a flat, low-lying topography. The existing site generally drains towards Narrabeen Creek along the northern boundary. An elevated area is located at the southern site boundary on No 8 and 6 Macpherson Street, rising to levels of RL 9.2 m AHD. An existing topographic depression is located off-channel to Narrabeen Creek on No. 10 Macpherson Street.

Macpherson Street, along the southern boundary, is only marginally higher than the existing site.

2.4 Key WMS Parameters applicable to the ARV Site

The WMS and Warriewood Valley Flood Study and Addendum 1 (April 2005 and July 2005) lists a number of key hydrological parameters, applicable to the ARV site, which set flood levels and flood peaks applicable to the site.

2.4.1 Existing Conditions Flooding

Referring to Figure 2, key Warriewood Valley Flood Study cross-sections names adjacent to the ARV Site are listed in Table 3.

Table 3 Key cross-section names and locations used in the Warriewood Valley Flood Study

Flood Study Cross-section	Location	Flood Study Cross-section	Location
XS23 also Sec2-xs-90.000	Brands Lane and upstream boundary 14 Macpherson	G Narrabeen 7	Downstream boundary 8 Macpherson
G Narrabeen 1	Downstream boundary 14 Macpherson	Between G Narrabeen 8 and 9	Downstream boundary 6 Macpherson
G Narrabeen 3	Downstream boundary 12 Macpherson	G Narrabeen 12	Downstream boundary 4 Macpherson
G Narrabeen 6	Shortly upstream of downstream boundary 10 Macpherson	G Narrabeen 13	Downstream of Macpherson Road crossing

Design peak discharges at key locations, as listed in the Warriewood Valley Flood Study – Addendum 1 (July 2005), are tabulated in Table 4.

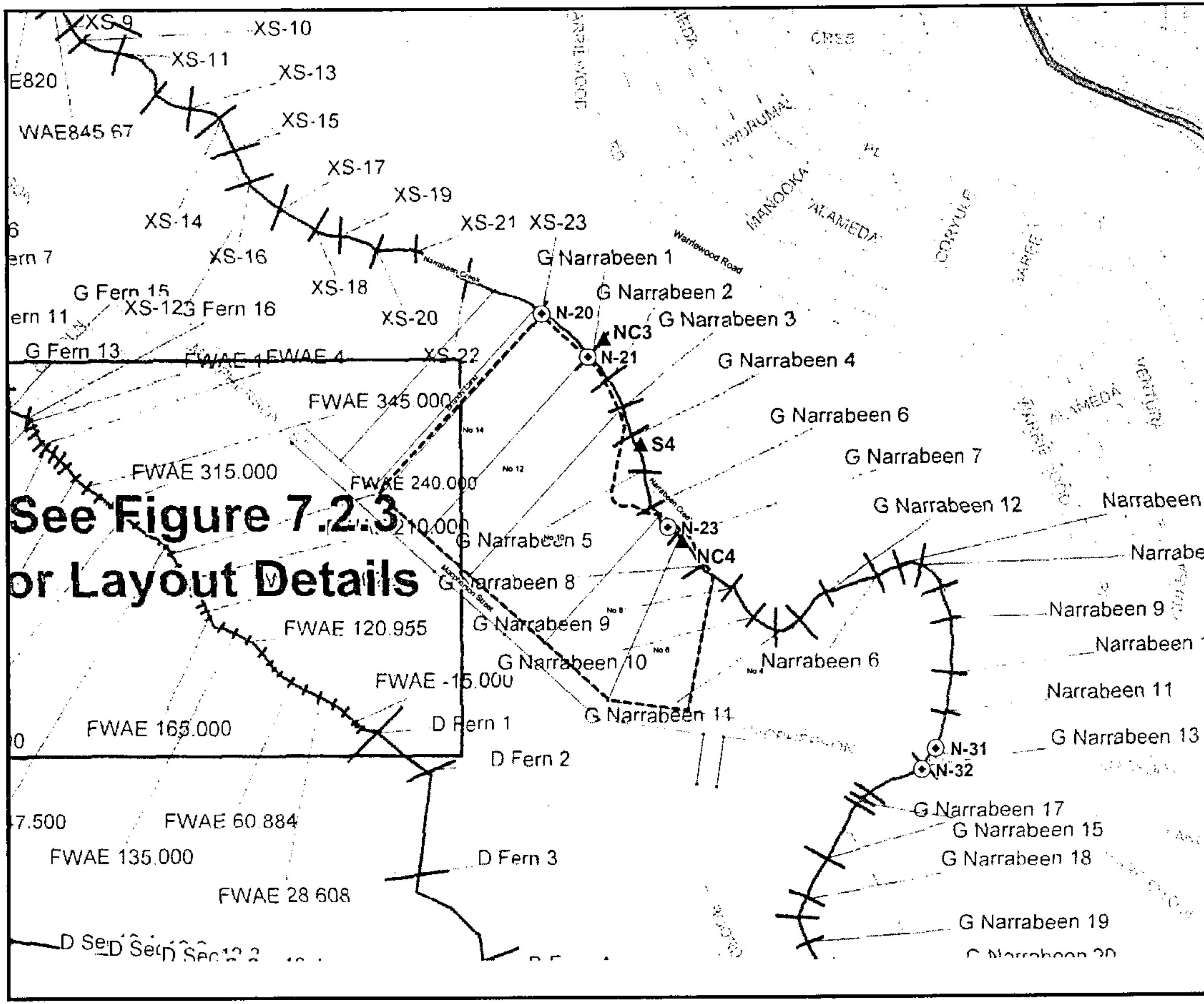


FIGURE 2

LEGEND

- ARV Site
- Discharge Locations
- Flood Study Cross-section Locations
- Water Quality Monitoring Locations

North

CLIENT	ARV
PROJECT	Warriewood Water Management Report
TITLE	Flood Study Cross-Section, Flow Measurement and Water Quality Measurement Locations
DRAWN	RRB
CHECKED	
REVISION	
SCALE	SEE SCALE BAR
DWG NO	21/13577/M-001
DATE	10/10/2005
SIZE	A4

Table 4 Design Peak Discharge

Location	Location	PMF (m^3/s)	100-yr ARI (m^3/s)	50-yr ARI (m^3/s)	20-yr ARI (m^3/s)	5-yr ARI (m^3/s)
N-20	Brands Lane and upstream boundary 14 Macpherson	144.4	39.6	37.60	33.45	25.35
N-21	Downstream boundary 14 Macpherson	130.4	37.6	38.64	34.30	25.99
N-23	Downstream boundary 8 Macpherson	149.0	39.1			
N-31	Upstream of Macpherson Road crossing	171.2	32.3	29.43	24.69	18.07
N-32	Downstream of Macpherson Road crossing	139.3	35.0	32.92	27.92	20.18

*Note : 50, 20 and 5-year ARI peaks from the Warriewood Valley Flood Study (April 2005)

Design peak flood levels at key locations are tabulated in Table 5. The PMF and 100-yr ARI levels were derived from the Cardno Lawson Treloar flood modelling, provided as part of the 15 July 2005 flood modelling results undertaken for ARV. The 50, 20 and 5-year ARI flood levels were provided in the Warriewood Valley Flood Study report (April 2005).

Table 5 Design Flood Levels (High Tail Water)

Location	Location	PMF (m AHD)	100-yr ARI (m AHD)	*50-yr ARI (m AHD)	*20-yr ARI (m AHD)	*5-yr ARI (m AHD)
XS23 also Sec2-xs-90.000	Brands Lane and upstream boundary 14 Macpherson	6.07	5.04	4.93	4.87	4.72
G Narrabeen 1	Downstream boundary 14 Macpherson	5.66	4.77	4.38	4.32	4.19
G Narrabeen 3	Downstream boundary 12 Macpherson	5.31	4.33	4.19	4.13	4.01
G Narrabeen 6	15 mupstream of downstream boundary 10 Macpherson	5.18	3.98	3.92	3.83	3.71
G Narrabeen 7	Downstream boundary 8 Macpherson	5.14	3.86	3.76	3.69	3.59

G Narrabeen 8	Downstream boundary 6 Macpherson	5.10	3.82	3.73	3.66	3.55
G Narrabeen 9		5.06	3.77	3.66	3.59	3.47
G Narrabeen 12	Downstream boundary 4 Macpherson	5.02	3.74	3.63	3.56	3.44
G Narrabeen 13	Downstream of Macpherson Road crossing	4.73	3.26	3.24	3.09	2.75

*Note : 50, 20 and 5-year ARI levels from the Warriewood Valley Flood Study (April 2005)

2.4.2 Permissible Site Discharge and On-site Detention

The WMS requires the following:

- On-site Detention at 368 m^3/ha
- Permissible Site Discharge (PSD) during the 100-year ARI event as listed in Table 6 below (see Appendix A for Sectors).

It is noteworthy that the site is mostly located within Sector 4. The stormwater strategy for the site, discussed in Section 3.1, aims to discharge at one outlet point to the creek. To this end it is elected to use the Sector 4 PSD requirements for the ARV site.

Table 6 Permissible Site Discharge (PSD) during 100-yr ARI event

Event	Sector 4 PSD (l/s/ha)	Sector 3 PSD (l/s/ha)	Sector C PSD (l/s/ha)
100-yr - 30 min	92	57	73
100-yr - 1 hr	159	123	141
100-yr - 2 hr	166	148	161
100-yr - 3 hr	145	140	151
100-yr - 6 hr	151	154	165

2.5 Soils, Geology and Potential Acid Sulphate Soils (PASS)

A desk study review of published information and in-house records of a limited number of investigation holes was undertaken as part of the Warriewood Due Diligence Assessment undertaken for the ARV site in 2004 (GHD, 2004). The key soil, geological, geotechnical and PASS findings from this report are summarised below.

Soil Landscapes

The 1:100,000 scale Soil Landscape plan for Sydney (9130, 1989) shows the site landform to comprise the Warriewood 'swamp' landscape on the north-west section and disturbed terrain (within this landscape) on the south-west.

The Warriewood landscape comprises level to gently undulating sand swales, with depressions and in-filled lagoons on Quaternary sands. Typical relief below RL 10m AHD, slopes of less than 3% and water table less than 2m below the natural surface.

Geology

The 1:100,000 Geological Series Sheet for Sydney (9130, Edition 1, 1983), indicates that the site is underlain by Quaternary Alluvium comprising sand, peat, silt and clay, with common shell layers. The Newport Formation within the Narrabeen Group appears to underlie the alluvium at depth. This typically comprises interbedded laminite, shale and sandstone with minor claystone beds.

Geotechnical Conditions

The site is described in previous geotechnical reports as generally flat, low-lying terrain, with vegetation typically comprising grassed paddocks, reedy creek banks and areas of uncontrolled filling (particularly towards the rear of properties along Macpherson Street near Narrabeen Creek) at up to 2m thickness. GHD's geotechnical records indicate that, in general terms, the subsurface conditions comprise variable filling overlying alluvium. The thickness of the alluvium was proved to below some 5m depth over parts of the site. The alluvial soils encountered ranged in nature from soft to firm clays, to loose to medium dense sands and clayey sands. The alluvial soils showed significant variation, as would be expected in an alluvial floodplain adjacent to a creek. Residual soils were possibly encountered beneath the alluvium at about 6m depths on the northwest.

The water table, where encountered during the investigations, ranged from about 0.5m to 2m below the existing site levels.

A Geotechnical Risk Management Report (GHD, 2005a), which is understood, will accompany this DA submission, provides further information on managing the geotechnical risks on the site.

Potential Acid Sulphate Soils (PASS)

The Acid Sulphate Soil Map for Hornsby/Mona Vale (Ed1, 1995), indicates high PASS within the centre of the site, and low PASS either side (north-east/south-west). The high-risk areas are indicated as alluvial swamp deposits with a water table between 1m and 3m below the ground surface areas.

The low risk areas are described as plains and dunes dominated by aeolian sands, with water table greater than 3m below the ground surface. The surface elevation of these deposits is described as generally greater than RL 4m AHD.

The site levels are indicated on the topographical map for Mona Vale (9130-1S) to be between RL 10m and RL 0m AHD.

The PASS nature of the alluvium, where encountered beneath the water table, was confirmed in GHD's report (GHD, 2005b). Moreover, existing acidic conditions (pH 4.4 to 5.5) were recorded in some of the samples tested near the water table. An Acid Sulphate Soils Management Plan (GHD, 2005b), which is understood will accompany this DA submission, provides further information on managing the acid sulphate soils.

Management of general contamination issues is discussed in the Remediation Action Plan (GHD, 2005c) for the site.

2.6 Land Use

Historic

A review activities for the due diligence report indicated that a variety of uses were historically undertaken at the site. These included use as a nursery, market gardening, material and equipment storage, joinery and residential.

Present

After purchase of properties by ARV, land clearing has been undertaken, primarily at No's 14 to 10 Macpherson Street. Some houses and sheds are present on the remaining properties.

Future

The proposed development footprint is provided in Appendix H. The development comprises a Retirement Village of 10 buildings servicing a number of functions. Further description is provided in Section 3.1.1.

3. Proposed Stormwater Management Strategy

3.1 Stormwater Management Concept Plan

3.1.1 The Development Form

The proposed development footprint is provided in Appendix H together with the latest staging plan (still under development). The development comprises a Retirement Village of 8 buildings containing independent living units, an retirements age care facility (RACF), an administration building and a childcare facility. Buildings are serviced by internal access roads, and the development includes a village green and wetland. Numerous footpaths link the buildings and provide access to the rehabilitated Narrabeen Creek.

Construction is proposed in 4 stages. The first stage includes buildings along Macpherson Street. Thereafter the RACF will be constructed, followed by buildings along Narrabeen Creek on the eastern half of the site. The last stage will comprise buildings along Narrabeen Creek and buildings on the western half of the site. While this presents the general staging approach, staging plans are still development at this stage, involving some fine-tuning. Further comment on staging is provided in Section 3.6

In terms of flood planning levels, the WMS requires building floor levels to be at or above the PMF level for habitable buildings and underground car park entries. For non-habitable buildings floor levels need to be above the 100-year ARI level plus freeboard. This has required the developed form to be raised significantly compared to existing conditions. The raising however needed to make allowance for the conveyance of the PMF through the site, to ensure off-site impacts (raised flood levels) are minimised. These issues are further discussed in Section 5.3.

As part of the works, the WMS requires construction of Narrabeen Creek. This creek construction will take place in two stages, namely the southern bank only until the northern bank is developed, followed by the northern bank at the appropriate time. This raises issues regarding an interim creek form, which are further discussed in Section 5.2.2. Further information on site stormwater management is provided in the ensuing sections.

3.1.2 General

A Stormwater Management Concept Plan for the site is provided in Appendix I. The plan incorporates the following general features:

- The entire site is graded generally towards the existing topographic depression on the site, which will be rehabilitated and upgraded to a Village lake/wetland. This wetland will provide the dual functionality of water quality treatment and, by incorporation of the village green area, detention during larger events;
- A "treatment train approach" will be utilised to treat all stormwater runoff quality;

- Stormwater from all pervious and impervious surfaces on the site will discharge, via local on-route treatment strategies and the wetland, to Narrabeen Creek;
- Infiltration is not proposed as a means to discharge runoff. It is proposed to 'tank' the wetland and bio-retention areas/swales using impermeable membranes or clay layers, providing a barrier to ground-water; and
- Rainwater harvesting from roofed areas (tanks will be provided for each building or clusters of buildings) will supply non-potable toilet water and irrigation demands. Rainwater tanks will be located in or in close proximity to building basements and overflow to the sub-surface stormwater system.

Key catchment areas are tabulated in Table 7 below.

Table 7 Key Catchment Areas on the ARV site

Catchment	Area (ha)
Total to all lot boundaries	6.65
Total to all lot boundaries less 25m setback from creek	5.73

3.1.3 Stormwater Quantity /Quality Management

Stormwater quantity and quality management for the site will comprise:

- Roof water harvesting using a total of 30 kl tanks for each building (as individual tanks or groups of tanks) for non-potable use (toilet and irrigation). It is proposed that these will be installed in the underground car-park areas under Buildings A to J and the RACF. All downpipes will be routed directly to the tanks, and overflow from the rainwater tanks will be routed to a site sub-surface drainage system, which generally drains to the Village lake/wetland. Top up of rainwater tanks will be supplied via the Sydney Water potable water supply with approved backflow preventers installed. The rainwater tanks have been oversized to assist in managing the site water balance;
- Impervious and pervious (at ground) areas will be routed to a number of local bio-retention areas and swales for water quality treatment. Small gross pollutant trap systems, comprising pit inserts, will be provided at the inlets to major bioretention systems. Road runoff will be directed to bio-retention swales located between the road and the footpath. Kerbs will be provided along selected roads, with laybacks at regular intervals to permit discharge of road runoff to the swales The swales and bio-retention areas will be connected to the sub-surface drainage system at a number of locations;
- Supplementary end-of-line water quality treatment for the bioretention systems will occur in the Village lake/wetland, before discharging to Narrabeen Creek via a multi-staged outlet and spillway. The wetland will have a minimum surface area of approximately 1430 m^2, and be provided with a small vertical edge to a depth of approximately 200 mm. From here 1 in 3 slopes extend to the full wetland depth of approximately 0.5 to 0.8 m;

- Events in excess of the sub-surface drainage system will be routed to the Village Green via the internal road network. The Village Green, which incorporates the Village lake/wetland is bunded or walled (by the site platform and potentially a berm between the wetland and the creek) using local landscaping to provide the minimum detention storage of 2450 m^3 during a 100-year ARI event. The landscape bunding will incorporate a 1 in 6 side-slope for safety reasons. The maximum depth of the detention area will be approximately 0.8m to 1.0m during a 100-year ARI event on-site;
- Stormwater runoff from Macpherson Street kerbs will be captured and directed to Brands Lane. Here a box culvert designed to the 100-year ARI, located within the ARV property boundary, will drain this runoff to Narrabeen Creek. A concept design drawing for these works is shown in Appendix I; and
- A small area of Macpherson Street frontage associated with half the length of Building K, the full length of Building K and the area in between will drain to Macpherson Street. These flows will be routed to Narrabeen Creek in the aforementioned box culvert.

Further details of the onsite stormwater quantity /quality management system performance are provided in Section 4.

3.2 Mosquito Management

In general, newly flooded and areas of stagnant water provide favourable breeding conditions for the mosquitos. Permanent, stabilised habitats, with diverse faunal ecologies and opportunities of mixed water will generally result in much fewer individuals reaching the nuisance adult stage. The following will be implemented as a means of reducing mosquito breeding risk on site:

- Swales – All swales are proposed as bio-retention systems, namely engineered infiltration devices, and will not contain permanent surface water;
- Wetland – This feature will be designed to minimise the risk of mosquito breeding as follows:
  - Open water areas will be sufficiently deep, with edges gently sloping (preferably not steeper than 1V:3H) and preferably free of vegetation;
  - Accumulations of debris, dead vegetation and algal mats will routinely be removed, particularly from wetland margins, from the wetland site;
  - Shallow areas will be graded for rapid dewatering;
  - Weirs, siphons, pumps or other appropriate outlet structures will be incorporated into the overall design to enable water level management of the wetland;
  - The interior of open water areas will be maintained free of vegetation;
  - Vertebrates (i.e. fish), invertebrates (eg, dragonflies, water beetles, water bugs) will be encouraged by providing appropriate habitat;
  - In shallow waters, macrophytes will be periodically removed or thinned out to maintain the effectiveness of fish predation;

- Perimeters will be uniform instead of irregular to minimise the potential for stagnant waters; and
- The wetland will be monitored using standard mosquito sampling techniques, to detect the relative abundance of both larval and adult population.

3.3 Stormwater Quality Device Maintenance

3.3.1 Construction Period

After every rainfall event (in excess of 5 mm in a day) and at least weekly the following will be undertaken:

- Inspect and assess the effectiveness of the sediment and erosion control strategies and identify any inadequacies that may arise during normal work activities or from any revised construction methodology. Construct additional erosion and sediment control works as necessary to ensure the desired protection is given to downstream lands and waterways;
- Ensure that all strategies operate properly and to effect any repairs as necessary;
- Remove spilled sand or other materials from hazard areas, including lands closer than 5 metres from areas of likely concentrated or high velocity flows especially waterways and paved areas;
- Remove trapped sediment whenever less than design capacity remains within the structure;
- Ensure rehabilitated lands have effectively reduced the erosion hazard and to initiate upgrading or repair as appropriate;
- Maintain erosion and sediment control measures in a fully functioning condition until all construction activity is completed and the site has been rehabilitated; and
- Remove temporary erosion and sedimentation strategies as the last activity in the rehabilitation program.

3.3.2 Defects Liability Phases

The proposed maintenance regime for the water quality and quality units will include, for the construction and defects liability phases:

- Gross Pollutant Trap Systems – A program for:
  - Inspection of collected litter/sediment after every event where site rainfall exceeds 10 mm in 1 day;
  - Inspection of collected litter/sediment at three (3) month intervals if there has not been a 10 mm daily rainfall in any three (3) consecutive months; and
  - Removal of sediment and litter as identified to be necessary by the visual assessment.
- All above ground detention structures – A program for:
  - Inspection after every rainfall event of 5 mm in a day; and

- Removal of sediment and litter as identified to be necessary by the visual assessment.
- Swales and bio-retention swales – A program for:
  - Inspection and removal of sediment every three (3) months; and
  - Removal of sediment and litter as identified to be necessary by the visual assessment.

3.3.3 Operational Phases

The anticipated maintenance during the operational phases:

- Gross Pollutant Trap Systems – A program for:
  - Inspection of collected litter/sediment at three (3) month intervals; and
  - Removal of sediment and litter as identified to be necessary by the visual assessment.
- All above ground detention structures – A program for:
  - Inspection of collected litter/sediment at twelve (12) month intervals; and
  - Removal of sediment and litter as identified to be necessary by the visual assessment.
- Village Lake wetland– A program for:
  - Inspection of collected litter/sediment at twelve (12) month intervals;
  - Removal of sediment and litter as identified to be necessary by the visual assessment;
  - Rehabilitation works (possible microphyte management) every two (2) years;
  - Rehabilitation works (possible reconstruction) every five (5) to ten (10) years;
- Swales and bio-retention swales – A program for:
  - Inspection of collected litter/sediment at twelve (12) month intervals;
  - Removal of sediment and litter as identified to be necessary by the visual assessment;
  - Rehabilitation works (possible microphyte management) every two (2) years;
  - Rehabilitation works (possible removal and reinstatement of base) every five (5) to ten (10) years.

3.4 Basin and Creek Corridor Vegetation Planting Schedule

The landscape architects, Taylor Brammer Landscape Architects have compiled the site and creek corridor vegetation-planting schedule. Their draft Vegetation Management Plan is provided in Appendix J.

3.4.1 Concept Landscaping Plan

A concept landscaping plan has been developed for the creekline works to provide a suitable balance between the issues of:

- Providing adequate flood conveyance for the interim creekworks condition;
- Providing visual screening of the proposed buildings;
- Maintenance requirements; and
- Provision of APZs along the creekline.

To balance these competing interests a linear concept landscaping planting has been selected. The main features of the creekline concept landscaping plan, with planting species and densities given in Table 8 and Table 9, are:

- Provision of a native grassed area that is 5m wide immediately adjacent to the buildings along the creekline – this corridor will provide vehicular access for Council maintenance of the creekline, will contain a pedestrian path for recreational use and will provide a low flammable buffer adjacent to the buildings;
- A tree/shrub area on the relatively high portions of the creekline bank on the ARV site – this area will contain species selected from the Council list of potential plantings that will, when mature, provide a visual screening of the buildings from adjacent areas. The larger, when mature trees, will be initially under planted by selected shrubs and groundcovers. The extent of the area has been selected so that the relatively densely planted trees will be in low flow velocity area so that they do not significantly impact of flood conveyance capacity and a break has been provided in the area of the ARV lake to provide a view where the buildings are not as close to the creekline;
- A groundcover area in the main part of the creekline – in this area the groundcovers have been selected so that they are relatively soft and will lay over during flood times to minimise flow resistance. Some trees are permitted in this area to assist in the site screening – the maximum density of planting of the trees (*Casuarina glauca or Eucalyptus robusta*) is not to exceed one mature tree every 70 m^2 within this area. A planting density in excess of this would impact on flood levels while the Interim creekline form is operational but the density could potentially be increased when the remaining half of the creekline works is constructed, subject to hydraulic analysis when the planting regime is known. This part of the creek cross section will contain the reconstructed low flow channel for Narabeen creek. In the short term, Interim creek form, the groundcover area will extend from the ARV side of the creek to the centreline of the creek;
- On the northern side of the creek a mix of trees is shown on the three provided typical cross sections. The landscaping on this side of the creek will be designed when the development on the north proceeds. The hydraulic analysis has been completed for the existing vegetation condition on the northern bank.

Referring to Appendix K, three typical sections, XS1, XS2 and XS3, are provided showing the distribution of the landscape planting areas. These areas will be adopted for the detailed design. At the detailed design stage there will be minor reshaping of the creekline works to soften the batters and provide some variety in form along the length of the creek.

The tables below provide planting schedules and densities for the different landscaping areas along the creekline. Table 8 provides initial plantings that will be adopted. When the canopy cover has developed in the Trees/Shrub area then it is proposed to under plant with some of the less sun tolerant species shown in Table 9.

Table 8 Planting Schedule for initial revegetation works

Zone	Type of Vegetation	Scientific Name	Common Name	Densities
Grassed Area (refer Concept Landscape Plan)	**Ground cover**	Various	**Native grasses – species to be selected to suit final landscape and APZ requirements**	**Density to suit selected species.**
Trees and Shrub Area (refer Concept Landscape Plan)	Canopy	*Casuarina glauca*	She-Oak	1 per 15 m^2
		Eucalyptus botryoides	Red Mahogany	1 per 15 m^2
		Eucalyptus robusta	Swamp Mahogany	1 per 15 m^2
	Shrub Layer	*Acacia longifolia*	Sydney Golden Wattle	1 per m^2
		Acmena smithii	Lilly Pilly	1 per 9 m^2
		Backhousia myrtifolia	Grey myrtle	1 per m^2
		Banksia spinulosa	Hairpin Banksia	1 per m^2
		Bauera rubiodes	Dog Rose	1 per m^2
		Callicoma serratifolia	Black Wattle	1 per 9 m^2
		Glochidion ferdinandi	Cheese Tree	1 per 9 m^2
		Lomandra longifolia	Spiny-headed Mat Rush	1 per m^2
		Melaleuca stypheloide s	Prickly-leaved Paper-bark	1 per 10 m^2
	Groundcover (Densities to be in-filled by ferns in 3rd	*Cissus hypoglauca*	Five-leaf Water Vine	1 per m^2

	year)			
		Dianella caerulea	Paroo Lilly	1 per m^2
		Dichondra repens	Kidney Weed	2 per m^2
		Gahnia sieberana	Red-fruited Saw-sedge	1 per m^2
		Pandorea pandorana	Wonga Vine	1 per m^2
		Viola hederacea	Showy Violet	2 per m^2
Ground Cover Area (refer Concept Landscape Plan)	Canopy	*Casuarina glauca*	She-Oak	1 per 70 m^2
		Eucalyptus robusta	Swamp Mahogany	1 per 70 m^2
	Ground Layer	*Baumea articulata*	Jointed Twig-rush	4 per m^2
		Baumea rubiginosa	Soft Twig-rush	4 per m^2
		Carex appressa	Tall Sedge	4 per m^2
		Juncus usitatus	Common Rush	4 per m^2
		Lomandra longifolia	Spiny-headed Mat Rush	4 per m^2
		Phylidrum lanuginosum	Woolly Frogmouth	4 per m^2
		Schoenoplectus validus	River Club-rush	4 per m^2
		Villarsia exaltata	Yellow Marsh Flower	4 per m^2

Table 9 Supplementary Planting Schedule for Follow-up Plantings in 3rd or 4th year

Zone	Type of Vegetation	Scientific Name	Common Name	Densities	Comments
Tree & shrub Area (refer	Shrub Layer	*Cyathea australis*	Rough Tree-fern	1 per 10 m^2	TO BE PLANTED IN 3rd or 4th

Concept Landscape Plan)					YEAR
	Groundcover	*Adiantum aethiopicum*	Common Maidenhair Fern	2 per m^2	TO BE PLANTED IN 3^{rd} or 4^{th} YEAR
		Calochlaena dubia	Soft Bracken	2 per m^2	TO BE PLANTED IN 3^{rd} or 4^{th} YEAR
		Gleichenia dicarpa	Pouched Coral-fern	2 per m^2	TO BE PLANTED IN 3^{rd} or 4^{th} YEAR

3.5 Creek Corridor Vegetation Monitoring and Management

The wetland and creek corridor vegetation monitoring and management has been compiled by the landscape architects, Taylor Brammer Landscape Architects. Their Vegetation Management Plan is provided in Appendix J.

3.6 Creek Corridor Rehabilitation and Site Staging

With reference to the staging plans in Appendix H, it is likely that Stage 1 would proceed before the interim creek works are constructed. This could partly be on account of timing issues associated with 3A Permit Applications. A temporary arrangement would thus be required for Stage 1, and runoff for this condition could be detained in a pond approximately located in the area of Buildings D and F, extending towards the proposed wetland. In a similar manner, for Stage 2 (RACF) a pond approximately in the location of Building C could be provided. Stages 3 and 4 would require construction of the interim creek works as further detailed in Section 5.2.

4. Water Cycle Assessment

4.1 Daily Rainfall

Daily rainfall data was available for the Bureau of Meteorology station at Mona Vale Golf Club (Station 066141) between 1969 and 1995. Data was missing for the years of 1971 and 1982. The average annual rainfall, for years with complete records, was 1113 mm with values ranging from approximately 620 mm to approximately 1820 mm.

The period between 1987 and 1993 inclusive was selected for the water balance assessment analysis, as these include periods of high and low rainfall. Total annual rainfall for the selected period is summarised in Table 10.

Modelling results are reported for 1987 (approximately average annual rainfall year), 1988 (wet year) and 1993 (dry year), and for the average of the 7 year period.

Table 10 Annual Rainfalls at Mona Vale Golf Club (St. 066141)

Year	Annual Rainfall (mm)
1987 (average)	1126
1988 (wet)	1820
1989	1645
1990	1712
1991	917
1992	916
1993 (dry)	670
Average	**1258**

4.2 Water Re-use

Water re-use on the site is proposed as a minimum to capture roof water in tanks associated with the buildings. This water will be used for toilet flushing and immediate building grounds irrigation re-use.

4.2.1 Re-use Water Demands

The building hydraulics consultants advised estimated toilet re-use demands for each of the buildings based on unit types and occupants. Detailed calculations how the estimates were derived are provided in Appendix L, and daily demands summarised in Table 11. It has been assumed that roof water will be reused and reticulated for toilet and irrigation of grounds surrounding the buildings. Irrigation demands were provided by the landscape architects and are summarised in Table 12. The total landscape area for the site equals 3.4 ha.

Table 11 Toilet Re-Use Estimate per Building

Building	No. Units	No. Occupants	Toilet flushing Demand (l/day)
A	22	42	1260
B/C	42	80	2400
D	36	71	2130
E	30	60	1800
F	30	60	1800
G	33	64	1920
H	30	60	1800
I	24	44	1320
J	12	23	690
RACF			3600

Table 12 Site Irrigation Demands (after allowing for rainfall)

Month	Plant Needs (mm)	Demand for 3.4 ha (kl/day)
Jan	110	12.06
Feb	88	10.32
Mar	82	8.99
Apr	63	0.00
May	45	0.00
Jun	39	0.00
Jul	45	0.00
Aug	57.5	0.00
Sep	70.5	7.99
Oct	85.5	9.38
Nov	96	10.88
Dec	119.5	13.11

4.3 Assessment Methodology

The water cycle assessment has been undertaken using MUSIC (Version 3.01). In accordance with the WMR, simulations were undertaken for the following scenarios:

- Pre-development, assessing the existing site, and

- Post-development:
  - Without re-use strategies; and
  - Incorporating the water re-use strategies.

4.3.1 Pre-development

The existing site was digitised into sub-catchments (based on the existing lots) and pervious/ impervious areas were determined. It was assumed that all roof areas from dwellings and glass-houses drained to the adjacent grounds, which could either be pervious or impervious. The entire runoff was assumed to drain to Narrabeen Creek. Key data included:

- Total site area 6.65 ha;
- Total roof area or 1.5 ha;
- Total pervious area of 3.7 ha; and
- Parking and gravel areas surrounding buildings of 1.45 ha.

4.3.2 Post-development

The site was delineated into a number of sub-catchments, representing roof runoff and on-ground pervious/impervious areas, which included roads, landscaping and other hardstand areas. Using the stormwater strategy discussed in Section 3, the following was implemented in compiling the MUSIC model:

- None of the treatment and conveyance strategies in MUSIC were allowed to infiltrate as seepage loss;
- Bio-retention runoff is included in the total site outflow;
- Roof areas discharge to 30 kL rainwater tanks at each buildings (A to J plus the RACF);
- Rainwater tanks from each building overflow to sub-surface stormwater system;
- On-ground pervious/impervious (hardstand and pavement) areas discharged to bio-retention swales located between the road and footpaths and/or bio-retention depressions;
- Bio-retention swales and/or depressions are connected to the Village lake/wetland; and
- The Village lake/wetland overflows to Narrabeen Creek.

Figure 6 shows a schematic of the MUSIC configuration for the site. Appendix L provides a summary of modelling data and detailed results.

4.4 Water Yield Results

Results of the water yield analysis were calculated on a daily basis and the results summed into annual values and for the 7-year average. The results are listed in Table 13. Appendix L provides a summary of other modelled scenarios and detailed results.

The results indicate a significant increase in the annual runoff from 37.8 ML/yr to 45.6 ML/yr on account of increased impervious areas, due to the development. These are mitigated using the proposed storage and re-use strategies, resulting in post-development runoff being less than pre-development conditions. For an average year post-development runoff will be similar to pre-development runoff. In a wet year post-development runoff could be expected to be marginally more than pre-development conditions, while in a dry year post-development runoff could be expected to be less than pre-development conditions.

While the contribution to runoff in the creek from the site during dry years could be reduced, this effect on creek runoff adjacent to the site would need to be evaluated in light of the overall catchment runoff draining to the creek at that position. The ARV site makes up approximately 3% of the entire valley upstream of Brands Lane, and thus the impact of reduced runoff from the ARV site during a dry year is expected to be small.

Table 13 Water Yield Results

Year	Annual Rainfall (mm)	Existing (ML/yr)	Developed No Reuse (ML/yr)	Developed with Reuse (ML/yr)
1987(avg)	1126	28.4	36.8	27.7
1988 (wet)	1820	62.8	72.4	63.3
1989	1645	55.6	64.6	56.3
1990	1712	62.8	70.9	62.0
1991	917	24.5	30.8	22.7
1992	916	20.1	27.2	20.1
1993 (dry)	670	10.7	16.9	8.7
Average	**1258**	**37.8**	**45.6**	**37.3**

4.5 Swamp Mahogany Impact Assessment

As part of the draft DA conditions (Appendix D), comments on the potential hydrological impact to the swamp mahogany located along Narrabeen Creek, opposite No's 10, 8 & 6 Macpherson Street, due to the development are required. To this end, Anne Clements and Associates were commissioned. Anne Clements and Associates was briefed on the hydrology by GHD, and was provided supported with a number of hydrological simulations results. In addition, the following two documents were made available:

- Pittendrigh Shinkfield Bruce (2005): Narrabeen Creek Riparian Restoration Vegetation Management Plan. Prepared for Anglican Retirement Village. Dated 20 October 2005; and

- Tree and Landscape Consultants (2005): Arboricultural Assessment Report. 6-14 Macpherson Street Warriewood 2102; Prepared for Pittendrigh Shinkfield Bruce; dated 8 September 2005.

The Anne Clements and Associates report and associated addendum (Appendix M) provides key correspondence with Anne Clements and Associates. Key findings of the Anne Clements and Associates reports are:

- Eucalyptus robusta is a dominant species of the Open-forest form of Coastal Swamp Forest Complex (map unit 27a) mapped by Benson and Howell (1994) in the southeast of the Site and extending off site adjoining Narrabeen Creek. The Coastal Swamp Forest Complex includes Reedland dominated by Phragmites australis and Typha orientalis;
- By assessing impacts of the proposal on the key species Eucalyptus robusta of endangered ecological community Swamp Sclerophyll Forest, the effects on the community can be assessed;
- The effects of the proposal, based on GHD (2006) modelling (Appendix 1), is to decrease the existing depths of inundation of the area containing Swamp Mahogany within the creek corridor on and to the north of the Site and shorten duration of the period of inundation. The resultant hydrological changes from the development proposal on the Site are not likely to lead to death or decline of Eucalyptus robusta; and
- Commenting on the impacts during dry years, it was noted that *Eucalyptus robusta* is an adaptable landscaping and commercial timber species that has been found to grow in a range of habitats. A 17% reduction in runoff from the Site during dry years (for example 1993) is not likely to lead to death of *Eucalyptus robusta*. It is likely that *E. robusta* may show reduced growth and vigour in response to the reduced soil moisture in dry years.

4.6 On-site Detention and Permissible Site Discharge

4.6.1 General

Requirements of the WMS in terms of on site detention (OSD) and permissible site discharge (PSD) are provide in Section 2.4.2. Based on a total site area of 6.65 ha, Table 14 lists the on-site detention requirements and permissible site discharges applicable to the ARV site. As mentioned before, the site is mostly located within Sector 4. To this end it is elected to use the Sector 4 PSD requirements for the ARV site.

Table 14 OSD and PSD requirements for the ARV site

Item	WMS Requirements
Onsite Detention:	2447 m^3
Permissible Site Discharge:	Sector 4

Item	WMS Requirements
100-yr - 30 min	612 l/s
100-yr - 1 hr	1057 l/s
100-yr - 2 hr	1104 l/s
100-yr - 3 hr	964 l/s
100-yr - 6 hr	1004 l/s

4.6.2 Methodology and Results

A DRAINS stormwater model was established for the ARV site according to the Stormwater Management Concept Plan outlined in Section 3.1. This allowed:

- Calculation of on-site peak flood events; and
- Confirmation of conformance to the PSD's and SSR requirements.

The results indicated that the PSD and SSR values would be achieved as indicated in Table 15. Figure 3 shows a plan of the DRAINS model layout, while detailed output is provided in Appendix N. Figure 4 provides a comparison pre and post-development hydrographs discharging from the site.

Table 15 DRAINS simulation results of PSD and SSR

Item	Proposed PSD and SSR
Onsite Detention:	2500 m^3
Calculated Site Discharge:	Sector 4
100-yr - 30 min	888 l/s (to be throttled using a multi- stage outlet)
100-yr - 1 hr	1030 l/s
100-yr - 2 hr	1020 l/s
100-yr - 3 hr	943 l/s
100-yr - 6 hr	910 l/s

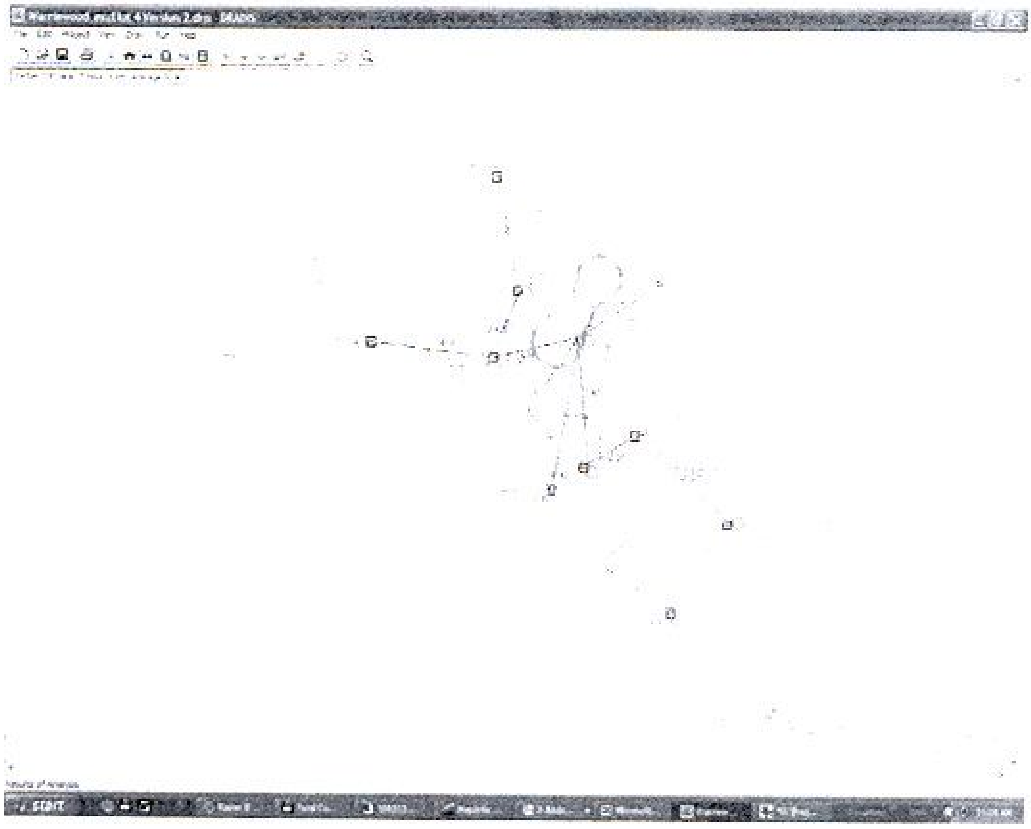


Figure 3 Plan of DRAINS model set-up

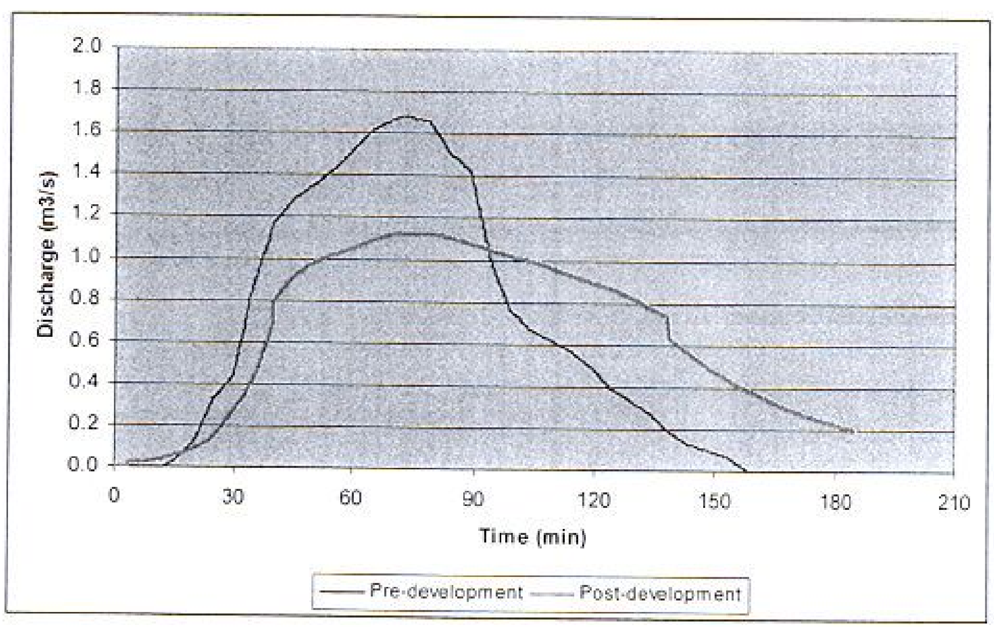


Figure 4 Comparisons of Event Hydrographs

5. Narrabeen Creek Corridor Rehabilitation Design and Flooding

5.1 Methodology

Narrabeen Creek corridor rehabilitation design and flooding assessment has been undertaken in two separate models:

- For the creek rehabilitation design: A HECRAS model was used to undertake the creek concept hydraulic design and calculate flood levels for the creek corridor adjacent to the ARV site for a range of events; and
- For 100-year and PMF flooding assessment: The 2-D SOBEK model was used by Cardno Lawson Treloar to simulate the passage of the 100-year ARI and PMF events through the Warriewood Valley and determine/mitigate the impact of the proposed ARV site on valley wide flood levels. The simulations were undertaken by Council's Water Management Consultants Cardno Lawson Treloar, and were based on the SOBEK model used for the Warriewood Flood Study.

  The reasons for this approach was that the conveyance of the 100-year ARI and PMF events through the Narrabeen Creek Valley is complex due to inflow assumptions, numerous overflow channels, interaction with existing developments and associated landforms, lag and attenuation effects and other hydraulic controls. These are best simulated using the already established 2-D SOBEK model.

  The simulation methodology was undertaken using an iterative approach involving in excess of 10 iterations of creek and site landforms. This simulation approach is further described in Section 5.3.1.

5.2 Narrabeen Creek Corridor Rehabilitation Design

5.2.1 General

General design requirements for the creek rehabilitation works are:

- Creek corridor design must be in accordance with the WMS;
- Creek design must transition with either the natural profile at Brands Lane or the works upstream of Brands Land undertaken adjacent to Sector 2;
- Creek design must accommodate a range of flood events and contain the 100-year ARI flood within the 50 m wide riparian corridor;
- Works are not to adversely affect (direct flow onto) the downstream property located south-west of the ARV site;
- There must be a minimal impact on the Sydney Water STP and associated facilities; and
- Creek corridor must incorporate the Swamp Mahogany area (Figure 1) on the opposite bank of 6 and 8 Macpherson Street.

It is ARV's preference that the creek detailed design, construction and landscaping will be undertaken by Council. The creek construction works will require an Environmental Management Plan, which will address PASS issues as well as erosion and sediment control during construction. PASS is further discussed in Section 5.2.6.

5.2.2 Definitions: "Ultimate" versus "Interim"

For the purposes of this WMR the following definitions are adopted:

- Ultimate: this scenario represents the full development of the ARV site plus the full rehabilitation of Narrabeen Creek. This will require landowners on the northern bank to rehabilitate the creek on their property; and
- Interim: this scenario represents the full development of the ARV site plus the half rehabilitation of Narrabeen Creek, along the entire reach adjacent to the ARV property. This rehabilitation would be south of the creek centreline. ARV has advised us that they are negotiating access to the creek for the purposes of construction, on the southern bank up to the existing creek centreline, as it currently exists. This scenario will not require landowners on the northern bank to rehabilitate the creek on their property, and the existing topography would prevail north of the creek centre line.

5.2.3 HECRAS Simulations

The HECRAS model has been used to undertake the creek concept hydraulic design and calculate indicative flood levels for the creek corridor adjacent to the ARV site. The extent of the modelling is from downstream of Brands Lane to the downstream site boundary (downstream boundary of 6 Macpherson). Flow rates and downstream boundary conditions, for use in the analysis have been extracted from design information listed in Section 2.4.1. Further details of HECRAS modelling are included in Appendix O.

5.2.4 Existing Conditions

An analysis was undertaken for the creek existing conditions. Cross sections were extracted from survey information provided by Council and covering the area from Brands Lane to beyond the Macpherson crossing over Narrabeen Creek. For comparative purposes, calibration of the HECRAS model was undertaken by adjusting the Manning's n roughness until flood levels agreed with the existing conditions modelling results simulated by Cardno Lawson Treloar using the SOBEK model.

The flood profiles were calculated for the PMF the 100-, 20-, 5-, 2- year ARI design events. Further details of HECRAS modelling are included in Appendix O.

5.2.5 Proposed Creek Rehabilitation

Ultimate

A number of creek cross-sectional arrangement options were iterated. While iterating cross-sections, in addition to the factors mentioned in Section 5.2.1, the following was considered:

- The fact that the creek in this area experiences backwater effects from downstream, particularly during larger events; and
- The requirement for locating a cycleway above the 5-year ARI event flood level; and
- The requirement that the cross-section must permit overflow to the swamp mahogany area.

The two cross-sections considered being the most appropriate for the site were:

- A trapezoidal channel section, approximately 1.8 m deep with a 20m wide base and side slopes of approximately 1V:5H; and
- A compound channel section with a 0.5 m deep 6 m wide low flow base channel with 1V:6H low flow side slopes. From here the high flow section had 1V:20H base slope and a 1V:6H low flow side slope to a depth of approximately 0.5m

Of these two cross-sections, the preferred option was considered the trapezoidal channel. It is proposed, during detailed design of creek works that erosion risks will be further examined. During this time, the design will be refined to provide a ecological channel, which will likely include a small low flow channel within the main channel to route dry weather flows along a predetermined path. The proposed design cross-sections for the ultimate scenario are provided in Appendix P.

For the creek reach adjacent to the swamp mahogany, it is proposed to limit the creek rehabilitation to the southern bank. Invert levels will be similar to existing invert level to facilitate the lateral flow processes to provide the swamp mahogany inundation, which presently exists.

Interim

An interim condition analysis was undertaken on the assumption that the proposed creek rehabilitation works have been undertaken, on the southern side of Narrabeen Creek, as described in Section 5.2.2 above. ARV has advised us that they are negotiating access to the creek for the purposes of construction, on the southern bank up to the existing creek centreline, as it currently exists.

For the northern bank it was assumed that existing conditions landform prevails. In all analysis it was assumed that the same water levels would exist at the downstream end of Narrabeen Creek, which may not necessarily be the case for the range of floods investigated, due to the effect of proposed works at the Macpherson Road crossing over Narrabeen Creek. The proposed design cross-sections for the interim scenario are provided in Appendix P

5.2.6 Pinch Points

In addition to the proposed creek profile, a 'pinch-point' is proposed in the channel opposite Building A. The purpose of this will be to attenuate the 100-year ARI event upstream of the 'pinch-point'. The pinch-point will be designed to permit overtopping by the PMF, in order to prevent an increase in PMF flood levels. Two pinch-point locations have been examined:

- Pinch-point (downstream): Opposite the village lake and upstream of the swamp mahogany area; and
- Pinch-point (upstream): Opposite Building A and at the downstream extent of the sewer pump station located in Sector 2.

For initial simulations pinch-point (downstream) was favoured as it assisted in the footpath crossing at that location. However, for the interim scenario it became apparent that the land on the northern creek bank might not be available to construct the pinch-point. Pinch-point (upstream) was thus favoured as Council has control of the land on the opposite bank, being the sewer pump station.

Further details on the performance of the pinch-points are provided in Section 5.3.

5.2.7 Acid Sulphate Management for Creek line Corridor Works

The creek rehabilitation works are not planned to lower the level of the existing creek invert. However, cuts of up to 2.5 m depth into the adjacent ground surface are possible in selected locations as a result of planned channel widening. Such cuts are expected to encounter the existing groundwater table draining down to Narrabeen Creek. Where the excavations intersect the existing groundwater table, two PASS processes will be encountered as follows:

- Excavation spoil, where the excavated material is PASS or ASS, will require treatment; and
- The groundwater table will recede within the surrounding landscape, draining to the new (widened) 'edge of creek bed' position. This will result in the draining of a wedge of insitu soil, outside the proposed channel excavations, existing between 'old' and 'new' positions of the groundwater table draining down to Narrabeen Creek.

A permanent decrease in the groundwater level, as indicated in the second point above, may result in acidification of the insitu 'wedge' of soil (if PASS) and possible resultant movement of acidified water off-site. Measures to counter potential acidification of soils left in situ include:

- The use of limestone filled interception trenches and/or limestone gravel channel lining; and
- Excavation, treatment by neutralisation and reinstatement of the 'wedge' materials. In this exercise it will be necessary to first excavate a probable non-PASS surficial soil lying above the current groundwater table, then to remove underlying PASS soil down to say 0.3m below the estimated new (lowered) groundwater table, for treatment and reinstatement.

The measure/s selected will be determined by a combination of the existing groundwater profile, the depth of the proposed cuts, the topography and Council preferences. The groundwater profiles draining down to Narrabeen Creek should be determined in the areas where cuts are planned, and these reviewed by a PASS experienced geotechnical engineer, in order to select/agree the appropriate measures for addressing the PASS processes identified above.

Water quality monitoring (standpipe) piezometers should be installed at regular locations along the creek channel (downstream of any limestone filled interception trenches). Typically the pH should be within pH 6 to pH 8, and conductivity less than 1dS/m or equivalent to the surrounding surface water (if this has a higher conductivity). Treatment on a case by case basis would need to be considered, should the results of this monitoring indicate that acidified water (pH<5) is draining from the adjacent land into Narrabeen Creek within the re-profiled channel zone.

The Acid Sulphate Soils Management Plan (GHD, 2005b), discussed in Section 2.5 has been updated to address acid sulphate management for works on the site, and specifically the creek line corridor works as described above.

5.3 100-year and PMF event simulations using SOBEK

5.3.1 General

To simulate the conveyance of the 100-year ARI event and the PMF at the site, and to examine the on-site and off-site effect on flood levels in the vicinity of the site, simulations were undertaken using the SOBEK model held by Cardno Lawson and Treloar. This model has been used throughout the Warriewood Valley and was considered the best means to test the impacts of the ARV site development and associated creek rehabilitation works (both ultimate and interim).

In compiling the SOBEK model to simulate the impact of the site on 100-year and PMF levels, the following methodology was used:

- Cardno Lawson Treloar were provided with proposed site landforms and creek rehabilitation concept designs as a DTM, which was inserted into the SOBEK model;
- Cardno Lawson Treloar then simulated the SOBEK model and reported the results in a letter report and as a series of MAPINFO tables of depth flood level and velocity, on a 5x5 m grid; and
- The results were interpreted by GHD and adjustments made to the landform as necessary; within the overall site constraints.

The above procedure was iterated a number of times, with key changes listed in Table 16 below. Detailed Cardno Lawson and Treloar output reports are provided in Appendix Q.

5.3.2 Interim Simulations ("full" versus "partial" rehabilitation)

With reference to Section 5.2.2 regarding definition of "interim", the base interim scenario requires that the entire ARV site would be fully constructed, however Narrabeen Creek will be rehabilitated for the entire reach length adjacent to the site, only on the southern creek bank. ARV has advised us that they are negotiating access to the creek for the purposes of construction, on the southern bank up to the existing creek centreline, as it currently exists.

Over and above this base interim scenario, a number of additional simulations have been undertaken, which include partial construction of the "interim" creek rehabilitation. These included the situations where:

- The development would occur in a number of stages, and that the creek rehabilitation would only occur adjacent to each stage; and
- That the triangle of land, which protrudes across current the creek channel on Lot 10 was not in the ownership of ARV. Rehabilitation could therefore only occur on the southern bank, upstream and downstream of the triangular piece of land. The triangular portion of land (in the creek buffer zone) is in the process of being acquired by ARV, which will enable this part of the creek to be constructed and maintained. Formal agreement between ARV and the landowner will enable the balance of the triangular piece of land in the creek corridor zone to be accessed for creek construction and maintenance. A Section 96(1A) Application has been submitted to Council to incorporated the full triangular portion of land into the DA;

For ease of reference the simulations are defined as:

- Interim (full) - Site Option 1: Base case as described above;
- Interim (partial)- Site Option 2: For this scenario, the entire ARV site would be constructed and Narrabeen Creek will be rehabilitated for the reach length adjacent to the site, within the ARV lot boundary. This excludes the triangle of land, which protrudes across current the creek channel on Lot 10. Rehabilitation would only occur on the southern bank as before upstream and downstream of the triangular piece of land;
- Interim (partial) - Site Option 3: For this scenario, part of the ARV site would be constructed. The constructed part essentially allows Stage 1 of the works to proceed. The remainder of the land would at existing ground level. Narrabeen Creek would be rehabilitated for the reach length adjacent to the site, within the ARV lot boundary. This excludes the triangle of land, which protrudes across current the creek channel on Lot 10. Rehabilitation would only occur on the southern bank, upstream and downstream of the triangular piece of land (Interim (partial) - Site Option 3 is shown at the end of Appendix Q); and
- Interim (partial) – Site Option 4: This is essentially a variation of Interim (partial) - Site Option 3, which responds to an adjusted bulk earthworks platform for Stage 1 works. The platform protrudes slightly beyond the Interim (partial) - Site Option 3 (Interim (partial) – Site Option 4 is shown at the end of Appendix Q).

5.3.3 Model Iterations

Table 16 100-year ARI and PMF event SOBEK Model Iterations

Iteration	Simulation Report Date	Key Changes
1	17 June 2005 (Ult 3)	[Original landform simulated]
2	15 July 2005 (Ult 11 & 12)	Significant changes to landform to better convey PMF through the site. Two runs were undertaken, namely with a high site roughness and with a low site roughness factor.
3	27 September 2005 (Ult 65)	Further adjustments to the landform, buildings moved, updated to Rev F layout and estimation of roughness according to proposed site land use and landscaping. In addition a 100-year ARI pinch-point (downstream) was introduced to attenuate the 100-year event.
4	10 October 2005 (Ult 68, 69, 70 & 71)	Site entrance levels raised, flow entries from Brands Lane throttled and overflow opportunities increased between buildings at downstream site boundary. Three options of 100-year pinch-point (downstream) are investigated.
5	29 November 2005 (Ult 73 & 74)	Modifications to the DTM at the site entrance and exist and ground levels throughout the site were raised to raise building floor levels. Some buildings were relocated and the full creek was simulated with a pinch point (downstream)
6	8 December 2005 (Ult 75)	Site design is same as for 29 November simulations. Interim (partial) – Site Option 2 creek condition was simulated which involves construction of half the creek for part of the creek line reach.
7	31 March 2006 (Ult 80, 81 & 83)	Simulations of the ultimate site layout, the Interim (full) – Site Option 1 site layout with half creek construction adjacent to the site, and an Interim (partial) – Site Option 3 site layout that assumes a phased development (north-western portion of site remains undeveloped). A number of grid adjustments were made to manage the PMF flow for the ultimate conditions.
8	2 June 2006 (Ult 83 – 6hr)	Simulations of the 6 hr design storm, as this is the critical storm at the Warriewood STP. The purpose was to investigate off-site flood risk impacts, due to marginally raised flood levels.
9	18 July 2006 (Ult 84)	Simulations of an Interim (partial) – Site Option 4 site layout that would facilitate the phased development of the site. The site has no development on a large portion of the north-western corner, and Buildings A to F and the RACF would not be constructed
10	7 December 2006 (Ult 88 [interim] and	Simulations of an Interim (full) – Site Option 1 site layout. In these simulations, the creek profile was widened opposite Building A and in the vicinity of the

Iteration	Simulation Report Date	Key Changes
	Ult 89 [Ultimate])	lake. In addition the pinch-point was moved to upstream and a floodway was provided between Building A and the RACF. The purpose of these simulations was to mitigate raised flood levels observed in Iteration 7, Interim (full) – Site Option 1 simulations. In addition, the roundabout in Macpherson Street was represented in the model.

5.3.4 Discussion of Results

Key findings and actions inferred from the Cardno Lawson and Treloar simulations are listed in Table 17.

Ultimate Scenario

Based on the results, significant effort has been made to accommodate the passage of the 100-year ARI event and the PMF through the site. From Iteration 10 it can be seen that for the ultimate conditions, the passage of the PMF does not result in flood level increases off site, however the 100-year flood results in flood level increase in the order of 20 to 50 mm downstream of Macpherson Street. The potential effect of this on STP operations is further discussed and reported in Section 5.5. In a PMF, flood levels are lowered upstream and in the vicinity of Brands Lane and Macpherson Street. Flood levels are increased between 50 to 100 mm, however the increases are primarily contained within the creek corridor adjacent to the site.

Interim Scenario

The results for the interim scenario are similar to the results of the ultimate scenario., with flood levels generally reducing upstream and adjacent to the site. In the case of the 100-year ARI flood, flood level increase in the order of 20 to 50 mm downstream of Macpherson Street as with the ultimate scenario.

Table 17 Key SOBEK Findings and Actions

Iteration	Simulation Report Date	Key Findings and Actions
1	17 June 2005 (Ult 3)	100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are raised upstream of site by up to 150 mm at Brands Lane and decreasing through Sector 11. PMF lowered along Narrabeen Creek adjacent to the site. Action: Lower the landform to permit PMF passage
2	15 July 2005 (Ult 11 & 12)	High site roughness factor: 100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over

		Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are raised upstream of site by between 50 and 100 mm at Brands Lane and decreasing through Sector 11. PMF lowered along Narrabeen Creek adjacent to the site. Low site roughness factor: 100-YR ARI: same as above. PMF: Flood levels are lowered upstream of site by between 10 and 50 mm at Brands Lane and through Sector 11. PMF levels are raised downstream of the site by between 10 and 30 mm for some 200m downstream of Macpherson Street crossing over Narrabeen Creek.
3	27 September 2005 (Ult 65)	No significant change from the Iteration 2 low site roughness factor simulation results. Some benefits of the 100-year pinch-point (downstream) were observed.
4	10 October 2005 (Ult 68, 69, 70 & 71)	Similar trends as iteration 2 and 3: 100-YR ARI: Significant reduction on downstream impacts of raised flood levels achieved using a smaller pinch-point (downstream) opening. Flood levels raised upstream of 'pinch-point' by between 100 and 150 mm. PMF: PMF levels raised in comparison to Iteration 3 at Brands Lane and through Sector 11. Impact of raised PMF downstream of site reduced by between 10 and 30 mm (compared with previous iteration)
5	29 November 2005 (Ult 73 & 74)	100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are raised upstream and south of Macpherson Street by up to 50 mm. In addition flood levels raised in Sector 11 and 12. PMF lowered along Narrabeen Creek adjacent to the site. Inclusion of a pinch point (downstream) in Narrabeen Creek was noted to have an effect.
6	8 December 2005 (Ult 75)	100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are raised upstream and south of Macpherson Street. In addition flood levels raised in Sector 11 and 12. PMF lowered along Narrabeen Creek adjacent to the site.
7	31 March 2006 (Ult 80, 81 & 83)	Ultimate Condition 100-YR ARI: Flood levels are lowered upstream of the site. Flood levels increases in the order of 20 to 50 mm are noted downstream of Macpherson Street in the case of the low tail water simulation only. PMF: Flood levels are lowered upstream of the site. No

		increase in flood levels off-site is noted. <u>Interim (full) – Site Option 1</u> 100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are raised upstream and south of Macpherson Street by approximately 100 to 150 mm. In addition flood levels raised in Sector 11. <u>Interim (partial) – Site Option 3</u> 100-YR ARI: similar to the above PMF: Increased flood levels are mitigated, and flood levels decreased upstream of the site
8	2 June 2006 (Ult 83 – 6hr)	Simulations of the 6hr design storm, as this is the critical storm at the Warriewood STP. The purpose was to investigate off-site flood risk impacts, due to marginally raised flood levels.
9	18 July 2006 (Ult 84)	Similar to Interim (partial) – Site Option 3, however flood levels are raised 50 mm in Brands Lane and 100 mm in Macpherson Street. It appears these increases are contained generally within the road reserve.
10	7 December 2006 (Ult 88 [interim] and Ult 89 [Ultimate])	<u>Ultimate Condition and Interim (full) – Site Option 1</u> 100-YR ARI: Flood levels are raised downstream of site by between 10 and 50 mm, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. PMF: Flood levels are lowered upstream and in the vicinity of Brands Lane and Macpherson Street. Flood levels are increased between 50 to 100 mm, however the increases are primarily contained within the creek corridor adjacent to the site

5.4 Flood Levels

Pittwater Councils DCP 30 categorises the proposed development site as "Special Flood Protection Purpose". Based on this, *"all floor levels must be at or above the PMF level or Flood Planning Level (whichever is the higher)".*

Appendix S provides ultimate condition (Ult 88 and 89) flood maps showing the 100-year ARI and PMF flood levels. All ultimate developed condition data shown has been extracted from the Cardno Lawson Treloar Iteration 10 results (see Table 17). Referring to these maps and Appendix Q, the following is noted:

- Referring to Table 18, for both the interim and ultimate development scenario (Iteration 10), floor levels of habitable buildings across the site are at or above PMF levels at the building entrances. While non-residential Buildings K and J are removed from the creek, their floor levels are nevertheless approximately 0.30 to 0.50 m above the 100-year ARI level within the creek respectively;

- Referring to Table 18, for both the interim and ultimate development scenario (Iteration 10) PMF flood levels are higher at a few locations around the Building H, I and RACF perimeter. It is argued that the building entrances are at or above the PMF level. Furthermore, at worst the perimeter PMF level is 160 mm higher than the floor level for a short duration in a PMF event;
- The two entries to underground car parking at Building A/B and Building F) are at levels 6.00 m and 5.45 m, and are therefore above the PMF flood level. For the RACF the building design and earthworks design is still being examined. It is the preference to raise the car park entry to above the PMF if at all possible. If this is not possible, then the design would raise the entry level to the maximum level achievable, and provide flood proofing using flood gates beyond that level to above the PMF level;
- The latest ultimate iteration (Iteration 10) of the SOBEK model shows that 100-year and PMF levels are raised up to 50 mm in selected areas downstream of the site. This effect potentially extends to areas within the Sydney Water Warriewood STP. To assess the impact of the off-site flood level increases, an assessment was made with the assistance of the Warriewood STP staff. The findings of this assessment are reported in Section 5.5; and
- It will be necessary to flood proof all basements providing ventilation with inlets above the PMF level, on outside walls.

Table 18 PMF Flood Levels at Buildings Entrances

Building	PMF Flood levels (m)				
	Floor levels (m)	At entrance		At worst location around building circumference	
		Interim	Ultimate	Interim	Ultimate
A	6.00	5.45	5.44	5.99	5.98
B/C	5.60	5.43	5.43	5.46	5.46
D	5.40	5.31	5.31	5.36	5.35
E	5.40	5.30	5.30	5.31	5.30
F	5.40	5.29	5.29	5.34	5.33
G	5.70	5.32	5.31	5.32	5.31
H	5.40	5.31	5.31	5.47	5.47
I	5.40	5.33	5.33	5.52	5.52
J (non-habitable)	4.90	5.52	5.51	5.53	5.53
K (non-habitable)	4.90	5.56	5.56	5.58	5.58
RACF	5.60	5.35	5.34	5.76	5.75

East car park	5.45	5.34	5.33
West car park	6.00	5.43	5.42

5.5 Assessment of Off-Site Flood Impacts

To assess potential off-site flood impacts in regard to the ARV site, numerous simulations have been undertaken using Councils flood model. The results of the flood modelling generally show small increases in flood levels at the Warriewood STP, located downstream of the site. Output from these simulations provided existing and post-development flood levels in Narrabeen Creek, including at the STP location.

The Warriewood STP was visited on the 8 May 2006 in the presence of Sydney Water staff. The site was inspected and all flooding high-risk areas were identified in discussion with Sydney Water. Referring to Appendix R, the critical areas identified were the Digester Entrance, galleries under the digesters, the Galleries Entrance, the Sludge Switch Room and the Detention Basin.

The flood modelling results were assessed in relation to the flooding high-risk areas and key findings were that:

- For all scenarios with low tail water conditions (relating to the assumed level in Warriewood Lagoon), none of the critical areas appear flood affected;
- The digester entrance is the most critical area on the site with flow depths being more than 0.5 m above the entrance ground level under existing conditions;
- Incremental increase in flood level compared to existing conditions is less than 10 mm for all cases and scenarios at the critical areas;
- Where an incremental increase is observed, flood inundation or overflow would be expected under existing conditions. Thus while the flood levels are increased in the order or a few millimetres, the increase in flood levels do not appear to initiate flooding in any of the critical areas. The modelling shows a change of level within the detention basin at the STP in the high tail water scenarios. While this basin is calculated to be overtopped under existing conditions and in the high tail water scenarios, the extents with which levels are shown to increase within the basin itself are considered excessive. In this regard there could potentially be a problem with the model in representing the basin.

In the conclusion of the assessment it was considered unlikely that off-site flood level increases would increase the flood risk at any of the critical areas at the STP site, as identified in consultation with Sydney Water. Further details of the assessment, together with supporting diagrams and maps is provided in Appendix R. The assessment has been forwarded to Sydney Water for comment, under a separate letter.

Subsequent to the assessment in Appendix R, further amendments have been made to the interim creek form. These have been simulated for a full range of events including events to assess if the findings at the STP site would change. The finding showed a 4 mm increase in flood levels at the Digester Entrance and Detention Basin. This increase is viewed as insignificant and therefore does not alter the above stated conclusions.

5.6 Interim Flood Protection Works

Flood protection works have focussed at amending the rehabilitated creek profile and landform for the interim scenario to provided PMF and 100-year ARI conveyance without increased flood levels off site. The proposed works are documented in Section 5.2.5, and include the following:

- Widening the creek profile between Brands Lane and the downstream extent of the sewage pump station on Sector 2;
- Providing a pinch-point at the downstream extent of the sewage pump station on Sector 2 to throttle the 100-year ARI event, however permitting passage of the PMF;
- Amending the Vegetation Management Plan for the interim scenario; and
- Providing a flood way between the RACF and Building A, which required relocation of the underground entry to basement car park under Building A.

5.7 Evacuation and Flood Emergency Management

All proposed dwelling floor levels are above the PMF flood level. As such the need for evacuation is unlikely, and a "vertical" evacuation strategy is proposed. The site generally grades towards Narrabeen Creek. An elevated area is located at the southern site boundary between No 8 and 6 Macpherson Road, rising to levels of RL 9.2 m AHD. In the event that evacuation should be necessary, some residents would be able to seek temporary shelter in this elevated area and move to higher ground away from the floodwaters. The proposed dwellings should not create any significant additional burdens on the SES or emergency services during flood times. In addition, it is expected that Macpherson Street will be significantly inundated in the vicinity of Brands Lane and at the Narrabeen Creek crossing, preventing site access to emergency vehicles during a PMF event.

Buildings K and J are non-habitable at ground level. During a PMF event evacuation from these buildings will occur to a mezzanine level in each building, located above PMF level.

6. Water Quality Monitoring and Results

6.1 Monitoring Program

Water quality monitoring was initiated in August 2004 to provide baseline data for this WMR and ongoing sampling as required by the WMS. A number of sampling tasks have been completed to date, and are reported in Appendix T in the following reports:

- Warriewood Land Release, Sector 4 Water Quality Monitoring August 2004 To January 2005 (MPR 01/2005);
- Warriewood Land Release, Sector 4 Water Quality Monitoring February To June 2005 (MPR 08/2005); and
- Warriewood Land Release, Sector 4 Water Quality Monitoring February To July 2005 June 2006 (MPR 07/2006);

6.2 Sites

Monitoring has been undertaken in accord with the requirements listed in the 2001 Water Management Specification. There are three sites as follows (refer to Figure 2):

- Site NC3 is located on the boundary of Sector 2 and 4;
- Site NC4 is located on or near the boundary of Sector 4 and Sector C; and
- An intermediate site S4 has been established in the creek within the Sector 4 area to enable sampling of stormwater runoff during wet weather sampling periods.

6.3 Results

For the period July 2005 to June 2006 the following sampling tasks were completed:

- Fourth Dry weather sampling; 9 and 12 September 2005;
- Second annual Dry weather sampling sediment quality and RBA (2 March 2006);
- Third Wet Weather Sampling (during event only) authorised by Cardno Lawson and Treloar - 15 March 2006; and
- Fifth Dry weather sampling; 19 June 2006.

The results of these sampling events were not available at the time of publishing this report, however are expected within the next week. Pre-construction sampling is continuing and a full wet weather run has been achieved in the week 17 to 21 July 2006.

Based on earlier sampling, with respect to physical and chemical results, both the dry weather and wet weather results are similar to results obtained from Narrabeen Creek upstream of Sector 4 for Sector 1 and 2 sample sites. That is, there would not appear to be any significant change in water quality of Narrabeen Creek resulting from activities on Sector 4 over the sampling periods.

Detailed results for the completed water-sampling undertaken for Sector 4 are provided in Appendix T. Key results to date are summarised below.

6.3.1 Dry Weather Sampling

- In general terms, measurements of water quality parameters upstream of the site are similar to downstream of the site, indicating no contribution from the undeveloped lots;
- Measurements at S4 are slightly elevated as this is located in an isolated pool, providing higher readings during dry weather; and
- Apart from a few of the chemical constituents, most of the key parameters were observed outside the long-term instream target value, except for pH.

6.3.2 Wet Weather Sampling

- In general terms, falling hydrograph limbs exhibit lower measured values than the rising limb, shown that water quality constituents are flushed through, and out, of the system; and
- While levels of most parameters were generally elevated, faecal coliform were significantly higher than for dry weather sampling.

6.3.3 Biotic Index (SIGNAL)

- 16 invertebrate taxa were measured at the upstream site compared with 13 at the downstream site; and
- The average SIGNAL score for the site was determined as 2.83.

6.4 Current Monitoring

Pre-construction sampling is continuing and a full wet weather run has been achieved in the week 17 to 21 July 2006.

7. Water Quality Impact Assessment

7.1 Assessment Method

The MUSIC modelling described in Section 4 was used to undertake the water quality impact assessment to simulate pre- and post-development conditions pollutant exports off the site. Sections 4.1 to 4.3 describe the rainfall, water re-use demands and simulation methodology respectively.

7.2 Adopted Water Quality Parameters

7.2.1 General

In undertaking the MUSIC modelling, the following assumptions were made:

- Event mean concentrations were adopted for both base flow and storm flow;
- Treatment efficiencies as recommended in the MUSIC manual (December 2003) were adopted;
- All seepage parameters were set to zero in the treatment devices;
- Simulations were undertaken using the Mona Vale Golf Club (Station 066141) data for the period between 1987 and 1993 inclusive; and
- Adopted pollution generation parameters were according to the WMS.

7.2.2 Compliance

The WMS specifies compliance for pollutant export to be the minimum of either a zero net increase in existing load, or an increase of 20% on the load if the catchment was forested.

Given the existing conditions land use on the site and the historic market garden uses, the increase of 20% on the load if the catchment was forested requirement is considered extreme. To this end it is elected that compliance is evaluated by ensuring a zero net increase in existing load from the site.

7.2.3 Predevelopment Surface Runoff

In accordance with Table 4.1 of the WMS, Table 19 lists the adopted parameters for the existing conditions event mean concentrations. This approach was adopted due to the lack of site-specific event data.

Table 19 Base Case Event Mean Concentrations for the Pre-Development

Scenario	Total Suspended Solids (mg/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)
Existing pollutant load	35	0.1	1

7.2.4 Post Development Surface Runoff

Post development pollutant parameters were adopted from the WMS due to lack of site data. Roof catchments typically experience lower levels of pollutant generation than other urban catchments. Therefore, pollutant concentration parameters for roofs, as sourced from Duncan (MUSIC 12/2003), were applied to roof catchments at this site.

The MUSIC model permits both stormflow and baseflow pollutant concentration parameters. Stormflow is generated principally from impervious areas while baseflow includes sub-surface soil moisture and groundwater. The parameters given in the WMS are stormflow parameters. Baseflow parameters, for given stormwater pollutant concentrations, were estimated using the same relationship between stormflow and baseflow as provided by the default parameters in the MUSIC model.

Table 20 Event Mean Concentrations for the Post-Development Condition

Catchment	Event Type	Total Suspended Solids (mg/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)
WMS Urban	Stormflow	100	0.30	1.50
	Baseflow	7.94	0.13	1.19
Roofs	Stormflow	35.0	0.14	1.00
	Baseflow	only stormflow	only stormflow	only stormflow

7.3 Water Quality Management

Water quality management at the site will be achieved primarily through:

- Rainwater retention tanks;
- Bio-retention swales (with gross pollutant traps); and
- A village wetland.

Runoff in excess of capacity of the wetland structure will overflow to the creek. MUSIC uses the first order kinetic decay mode to simulate output concentration, expressed algebraically as:

$$\frac{C_{out} - C^*}{C_{in} - C^*} = e^{-k/q}$$

Where:

- C_{out} = Output concentration (mg/L);
- C_{in} = Input concentration (mg/L);
- C^* = Equilibrium or background concentration (mg/L);
- k = Rate constant; and
- q = Hydraulic loading of the treatment measure (m/s).

Table 21 lists the adopted parameters used in each treatment device. These parameters are the default parameters for the MUSIC model.

Table 21 Pollutant Decay Parameters used in MUSIC

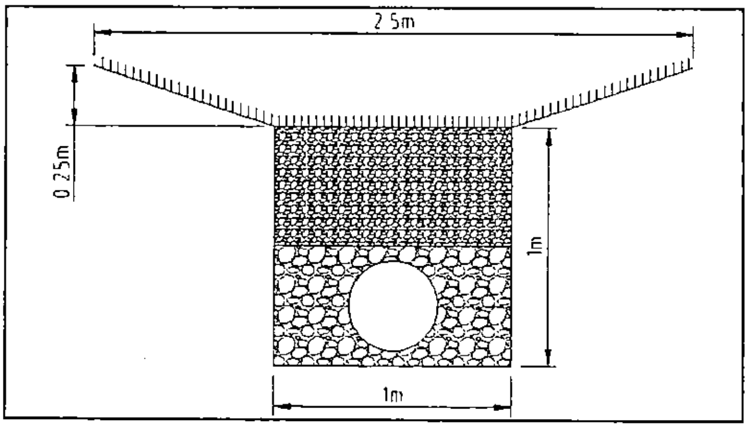
Treatment Device	Pollutant	k (m/year)	C* (mg/L)
Bioretention Swale	TSS	1000	12.0
	TP	500	0.13
	TN	50	1.3
Rainwater Tank	TSS	400	12
	TP	300	0.13
	TN	40	1.4
Wetland	TSS	5000	6.0
	TP	2800	0.09
	TN	500	1.3

The Gross Pollutant Traps (GPT's) were modelled assuming the following treatment efficiencies sourced from Walker et al (1999 MUSIC 12/2003). The relationships are:

- $TSS_{downstream} = 0.28 \times TSS_{upstream} + 27.23$;
- $TP_{downstream} = 0.64 \times TP_{upstream} + 0.13$; and
- $TN_{downstream} = 0.67 \times TN_{upstream} + 0.51$.

Bioretention swales were assumed to have the following typical cross section:

Figure 5 Bioretention Swale Typical Section



7.4 Results of Simulations

A measure of treatment train effectiveness is provided in Table 22, while Figure 6 shows a plan of the MUSIC model configuration. A comparison of pollutant loads for existing, developed without mitigation and developed with mitigation scenarios for each simulated year is provided in Table 23. The results show that the development would generally be expected to increase pollutant loads without the provision of the proposed on-site treatment strategies. The results also show that the strategies effectively mitigate the increase in pollutant loads, ensuring an improvement beyond a zero net increase in existing load from the site. This would thus satisfy the elected compliance as discussed in Section 7.2.2.

Table 22 Treatment-Train Effectiveness

Item	Source	Residual	% Reduction
Flow (ML/yr)	45.2	37.3	17.6
Total Suspended Solids (kg/yr)	2680.0	232.0	91.4
Total Phosphorus (kg/yr)	9.2	3.4	63.0
Total Nitrogen (kg/yr)	55.5	46.2	16.7
Gross Pollutants (kg/yr)	948.0	0.0	100.0

Figure 6 Plan showing MUSIC configuration

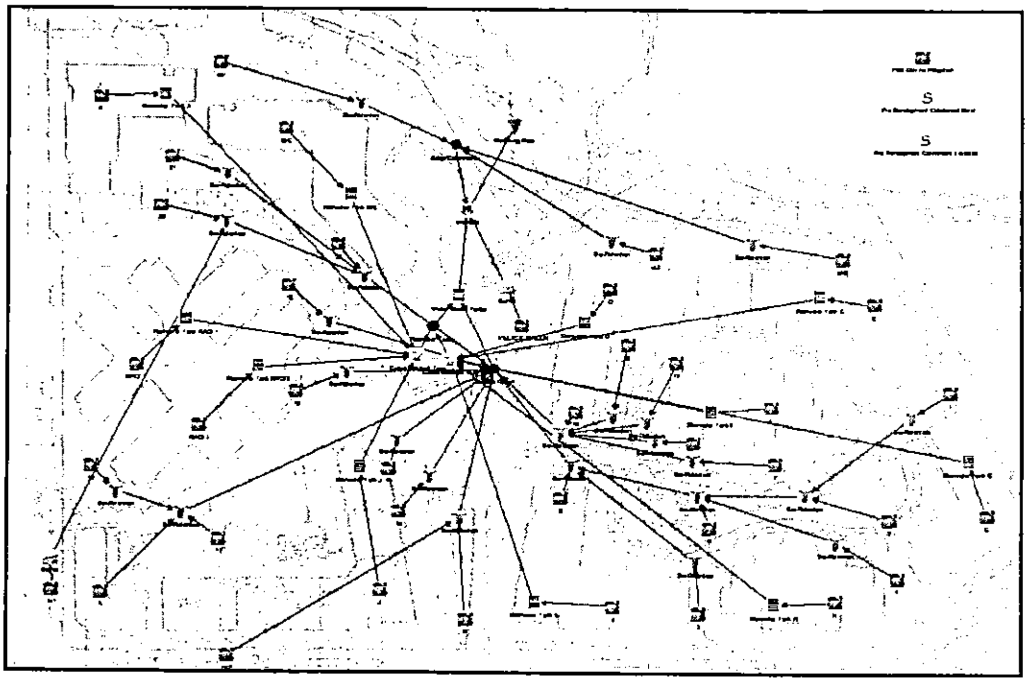


Table 23 Comparison of Pollutant Loads

Year	Flow (ML)			Total TSS (kg)			Total TP (kg)			Total TN (kg)		
	Existing	Developed No Reuse	Developed with Reuse	Existing	Developed No mitigation	Developed	Existing	Developed No mitigation	Developed	Existing	Developed No mitigation	Developed
1987(avg)	28.4	36.8	27.7	1371.0	2217.3	167.0	5.1	7.5	2.5	42.1	44.7	34.5
1988 (wet)	62.8	72.4	63.3	2917.2	4459.0	383.2	11.3	15.1	5.7	102.9	90.1	77.7
1989	55.6	64.6	56.3	2240.3	3530.4	338.6	9.2	12.7	5.1	88.5	79.0	71.6
1990	62.8	70.9	62.0	2807.3	4328.7	420.7	11.1	14.8	5.7	105.1	88.7	75.7
1991	24.5	30.8	22.7	1161.8	1857.4	138.9	4.4	6.3	2.1	37.1	37.6	27.8
1992	20.1	27.2	20.1	1004.4	1624.3	121.7	3.6	5.4	1.8	27.6	32.7	24.9
1993 (dry)	10.7	16.9	8.7	533.4	961.7	52.3	1.9	3.2	0.8	12.2	19.7	11.3
Average	37.8	45.6	37.3	1719.3	2711.3	231.8	6.7	9.3	3.4	59.4	56.1	46.2

8. Summary

- Anglican Retirement Villages (ARV) is currently planning the development of land in the Warriewood Valley. This Water Management Report (WMR) provides information for the Development Application stage;
- The ARV site, is located south of Narrabeen Creek and is bounded on the north-west by Brands Lane and on the south-east by an adjacent allotment (Lot 4) off Macpherson Street. It includes five properties along the south bank of Narrabeen Creek. The lots that define the subject study site are No 14, 12, 10, 8, and 6 Macpherson Street. The total site area is 6.65 ha;
- The Stormwater Management Concept Plan for the site incorporates grading the site towards the existing topographic depression on the site, which will be rehabilitated and upgraded to a Village lake/wetland, a "treatment train approach" to treat all stormwater runoff quality (using bioretention swales and the wetland), and rainwater harvesting from roofed areas to supply non-potable toilet and irrigation demands;
- A water cycle assessment has been undertaken using MUSIC for pre- and post-development scenarios. The results indicate a significant increase in the annual runoff on account of increased impervious areas due to the development. These are mitigated using the proposed storage and re-use strategies, resulting in post-development runoff being less than pre-development conditions;
- Narrabeen Creek corridor rehabilitation design and flooding assessment has been undertaken using the HECRAS model to undertake the creek concept hydraulic design and Council's 2-D SOBEK model by Cardno Lawson Treloar to simulate the passage of the 100-year ARI and PMF events through the Warriewood Valley;
- General design of the creek rehabilitation works required conveyance of a range of flood events and containment of the 100-year ARI flood within the 50 m wide riparian corridor. The preferred option is a trapezoidal channel section, approximately 1.8 m deep with a 20m wide base and side slopes of approximately 1V:5H. It is proposed, during detailed design of creek works, to provide a ecological channel, which will likely include a small low flow channel within the main channel to route dry weather flows along a predetermined path;
- A 'pinch-point' is proposed in the channel opposite Building A. The purpose of this will be to attenuate the 100-year ARI event upstream of the 'pinch-point';
- For both the ultimate and interim development scenario (Iteration 10), floor levels of habitable buildings across the site are at or above PMF levels, except for Buildings H, I and the RACF. For these buildings, flood levels are slightly higher at a few locations around the buildings perimeter, however the building entrances are at or above the PMF level. It is argued that in the case of these buildings the PMF level is only 50 mm (and in the case of the RACF 300 mm) higher for a short duration in a PMF. Floor levels in non-residential Buildings K and J are approximately 0.45 m above the 100-year ARI level respectively.

- Water Quality monitoring has been undertaken at three sites adjacent to the site. With respect to physical and chemical results both the dry weather and wet weather results are similar to results obtained from Narrabeen Creek upstream of Sector 4 for Sector 1 and 2 sample sites. That is, there would not appear to be any significant change in water quality of Narrabeen Creek resulting from activities on Sector 4 over the sampling periods; and
- MUSIC modelling was used to undertake the water quality impact assessment to simulate pre- and post-development conditions pollutant exports off the site. Post-development was simulated with and without mitigation strategies to compare effectiveness. The results show that the proposed strategy results in an overall decrease in the TSS, TP and TN annual loads compared with the existing conditions.

9. References

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- PSB 2005, draft Vegetation Management Plan Pittendrigh Shinkfield Bruce;
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- 1:100,000 Geological Series Sheet for Sydney (9130, Edition 1, 1983)
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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
DRAFT	R Berg	G Sproats	electronic	R Berg	electronic	10/02/05
0 (& 1)	R Berg	G Sproats	On file	G Sproats	On file	16/2/05
2	R Berg	G Sproats	On file	G Sproats	On file	24/2/05
3	R Berg	I Joliffe	On file	I Joliffe	On file	20/10/05
4	R Berg	I Joliffe	Onfile	I Joliffe	In Appendix E	1/08/06
5	R Berg	I Joliffe	Onfile	I Joliffe	In Appendix E	29/11/06

Appendix A

Sector, Buffer area and Sub-sector definitions

LAND TO WHICH THIS PLAN APPLIES

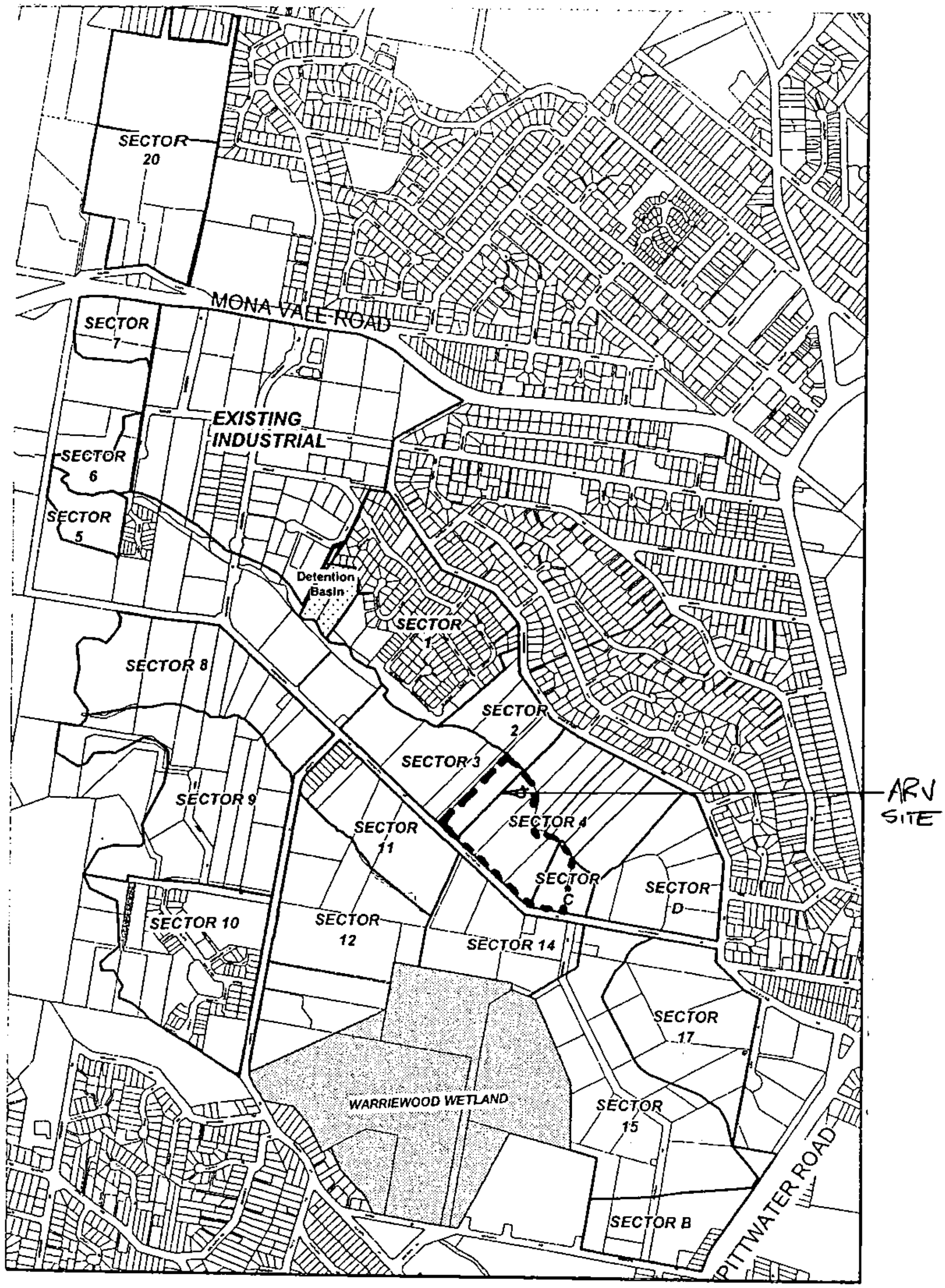


FIGURE 1.1

LAND TO WHICH THIS PLAN APPLIES

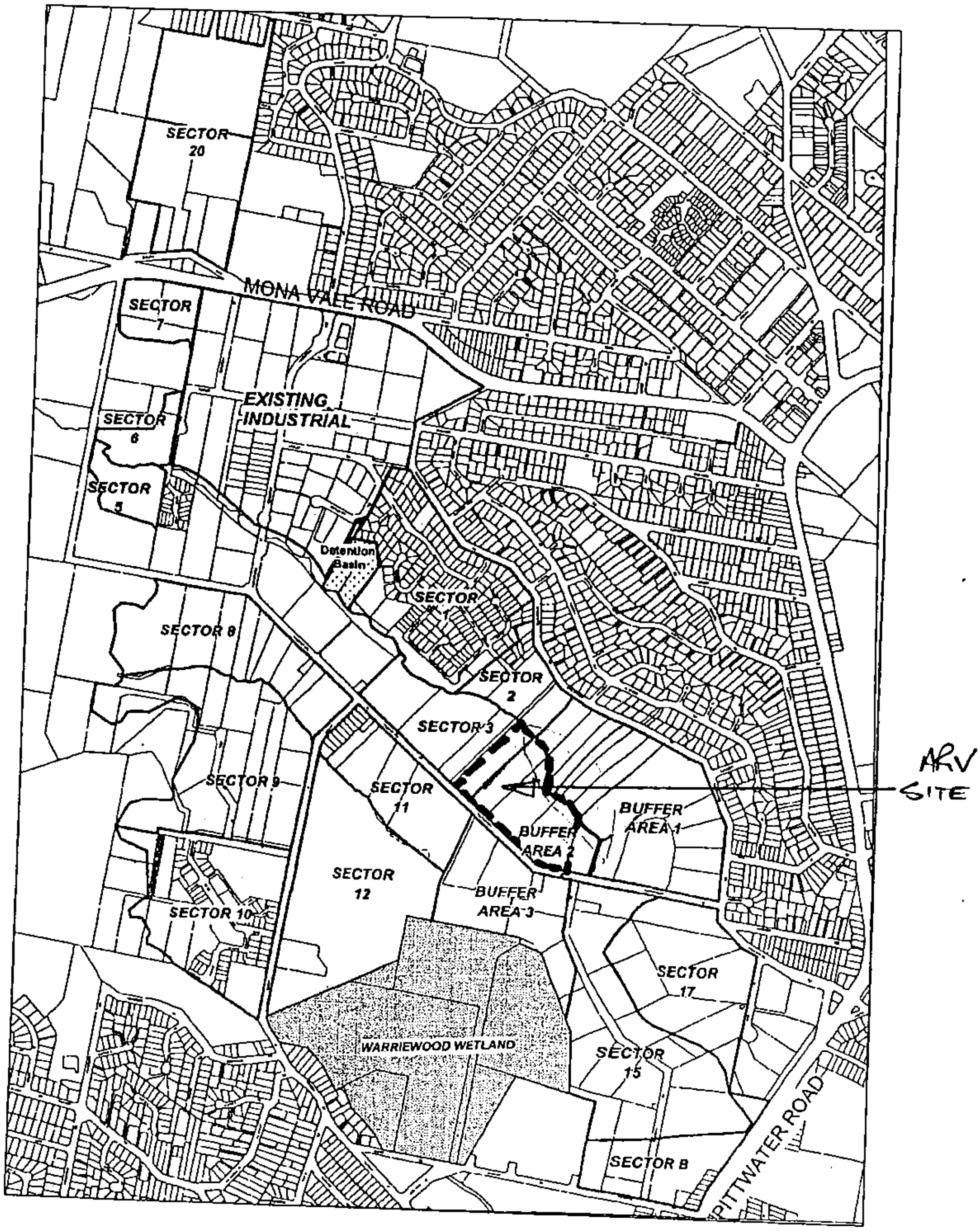
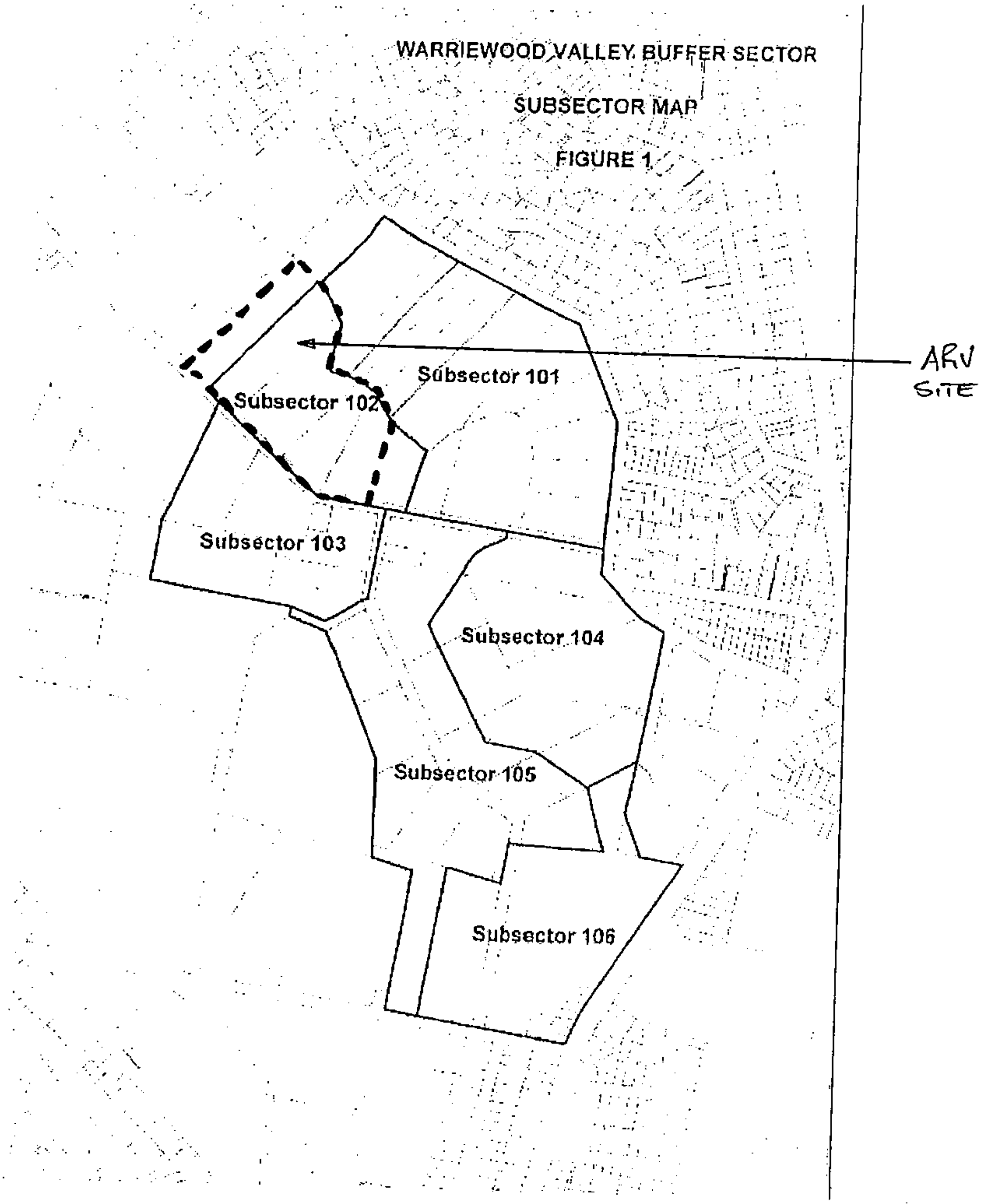


FIGURE 1.1

Figure 1


WARRIEWOOD VALLEY BUFFER SECTOR
SUBSECTOR MAP
FIGURE 1
Subsector 101
Subsector 102
Subsector 103
Subsector 104
Subsector 105
Subsector 106
ARV SITE

Appendix B

Comments received on Version 1 WMR and response to comments

ATTACHMENT A

Facsimile Transmission

Attention:	Mark Salvaterra/Ross McWhirter		
Organisation:	Pittwater Council		
Sent by:	Louise Howells	lhowells@cardno.com.au	
Date:	11 April 2005		
File No:	J2202/F3864	No. of Pages:	8
Fax No:	9970 7384	☐ Urgent ☒ Routine	

Mark/Ross

BUFFER AREA 2 DEVELOPMENT APPLICATION WATER MANAGEMENT REPORT

In response to Councils letter dated 30 March 2005 and following on from our preliminary advice dated 8 April 2005 (our ref: F3858/J2202), we have prepared the following assessment of the report and provide comments on its compliance with the Water Management Specification (February 2001):

GHD (2005) *Warriewood Retirement Village Water Management Report*, Prepared for Anglican Retirement Villages, February.

This water management report is for the land known as 6 – 14 Macpherson Street, Warriewood (a total of 6.61 ha).

There are some aspects of the documentation that require clarification or are incomplete and comments on these matters are provided below.

Water Balance

Water Cycle Assessment - Water Balance Modelling Pre and Post Development and use of local rainfall data

Water balance modelling is undertaken using an in-house spreadsheet program developed by GHD. This model has been previously used for the Sector 2 water balance.

The presentation of the results is such that it is unclear as to what the scenarios are that are included in Appendix D, whilst the main text indicates that there are two scenarios – an undeveloped case and a developed case, there is no identifying text in the Appendix to allow for the reader to distinguish this easily.

In the developed case, the model assumes a tank volume for reuse of 400 kL which appears to be consistent with the diagram in Appendix C that shows 13 tanks of approximately 30 kL each. The model also assumes a daily use of 6800 L/day for the site. It is unclear as to how this reuse value was derived and a justification for the adoption of this value is required (possibly based on the number of residents expected and an evaluation of likely toilet, laundry etc usage per person). Reference to a published document to support these assumptions is required.

It is unclear as to how the proposed infiltration devices affect or achieve the water balance, as limited details are provided on their operation and associated assumptions. Given the apparent lack of infiltrometer data (see below), it is difficult to justify the unstated assumptions surrounding the proposed infiltration systems (such as permeable pavements and bioretention swales). Clarification of this matter is required.

The water yield is balanced on average but for specific years the proposal will result in less volume delivered to the creek in dry years (6 ML down to 2 ML) and similar volume delivered to the creek in wet years (30 ML increase to 31 ML). Thus the overall hydrological regime during dry conditions for the locality will change. A comment as to the potential effects on the local environment associated with this change is required.

The annual rainfall for 1990 in Table 6 appears to be very small and perhaps indicates a typographical error.

Stream Gauging and infiltration testing

As outlined above, no infiltration testing appears to have been done to confirm the ability of the local soils to provide the infiltration rates assumed within the MUSIC and other modelling.

A hand held flow meter has been used to assess the flows during wet weather events reported in Appendix F. However, the data has not been converted to a meaningful flow rate and reported in the main document. This data has not been used in the checking/calibration of the water balance model discussed above. However, only one event has been sampled to date and is unlikely to provide a useful calibration point at this stage. Ongoing monitoring is required in accordance with the WMS (2001).

Stormwater Retention/Infiltration Facilities

Infiltration to groundwater via permeable pavement is proposed but it is unclear as to whether there will be any effects on the acid sulfate soils in the area. Clarification of this matter is required.

As outlined above, no double ring infiltrometer testing is reported and no assumed infiltration rates are reported in the document to allow for a comparison. This information is required to assess the likely performance of the proposed bioretention measures and related infiltration measures.

Mosquito Risk Assessment

Measures to manage mosquito risks are described in Section 3.2. A detailed mosquito risk assessment is required at the time of submission of the construction certification and should be prepared by an appropriately qualified professional with experience in mosquito risk assessment.

Water Quality Monitoring Plan

Data Assessment and Interpretation

Section 6.1 of the report makes reference to the MHL website which many developers utilise for the purposes of determining the rainfall conditions within the Valley. This data source is not the only site available for determining the conditions at the site and if information is unavailable from this source the developer should seek data from other sources (such as the Bureau of Meteorology's website which contains real-time radar and real-time rainfall gauges under the ALERT system for the Sydney Metro area). It is not reasonable to excuse the absence of data collection during a period to the lack of information available from a single source.

Rapid Biological Assessment, algal sampling, metal and sediment sampling have not yet been undertaken. Data collection was proposed for February 2005. Submission of this data under separate cover would be appropriate to complete the baseline data set for the sector. Until this data is received we are unable to fully assess the baseline conditions at the site.

The proposed Chromium detection limit for water samples listed in Appendix F is insufficient to aid the comparison with the in-stream long-term objectives. Future samples should be collected with a revised detection limit.

Water Quality Management (Pollutant Load Balance)

Load Modelling Pre and Post Development

Section 7.1 outlines the adopted water quality modelling parameters for the pre-development surface runoff condition. The approach assumes a pre-development condition of 'Forested' and in accordance with the WMS, adds an additional 20% load onto the calculated load for these conditions. The WMS (2001) requires that both this condition and the condition of a zero net increase from the catchment current condition be considered and the condition that produces the minimum developed load be adopted. A review of the aerial photography and knowledge of the site indicates that the pre-development condition of the majority of the site is not forested but instead rural. Therefore, both conditions need to be assessed in order for the requirements of the WMS to be met.

The MUSIC model requires the consideration of both baseflow and stormflow. It is unclear from the report whether the event mean concentrations were adopted for both baseflow and stormflow. Clarification of this matter is required.

Clarification of which version of the MUSIC model used for the assessment is required as recent versions of the software had a substantial error with respect to the estimated performance of bioretention facilities. If a version of the software has been used with this error, the results of the MUSIC modelling will need to be recomputed and the new results reported.

A summary of the loads from the site for Suspended Solids, Nitrogen and Phosphorous under the existing and developed conditions is required to demonstrate the load balance. Details of the assumptions associated with the treatment efficiencies of each of the proposed treatment devices is also required along with a justification of the assumptions (from literature or device testing).

Stormwater Quality Facilities

The flow entry points to the proposed wetland appear to result in potential short-circuiting of the wetland and are likely to result in a minimising of the contact time for treatment. Further details on the operation of the proposed wetland are required to demonstrate the flow paths and residence time of wet weather flows.

One section of the document makes reference to the use of the Cleansall product or similar (3.1.2 and 3.1.3) and other sections of the document (3.2) make reference to the use of CDS units. A consistent approach, with reported efficiencies of the proposed units adopted in the modelling is required.

A discussion of the current groundwater level on the site where the bioretention systems are proposed and the potential effects of elevated groundwater levels on the performance is required. Additionally, a comment on the potential impact of the BRS on the acid sulfate nature of the local soils is required.

Mosquito Risk Assessment

As outlined above, measures to manage mosquito risks are described in Section 3.2. A detailed mosquito risk assessment is required at the time of submission of the construction certification and should be prepared by an appropriately qualified professional with experience in mosquito risk assessment.

Stormwater Quantity Management (Pipe Network and OSD)

Design Storm Hydrological Modelling of the Site

Only the 100 year ARI event results are shown in detail in Appendix E. No hydrograph shapes are reported for the existing and developed scenarios for the runoff from the site (as required in Section A5 of the WMS, 2001). Clarification of this matter is required.

OSD Facilities

Both the PSD and SSR for Sectors 4 and Sector C – the majority of the land proposed for development lies within the former Sector 4 (Nos 8 – 14), only No 6 lies within Sector C. Thus the PSD's appear to have been pro-rated to account for this and the SSR is sufficient. This appears to be reasonable. The storage is located within a range of basins across the site. A cross section to show the profile of these basins is required to show their depth and side batter slopes.

Stormwater Concept Drainage Plan

The stormwater drainage concept plan submitted does not show a number of features that are required including:

- 1%AEP and PMF extents
- Creekline corridors
- Easements
- Site constraints (eg location of services, trees to be retained, etc).

A summary plan showing all of the relevant information is required.

Creekline Corridor Rehabilitation

Existing and Proposed Creekline Corridor in Plan with Cross Sections and Long Section with Flood Levels

The form of the cross section presentation in Appendix G is unsuitable for consideration of the proposed creekline conditions. No detailed cross sections showing the proposed creekline corridor have been provided, rather the sections from HEC-RAS are shown. These are shown in an unnatural scale format than that used for other cross sections presented previously by GHD (eg for Sectors 2 and 11). The size of the images also makes an assessment difficult. It is recommended that appropriate size and scaled cross sections with invert and chainage details be submitted for consideration.

The 50 m public buffer appears to be catered for, but the 25 m private buffer has buildings located in the buffer. The WMS allows for ancillary features (such as water quality features etc) in the buffer, but not buildings. There is no demonstration of the average buffer width being achieved.

A number of creekline cross sections are described in the text (Options 1 – 4). No definition of which condition was considered for the 'ultimate' condition is provided in the text.

It is unclear as to how the PASS will be managed for the site (reported below the water table in Section 2.4) with respect to the proposed creekline corridor works as it is unclear as to how much excavation will be required (an absence of cross sections with inverts shown clearly makes this assessment difficult).

The creek appears to be realigned in the adjoining land. It is unclear as to whether this land is owned by ARV and it is assumed that Council is clarifying this matter with ARV.

The impact of the proposed creek works on the inundation regime to the Swamp Mahogany area has not been investigated. It is recommended that an analysis on the change to the wetting and drying regime as a result of the works be provided.

Proposed Creekline Corridor Planting Schedule

This schedule is referred to have been prepared by others. A landscape plan has not been provided with this report and therefore we have not reviewed this plan. It is recommended that Council review this plan to ensure that it complies with the WMS (2001) and relevant landscape guidelines and policies.

Mosquito Risk Assessment

As outlined above, measures to manage mosquito risks are described in Section 3.2 for the in-sector works, but there is no mention of works within the creekline corridor. A detailed mosquito risk assessment is required at the time of submission of the construction certification and should be prepared by an appropriately qualified professional with experience in mosquito risk assessment.

Flood Assessments

Flood Analysis - Existing and Design Conditions

For the purposes of this review, the 100 year ARI and the 1%AEP flood events terminology are interchangeable.

The modelling is reported to have utilised a downstream water level boundary derived from the WMS (2001). However, the WMS contains no water level boundary information, simply peak flows at the upstream and downstream end of each sector. In other sections of the text, the boundary conditions are reported to have been derived from the Warriewood Valley Flood Study and associated Addenda.

It is unclear as to whether the control at Macpherson Street is retained in the modelled scenarios or whether an assumed bridge that can carry the PMF has been incorporated into the modelling scenario. Clarification of this matter is required.

Discrepancies in the adopted flood levels and discharges for modelling occur in the report. We note that the original draft of this report was issued the day before site specific flood data was sent (email Zollinger-Berg 11 February 2005) but the final version of this report was issued after the data was sent. It is appreciated that there have been changes to the peak levels in recent times, however specific information was sent to GHD to provide the latest information to work from:

- PMF Peak Water Level of 6.27 mAHD from the data sent by CLT to GHD (email Zollinger-Berg 11 February 2005) whereas the report gives the PMF level at the upstream end as 5.31 mAHD in Table 3 and 5.8 mAHD in Table 12.
- 1%AEP Peak Water Level of 4.87 mAHD from the data sent by CLT to GHD (email Zollinger-Berg 11 February 2005) whereas the report gives the 1%AEP level at the upstream end to be 4.42 mAHD in Table 3 and 5.01 mAHD in Table 12.
- Table 2 indicates Peak Q is 136.65 m^3/s at the PMF for a site downstream of Macpherson Street whereas Table 14 refers to the same location and indicates the existing flows are 122.6 m^3/s. The data provided by CLT in February 2005 was for the upstream end of the site and indicates the peak flow to be 129.12 m^3/s. Clarification of this discrepancy is required.
- Table 2 indicates Peak Q is 35.73 m^3/s at the PMF for a site downstream of Macpherson Street whereas Table 14 refers to the same location and indicates the existing flows are 27.5 m^3/s. The data provided by CLT in February 2005 was for the upstream end of the site and indicates the peak flow to be 39.21 m^3/s. Clarification of this discrepancy is required.

No comparison is made of the existing conditions flood extents (Appendix G) with those reported in the draft Warriewood Valley Flood Study or the Addendum 1 study, both of which have been publicly exhibited. The PMF extent is unclear in the figure within Appendix G. It is unclear which option (1 – 4 as outlined above) that the extents relate to.

Section 5.3.4 makes reference to the need for more detailed flood modelling to be undertaken. The document relies on the need for adequate modelling at the development application stage, sufficient to ensure that floor levels can be set and flood impacts mitigated. The level of detail submitted is considered to be insufficient and/or unreliable for these purposes.

The document claims that MIKE11 was used for the flood modelling, yet HEC-RAS is utilised for the presentation of results and all the results in Appendix G appear to have been derived from HEC-RAS. Clarification of this matter is required. It is recommended that the MIKE11 layout and cross sections be provided to demonstrate it has been used or the text modified accordingly to explain the nature of the model utilised for the assessment.

As a point of correction, the report makes reference to Council's 3D model of the Valley, which appears to be referring to the Warriewood Valley Flood Study model. This model is a 2D hydraulic model (SOBEK), rather than a 3D hydraulic model.

Section 5.6 makes reference to the matter of potential compensation strategies, including the use of land not under the control of the proponent for the management of flooding. This approach is unacceptable as all other sectors are self-reliant in the management of any change to the flood regime, or the works associated provide a benefit to the community with respect to decreasing flood risk.

Even if we were to accept that the peak flows utilised in the assessment are correct, the increase in the peak flows at the 1%AEP event, without relying on the areas downstream, is unacceptable. The increase, from 27.5 m^3/s to 33.1 m^3/s (20%) needs to be reduced in order to ensure the impact of the development on the areas downstream (including impacts on critical infrastructure and commercial property). The potential impacts on flood levels in these downstream areas is not demonstrated via flood levels and velocities in a comparable tabulated form.

Section 5.5 makes reference to no interim flood works being required since the floor levels of the property will be set at the PMF. However, the need for interim flood works is primarily related to the potential for downstream impacts or across stream impacts following the implementation of creek rehabilitation works which are often for only half of the creek section and/or cease at the downstream end of a sector. We would commonly expect details of the interim flood works associated with the transition between creek works across the creek centreline as well as both at the upstream and downstream ends of the creeks.

Overall, the discrepancies outlined above make it difficult to draw conclusions about the proposed benefits of the creekline corridor. Until such time as these matters can be clarified, further direction on recommendations for the creekline corridor and the management of site flood risks for site layout and related matters cannot be provided confidently.

Compliance of Structures with Creek Corridor and Flood Planning Levels

The report states that the floor levels of the proposed buildings will be set at the ~~PMF. However, no specific details of the proposed floor levels are included in the~~ report to allow for checking of this statement. Clarification of this matter is required.

Evacuation

Evacuation is dealt with in a satisfactory manner in Section 5.7.

Vegetation Management Plan

A vegetation management plan has not been provided with this report and therefore we have not reviewed this plan. It is recommended that Council review this plan to ensure that it complies with the WMS (2001) and relevant landscape guidelines and policies.

Summary of Recommendations

Issue	To be Addressed at Development Application Stage	To be Addressed at Construction Certificate Stage
Water Balance	• Appendix D – Clarification of Scenarios • Clarification of reuse assumptions • Clarification of infiltration assumptions • Clarification of effect of changes to the hydrological regime during dry conditions • Infiltration testing required	• Mosquito risk assessment
Water Quality Monitoring	• Submission of additional baseline data for Rapid Biological Assessment, algal sampling, metal and sediment sampling • Revision of proposed Chromium detection limit	• In accordance with WMS requirements
Water Quality Management	• Consideration of on-ground conditions for existing pollutant load exports • Clarification of MUSIC model assumptions for baseflow and stormflow • Clarification of MUSIC Version and remodelling if previous version used • Clarification of potential wetland short-circuiting • Clarification of proprietary products • Clarification of possible groundwater impacts	• In accordance with WMS requirements
Stormwater Quantity Management	• Hydrograph shapes to be reported for the before and after case for the runoff from the site • Cross section for proposed basins to show the profile required to show their depth and side batter slopes • Revision of Stormwater Concept Drainage Plan	• Mosquito risk assessment
Creekline Corridor Rehabilitation	• Appropriate size and scaled cross sections with invert and chainage details to be submitted • Resolution of items located within the private buffer • Clarification of 'Options' • Clarification of impact of proposed creek works on inundation regime to Swamp Mahogany area • Clarification of PASS issues •	• Mosquito risk assessment
Flood Analysis	• Numerous flooding issues – see main text.	• In accordance with WMS requirements

I trust that this assessment is of assistance to Council. Should you have any further queries regarding this matter, please do not hesitate to contact either myself or Neil Lawson on 9499 3000.

Regards

Louise Howells
Manager - Environment
for **Cardno Lawson Treloar**

Appendix C

Comments received on Version 2 WMR and response to comments

Response to WMR 2 comments

Comments Received: 25/11/2005

Document Ref: Email from Event Project Management consisting of consolidated comments

Issue	Response
2.1 Raise car park entry levels to comply with PMF. Council (sic) said that complying with the PMF is non negotiable. A paramount issue. Habitable floor levels are to be set at the PMF.	Refer to discussion in 2.25 and 2.26.
2.2 Raise building floor levels to PMF levels Council (sic) said that complying with the PMF is non negotiable. A paramount issue The preference is for the entry to car parks via raising of the entry. Alternatives, if demonstrated that they are feasible and can be operated and maintained appropriately on a permanent basis, would be considered on its merit (specific details will be required for consideration by council).	Refer to discussion in 2.25 and 2.26.
2.3 Raise Buildings J & K to flood plan level Building K will require a minimum floor level at the 100 year ARI + 0.5m. A refuge area for events up to the PMF to accommodate all staff and children will be required. Building J should have a minimum floor level of 100 year ARI + 0.5m with an evaluation of evacuation routes	The 100 year ARI Narrabeen Creek flood level does not impact on Buildings J and K as it is contained in the creek. Furthermore, Buildings J & K are removed from the are non-habitable, and floor levels are nominated 0.5m above local internal 100-year ARI flood levels. Since the buildings are at the 'head' of the internal catchment the internal 100-year ARI flood levels were taken as the ground level adjacent to the buildings. The same approach is nominated for entries to underground car parks. It is proposed that flood evacuation from these buildings will be to the ground floor of the RACF building
2.4 Council (sic) referred to the triangle of land that the creek runs through. He queried the position of the boundary and the position of the creek. If this piece of land is not acquired, and if Council cannot carry out creek remediation at this location, what are the flood related implications? Apparently, the implication is that floor levels will have to be raised due to water back-up (C Fyall / Cardno discussion 25/11/05)	Refer to discussion in 2.26
2.5 Council (sic) said that rezoning of the 'Bermuda Triangle' is required.	Not for GHD action
2.6 Council (sic) said that the STP gets fined if they stop operating. The STP can't afford to be flood impacted.	Noted
2.7 Water Balance - Clarification of this apparent overestimate of the reuse demand is required.	For the WMR (October 2005) submission a demand of 6.0 kL/day/building was assumed. We have received advice from the building hydraulics consultant that demand of 320 l/unit/day is more appropriate. Using the number of units this equates to 4.6 kL/day/building. This demand has been re-simulated, together with a reduced stormwater re-use facility size (75 kL to 30 kL).

The demand from this facility has additionally been reduced from 15 kL/day to 5 kl/day.

The simulations were undertaken with MUSIC, and detailed data input summaries are provided in Appendix I.

The results tabulated below show that post development runoff with strategies compare favourably with predevelopment runoff during average years. During a wet and dry years, post development runoff is less that predevelopment. In 1992 pre-development runoff is exceeded.

On average the post development runoff is less approximately 10% less than pre-development runoff. Should Council desire, further refinement can occur during detailed design.

Year	Pre-development Surface Runoff (ML)	Post-devel Runoff before strategies (ML)	Post-devel Runoff with strategies (ML)
1987 (average)	26.7	44.6	26.6
1988 (wet)	63.0	83.7	59.6
1989	56.5	74.7	51.3
1990	64.7	80.7	57.7
1991	23.3	36.7	19.8
1992	17.5	33.3	18.2
1993 (dry)	8.6	18.5	5.8
Average	**37.2**	**53.2**	34.1

2.8 Water Balance - Clarification of effect of changes to the hydrological regime during dry conditions.

The contribution to runoff in the creek, from the site, during dry years will be reduced. Using a typical dry year (1993), simulation shows that runoff from the site was reduced by 32%. The effect that this may have on runoff in the creek would need to be evaluated in light of the overall catchment runoff draining to the creek at a position adjacent to the site. The ARV site makes up approximately 3% of the entire valley upstream of Brands Lane, and thus the impact of reduced runoff during a dry year is expected to be small.

2.9 Water Quality Management - Clarification of the implications of the apparent overestimate of the reuse demand on load modelling is required.	Based on the discussion in 2.7, the revised concentration results are listed below. A comparison of simulation results, comparing the Pre-Development Forested+20% values to the Post-Development with Mitigation values, the results show that the proposed strategy results in an overall decrease in the TSS, TP and TN mean concentrations and that the requirements are met.

Scenario	TSS Conc. (mg/L)	TP Conc. (mg/L)	TN Conc. (mg/L)
Pre-Development	35.0	0.100	1.00
Pre-Development Forested +20%	12.0	0.036	0.38
Post Development no Mitigation	78.3	0.256	1.39
Post-Development with Mitigation	1.7	0.026	0.37

2.10 Water Quality Management - Clarification / revision of location of GPT's.	While source control is implemented at the site through provision of bio-retention channels, overland flows during larger events may reach the wetland. GPT's are proposed to provide primary capture of coarse sediment and litter of flows bypassing the bioretention swales, before discharge to the wetland.
2.11 Water Quality Management - Clarification check of load comparisons is required.	Based on the discussion in 2.7, the revised annual load results are tabulated below. The results show a 67% removal of TP and 25% removal of Total Nitrogen, of the total pollutant load generated from the development.

Parameter	Inflow and pollutants generated	Outflow from site	% Removal
Flow (ML/yr)	45.6	34.1	25
Total Suspended Solids (kg/yr)	2710	213	92
Total Phosphorus (kg/yr)	9.3	3.1	67
Total Nitrogen (kg/yr)	51.5	42.2	25
Gross Pollutants (kg/yr)	948	0	100

2.12 Water Quality Management - Clarification that the bioretention systems will be lined or 'tanked' to prevent exchange with groundwater.	It is proposed that the bio-retention systems be tanked. Most probably the tanking will be by means of a clay liner to separate from ground water.
2.13 Water Quality Management - Clarification of potential wetland short-circuiting.	Discharges to the wetland are now proposed from the southern end, thus preventing short-circuiting. Please refer to the updated Stormwater Concept Drainage Plan provided in **Appendix C.** The discharge into the wetland will be diffused to further restrict potential short-circuiting.
2.14 Water Quality Management - Evaluation of the inclusion of a water feature to improve circulation, reduce the risk of and reduce mosquito risk.	This will be discussed with the Client
2.15 Stormwater Quantity Management - Confirmation that the system is appropriately operational for the more frequent recurrence intervals is required.	Management of the stormwater quantity system for more frequent events is proposed using a multi-staged outlet. ARV will have on site personnel to undertake routine maintenance works.
2.16 Stormwater Quantity Management - Stormwater Concept Drainage Plan to be submitted to be compliant with WMS (2001) showing all relevant features.	An updated plan is provided in **Appendix C**
2.17 Creekline Corridor Rehabilitation - Resolution of issues related to land not owned by ARV and construction implications for the creekline corridor. ARV are to demonstrate to Council that formal agreement with affected landowners to their sites being used and associated land ownership issues being resolved to enable half creek (minimum) construction.	Not for GHD action
2.18 Creekline Corridor Rehabilitation - Resolution of items located within the private buffer.	Not for GHD action
2.19 Creekline Corridor Rehabilitation - Clarification of impact of proposed creek works on inundation regime to Swamp Mahogany area.	The creek works are proposed in such a way that overflow to the swamp mahogany is maintained from the creek invert, as is presently the case. It is further proposed that there will be no works in the northern half of the creek adjacent to the swamp mahogany, and the creek works tie into existing ground levels on the northern bank.
2.20 Flood Analysis - Clarification of half creek construction constraints and implications for future model assessments, particularly for design floor level requirements.	Refer to discussion in 2.26 below
2.21 Flood Analysis - Further evaluation of the impacts of the proposed roundabouts on flood behaviour in Macpherson Street at the PMF	Further iterations are proposed at the design stage to determine and minimise these impacts
2.22 Flood Analysis - Confirmation of design roughness values are for fully established vegetation conditions.	This is correct. GHD and the project managers and landscapers have liased to ensure the landscaping will reflect the roughness in the hydraulic analysis

2.23 Flood Analysis - Review of design floor levels (including child care facility) and car park entry levels.	Refer to discussion in 2.25 below
2.24 Flood Analysis - Identification of contingency measures for floor levels and car park entry levels if iterative flood modelling prior to construction certificate is unsuccessful.	Contingency measures have been discussed. While the exact form of these measure have not as yet been determined, the potential floodgates will be investigated. In this regard it is acknowledged that the system will: ▸ Need to be integrated into the site emergency system ▸ Need to be operation without power ▸ Need for regular maintenance and testing The intention is for flood proofing of car park entries to PMF level using a combination of raising of entry driveway levels and the floodgates above the entry driveway.
2.25 Flood Analysis - Further iteration of site layout to achieve design floor level conditions.	Cardno Lawson and Treloar 100-year and PMF simulation results for Rev G are provided in **Appendix D** with Flood Maps provided in **Appendix F.** Key findings of the latest simulations are: **100-YR ARI (Appendix D Figures 15 & 16):** Flood levels are affected downstream of site by between 10 and 50 mm in the low tail water case, potentially continuing a considerable distance downstream of Macpherson Street crossing over Narrabeen Creek. Flood levels are lowered upstream and adjacent too much of the site. For the high tail water case, the downstream effect diminished to zero effect 30 and 50m downstream of Macpherson Street crossing over Narrabeen Creek. In addition the 100-year pinch point assists in reducing the downstream impact **PMF (Appendix D Figures 11 & 12):** For the low tail water case, PMF levels are increased in Warriewood Lagoon by between 10 and 50 mm. There is no effect on flood levels downstream of the site, and adjacent and upstream of the site flood levels are reduced by between 10 and 50 mm. Some raised flood levels are observed in Sector 12. For the high tail water case, the increase in Warriewood Lagoon is not observed, however an approximately 10 mm increase in flood levels is shown in Sector 12. There is no effect on flood levels downstream of the site, and adjacent and upstream of the site flood levels are reduced by between 10 and 50 mm. Due to the fact that flood levels adjacent and areas upstream of the site are reduced, there is room for further refinement during the design stage. Given that further simulations are proposed to fine-tune the flood levels, nominated floor levels are shown on the figures in Appendix F. These are as follows: ▸ Building A = 6.00m ▸ Building K & J = 4.90m (see discussion in 2.3) ▸ RACF = 5.60m with local flood proofing to PMF level (5.90m) using building detailing ▸ Building B/C = 5.60m

	▸ Building D, F, I, H, E = 5.40m ▸ Building G = 5.70m ▸ Entry to Underground Car Park (Building A) = 5.20m ▸ Entry to Underground Car Park (Building F) = 4.90m ▸ Entry to Underground Car Park (RACF) = preliminary 5.0 m, to be reviewed during design development phase, when options such as flood gates will be investigated. Further refinement will be required during design development to remove the effect on Sector 12. This will most probably result in a slight lowering, from those advised to Cardno Lawson and Treloar, for the entry onto the RACF site from McPherson Street.
2.26 Flood Analysis - Interim flood protection works to be identified.	Cardno Lawson and Treloar 100-year and PMF simulation results for interim conditions and the half creek are provided in **Appendix E** with Flood Maps provided in **Appendix F** Key findings of the interim conditions simulations are: ▸ In terms of impacts, similar trends as discussed in 2.25 are observed; ▸ For the PMF flood, levels are increased at the north-western corner of the site by approximately 300 mm, this diminished rapidly to an increase of 100 mm at the intersection of Brands Lane and Macpherson Street. No effect is observed for the south-eastern half of the site. The effect on individual building floor levels are as follows: o Building A = +0.25m o Building K = +0.10m o Building J = +0.05m (see discussion in 2.3) o RACF = +0.2m o All other Buildings = nil impact Present nominated floor levels are based on the assumption that the entire creek will be constructed. However should this not be the case, than slight refinement of floor levels will be required which will be cognisant of flood risk and the staging of the development.
2.27 Flood Analysis - Clarification of impact on Sydney Water assets.	Refer to discussion in 2.25
2.28 Reduce Downstream Impacts - Demonstrate the effectiveness of flood modelling results on the following: ~ further restrict the entry of water off Macpherson Street into the site as long as flows down to Fern Creek are not increased; ~ Further restrict the entry of water at Brands Lane; ~ Increase the possible water interchange from the site to the creek. In the event that flood level impacts cannot be reduced, ARV is to obtain written documentation from the Water Board stating that the implication of raised levels are acceptable.	Refer to discussion in 2.25

Appendix D

Councils Deferred Commencement Consent Conditions

Pittwater Council

ABN 61 340 837 871 Telephone (02) 9970 1111 Facsimile (02) 9970 7150
Postal Address: P.O. Box 882, Mona Vale NSW 1660, DX 9018 Mona Vale

pittwaterlga.com.au e-mail: pittwater_council@pittwater.nsw.gov.au

BoR 9

CC. IAN JOLIFFE
GHD

James Payne
Phone 9970 1111
Business Hours:
8.00am to 5.30pm, Monday to Thursday
8.00am to 5.00pm, Friday

DA: N0102/05

12 January 2006

Comments on WMR 2 ADD A

Event Project Management
PO Box 6180
Frenchs Forest
NSW 2086

Attention: Craig Fyall,

Development Application for Anglican Retirement Village at 6-14 MACPHERSON STREET, WARRIEWOOD

Reference is made to the recent meeting and discussions in December 2005 regarding GHD's Water Management Report – Addendum A submission (see Reference A below). As a follow up and in order to finalise the Water Management issues to comply with the Warriewood Valley Water Management Specification (February 2001) and DCP 30 Pittwater Flood Risk Management (December 2002) for the Development Application phase, additional information is required as follows:

1. A revised Water Management Report is submitted that achieves full compliance with the *Warriewood Valley Water Management Specification February 2001* (WMS) and DCP 30 *Pittwater Flood Risk Management (December 2002)*.

2. The revised Water Management Report is to address the following outstanding issues: -

Issue		
Overall Report	• A single Water Management Report is to be submitted encapsulating all the final Water Management features proposed for the site and to be fully complying with the requirements of the Warriewood Valley Water Management Specification.	
Water Balance	• The impact on the Swamp Mahogany stand in dry years is to be resolved to ensure that there is no detrimental effect on the stand including comment from an appropriately qualified ecologist to supplement any water management advice.	→ ARV TO APPOINT ECOLOGIST
Water Quality Management	• Pollutant load balance table showing the range of results for the various years analysed is required. • The locations of the GPT's are be revised to be located as a series of small systems on the inlets of major bioretention systems.	→ DONE BY NICK. → LITTER BASKETS?

Issue		
	• Pollution load balance modelling is to be updated.	
Stormwater Quantity Management	A Stormwater Concept Drainage Plan showing all of the relevant information on an A1 sheet is required including: • Creekline corridors • Easements • Site constraints (eg location of services, trees to be retained, etc). • Flood Extents are to be shown for full and half creek construction for the 100 year ARI and the PMF.	A1 Need contours ?
Creekline Corridor Rehabilitation	• Preliminary engineering design for creekline corridor for both interim (half creek) and final conditions for the full length of the ARV site (i.e. from Brands Lane to the south-east boundary) to include longitudinal sections and cross sections. The cross sections are to identify where the ARV land boundary line is located. • Clarification of impact of proposed creek works on inundation regime to Swamp Mahogany area including comment from an appropriately qualified ecologist to supplement any water management advice. • Acid sulphate soils (ASS) management plan is to outline specifically how the ASS is to be managed for the creekline corridor works.	ECOLOGIST. ?
Flood Analysis	Revised flood analysis to demonstrate that there is no adverse affect on the adjoining properties due to the 100year ARI (1% AEP) event and the Probable Maximum Flood event and including: • Further evaluation of the impacts of the proposed roundabouts on flood behaviour in Macpherson Street at the PMF. • Review of design floor levels and car park entry levels and details to be submitted to Council • Interim flood protection works to be identified • Accompanying figures are to correspond with the levels reported in the text for the floor levels of the buildings. • Vertical evacuation within Building J to be provided.	BRANDS LANE MACPHERSON FLOOD GATES BOFFA?

As a guide, the following criteria for assessment of the flood model outcomes is as follows:

- Probable Maximum Flood (PMF) – Relevant building floor levels and car park entry levels at PMF for worst case of both Interim and Full Creek conditions and to satisfy Council's Development Control Plan No. 30 (DCP30)

- PMF – Impact on surrounding land and within the land release area yet to be developed - less than 5cm for worst case of both Interim and Full Creek conditions

- PMF – Impact on ~~land~~ floor !! already developed – no change in number of properties affected by overfloor flooding and no increase in flood levels at critical facilities within and surrounding the Warriewood Sewage Treatment Plant (STP), no increase in flood levels at Warriewood Square - all for worst case of both Interim and Full Creek conditions

- PMF – No increase in number of properties or public land areas (eg roads) affected by provisional high hazard

- 100 year ARI – Relevant building floor levels at 100 year ARI +0.5m for worst case of both Interim and Full Creek conditions and to satisfy Council's Development Control Plan No. 30 (DCP30)

- 100 year ARI – Impact on surrounding land and within the land release area yet to be developed less than 2cm for worst case of both Interim and Full Creek conditions

- 100 year ARI – Impact on land already developed – less than 2cm increase in peak flood level and no change in number of properties affected by overfloor flooding and no increase in flood levels at critical facilities within and surrounding the Warriewood STP, no increase in flood levels at Warriewood Square for worst case of both Interim and Full Creek conditions.

- 100 year ARI – No increase in number of properties or public land areas (eg roads) affected by provisional high hazard.

A copy of the Cardno Lawson Treloar Water Manangement Review Report (see Reference B below) is attached which details issues within the above summary. The applicant is encouraged to contact Council's Consultant - Cardno Lawson Treloar – Louise Howells on 9399 3000 to discuss these issues prior to resubmission.

Reference:

A. GHD (2005) Warriewood Retirement Village Water Management Report – Addendum A, Prepared for Anglican Retirement Villages, October, Version 2.A

B. Buffer Area 2 Development Application Water Management Review - by Cardno Lawson Treloar dated 21 December 2005.

Please note that any information or plans you submit regarding this application are made available to all interested persons on request and will also be made available on Council's website through Council's Development Application tracking process. You may also view any public responses to your application on this site.

When resubmitting the required information, please complete the attached form and make it to the attention of Development Officer - Andrew Pigott. If you have any queries in regard to this issue please contact me (see contact details above).

Yours faithfully

James Payne
Manager Urban Infrastructure

Cc: Mr Ian Jolliffe
GHD Pty Ltd
10 Bond Street
Sydney NSW Sydney

Appendix E

Comments received on Version 3 WMR

Agenda

18 October 2006

ARV – Consent DA N0102/05

(Deferred Commencement Condition 1)

Several issues have been raised following the technical assessment of ARV submission on Water Management (responding to deferred commencement condition 1).

1. ARV to confirm and clarify nature and extent of works proposed as part of current Water Management Report / documentation.

2. It is proposed that the meeting considers each of the issues as outlined in the advice from Council's Urban Infrastructure Unit dated 13 October 2006 as follows:

   Note: It is understood that the principle issue is the ability to provided for flood storage on site during the interim and final development scenarios such that there is no adverse impact of adjacent land in either condition.

Issue	To be Addressed as a requirement of the Deferred Commencement Conditions
Overall Report	• Plan 0439/DA05 B contained in appendix F is to show the Public Creekline Corridor consistent with the Plan associated with condition C19 of consent. Council will provide plans.
Water Balance	• No outstanding issues.
Water Quality Monitoring	• No outstanding issues.
Water Quality Management	• No outstanding issues.
Stormwater Quantity Management only do works on creeklines once !	• Stormwater Concept Drainage Plan to be submitted to be compliant with WMS (2001) showing all relevant features. This includes: ➢ For clarity, two plans (larger scale) are to be produced. One of each for the: ⊙ The interim development case ⊙ The ultimate development case might blend together. ➢ The 1% AEP & PMF extents in plan & cross-section. ➢ Proposed Stormwater bypass system from Macpherson Street, location and easement (minimum 3.5m) requirement, and proposed outlet. Clarification as to whether the pipeline is within the ARV property or proposed to run down Brands Lane. Also, possible conflict with proposed building along the Brands Lane frontage. to show. ➢ Public Creekline Corridor to be shown and to be consistent with the Plan associated with condition C19 of consent. ➢ An Easement and Restriction As To User be created over the private buffer area containing the creekline within the 1% AEP flood extent. This is to protect the integrity of the creekline and allow Council to undertake maintainence. ➢ Site constraints (eg location of services, trees to be retained, etc).
Creekline Corridor Rehabilitation	• No outstanding issues.
Flood Analysis	• It is understood that the development is to be staged for two conditions reported for the 'design' case being:

Issue	To be Addressed as a requirement of the Deferred Commencement Conditions
• One interim.	➢ 1. Interim Condition – interim creekline construction on ARV land and part site development scenario – Drawings 21-13577-SK07 to 11A – Buildings H, I, J & G. ➢ 2. Ultimate Condition – ultimate creekline construction on ARV and other private land not owned by ARV - Drawings 21-13577-SK027 to 6A – all other buildings. The applicant needs to clarify Interim & Ultimate Condition proposals for Water Management and requirements for a staged development consent. • For the design plans relating to the Interim Condition, the following additions/clarification are required: ➢ The proposed works shown on the plan layout does not correspond to that shown on the design cross-sections. Clarification required. ➢ Cross-sections Ch 0 to Ch 175 do not show any works proposed. Clarification required. ➢ Is the underground car park for Building F included in this proposal. Clarification required. ➢ Show the extent of the Swamp Mahogany forest on plan. ➢ Show public buffer area setback on plan & cross-sections consistant with the Plan associated with condition C19 of consent. ➢ Show property boundaries. ➢ Show 1% AEP floodline on cross-sections. ➢ Longsection to be provided. • For the design plans relating to the Ultimate Condition, the following additions/clarification are required: ➢ Show the extent of the Swamp Mahogany forest on plan. ➢ Show public buffer area setback on plan & cross-sections consistant with the Plan associated with condition C19 of consent. ➢ Show property boundaries.
clarification on whether we enter the Swamp-mahogany.	➢ Claification on the extent of works shown on Cross-sections Ch 300 & Ch 325 and how the relate to the Swamp Mahogany forest.
Dunsley to advise.	➢ The provision of an elevated shelter level/mezzanine above the PMF inside Building K of a sufficient size to accomadate the maximum number of staff and children in the Building. Evacuation to Building J via a covered walkway is unacceptable given the flood hazard to children during a PMF event.
	➢ If the underground carpark to Building F is proposed to form part of the interim proposal (to cater for required carparking to Buildings H, I, J & G), the proposed entry level of 4.9m AHD does not comply for the PMF (5.45m AHD). This needs to be resolved.

3. Agreed forward path and timeframes. Scope in detail design to sort this out.

[Floodgate]

4. Conclusion

Memorandum

To: Lindsay Dyce, Andrew Pigott
cc:
From: James Payne
Date: 13 October 2006
Subject: Deferred Commencement Conditions – Water Management
ARV Development Warriewood Valley DA N01012/05

Reference:

A. Buffer Area 2 Development Application Water Management DRAFT Review - by Cardno Lawson Treloar dated 14 September 2006.

B. GHD (2006) Warriewood Retirement Village Water Management Report, Prepared for Anglican Retirement Villages, August.

C. Lawson and Treloar (2001) - *Warriewood Valley Urban Land Release - Water Management Specification*, Prepared for Pittwater Council.

Reference is made to the updated Water Management Report (Ref. B) and your request on advice as to whether the deferred commencement conditions have been satisfied.

With regards to the Water Management requirements, there are a number of issues which need to be addressed prior to satisfying the deferred commencement development conditions.

The list of the issues to be addressed is summarised below:

Issue	To be Addressed as a requirement of the Deferred Commencement Conditions
Overall Report	• Plan 0439/DA05 B contained in appendix F is to show the Public Creekline Corridor consistent with the Plan associated with condition C19 of consent.
Water Balance	• No outstanding issues.
Water Quality Monitoring	• No outstanding issues.
Water Quality Management	• No outstanding issues.
Stormwater Quantity Management	• Stormwater Concept Drainage Plan to be submitted to be compliant with WMS (2001) showing all relevant features. This includes: ➢ For clarity, two plans (larger scale) are to be produced. One of each for ~~the:~~ • The interim development case • The ultimate development case

To be provided by BoFFA

Issue	To be Addressed as a requirement of the Deferred Commencement Conditions
	• For the design plans relating to the Ultimate Condition, the following additions/clarification are required: ➢ Show the extent of the Swamp Mahogany forest on plan. ➢ Show public buffer area setback on plan & cross-sections consistant with the Plan associated with condition C19 of consent. ➢ Show property boundaries. ➢ Claification on the extent of works shown on Cross-sections Ch 300 & Ch 325 and how the relate to the Swamp Mahogany forest. • The provision of an elevated shelter level/mezzanine above the PMF inside Building K of a sufficient size to accomadate the maximum number of staff and children in the Building. Evacuation to Building J via a covered walkway is unacceptable given the flood hazard to children during a PMF event. ? BOFFA. • If the underground carpark to Building F is proposed to form part of the interim proposal (to cater for required carparking to Buildings H, I, J & G), the proposed entry level of 4.9m AHD does not comply for the PMF (5.45m AHD). This needs to be resolved.

James Payne
Manager Urban Infrastructure

Appendix F

WMS Document Checklist

DOCUMENTATION CHECKLIST - DEVELOPMENT APPLICATION

(Detach and include with submissions)

Section	Item	Requirement	Check (√)
4.1	Water Cycle Assessment – Water Balance Modelling Pre & Post Development	++++++++	✓
4.1.1	Stream Gauging, infiltration testing and use of local rainfall data for modelling	♦♦♦♦♦♦♦♦	✓
4.2.1	Water Quality Monitoring Plan	♦♦♦♦♦♦♦♦	✓
4.2.1	Water Quality Monitoring Sites Shown on Plan (at least three)	♦♦♦♦♦♦♦♦	✓
4.2.1, 2, C	Water Quality Monitoring Data	♦♦♦♦♦♦♦♦	✓
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data	♦♦♦♦♦♦♦♦	✓
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data from SQID's	■■■■■■	
4.3	Water Quality Management Assessment - Load Modelling Pre and Post Development	++++++++	✓
4.3.1, 3	Justification of assumptions for Event Mean Concentrations	♦♦♦♦♦♦♦♦	✓
4.3.2	Identification of and details for Stormwater quality facilities	□□□□□□□□	✓
4.3.2, 4.4.5	Mosquito Risk Assessment for both Watercourse and Water Quality/Quantity features	♦♦♦♦♦♦♦♦	✓
4.3.6, 4.6.5	Inspection and Cleaning Reports for SQID's and OSD	■■■■■■	
4.3.6	Management Plan for Stormwater Quality Improvement Devices	♦♦♦♦♦♦♦♦	✓
4.3.5	Environmental Management Plan (Soil and Water Aspects)	■■■■■■	
4.3.4	Erosion and Sediment Control Plan	■■■■■■	
4.4.3, 4, 5	Existing and Proposed Creek Corridor in plan with cross/long sections with flood levels	♦♦Note 1♦♦	✓
4.4.4	Proposed Creek Corridor Planting Schedule	□□Note 1□□	✓
4.4.5	Creek Corridor Vegetation Monitoring and Management Plan	▓▓▓▓▓▓	✓
4.4.5	Vegetation and Creek Maintenance and Monitoring Reports	■■■■■■	
4.5	Flood Analysis – existing and design conditions		✓
4.5.2	Compliance of structures and creek corridor with flood planning levels	□□□□□□□□	*
4.5.4	Details of Interim Flood Protection Works	□□□□□□□□	✓
4.6.3	Design Storm Hydrological Modelling of Site - Pre and Post Development	++++++++	✓
4.6.3	On-Site Detention Facilities	□□□□□□□□	✓
4.6.4	Stormwater Retention Facilities	□□□□□□□□	✓
4.7	Stormwater Concept Drainage Plan	♦♦♦♦♦♦♦♦	✓

KEY:

*PROVIDED BUT NOT FULLY COMPLIANT

▓▓▓▓▓▓	*Preliminary Calculations/Assessment Required*	▓▓▓▓▓▓	*Work as Executed Plans*
□□□□□□	*Concept Design Required*	♦♦♦♦♦♦	*Required/Reviewed/Updated*
++++++	*Detailed Assessment/Calculations/Design*	■■■■■■	*Not required*

Note 1 Even if the works are not to be constructed by the Applicant on the land to be transferred to Council under the Material Public Benefit Option in the Section 94 Plan, preliminary investigation for Rezoning and concept design at DA stage is required

Completed by Principal Certifier:

Name:.................................... Ian Joliffe

Title:.................................... Principal Water Resources Engineer

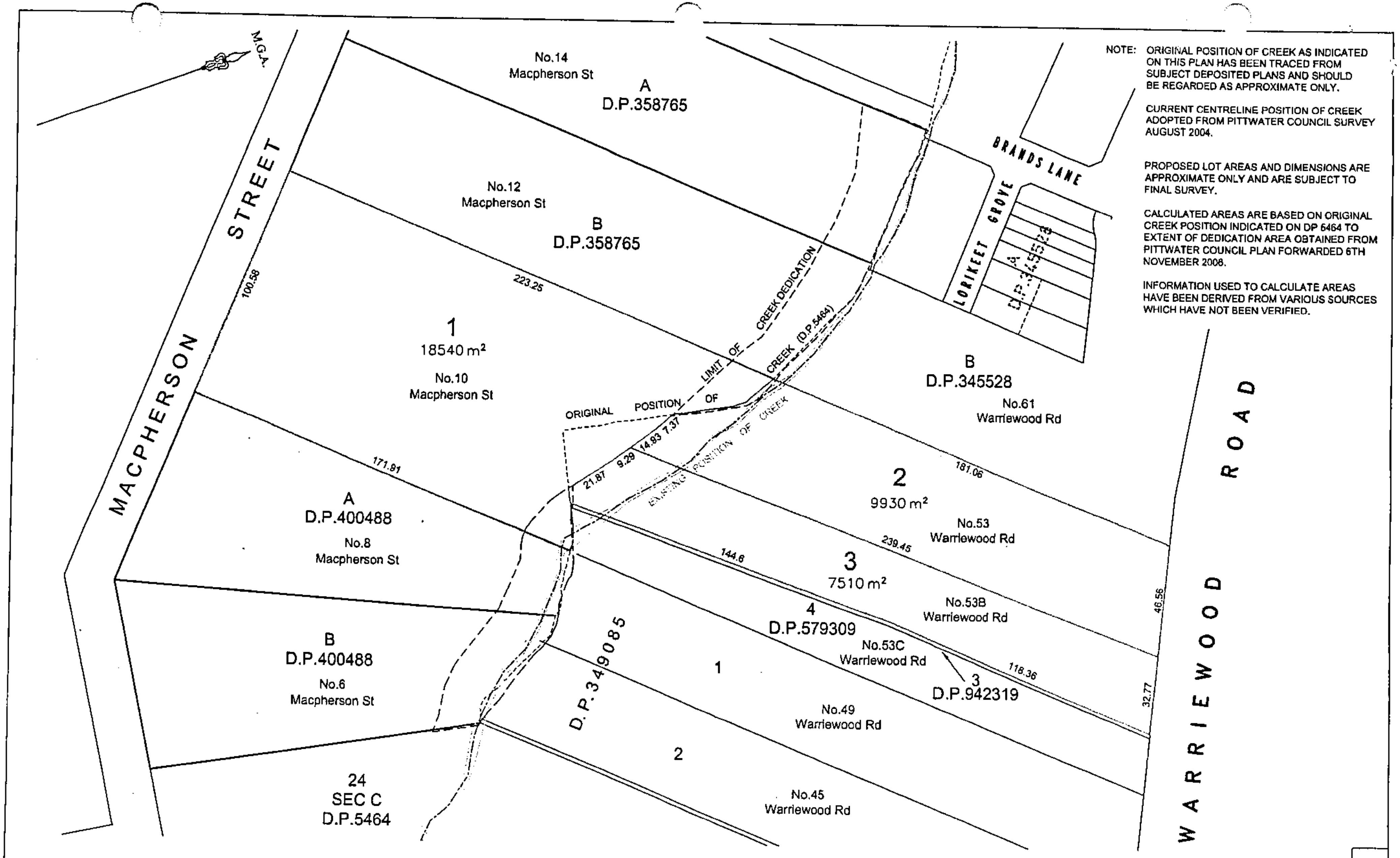
Organisation: .... GHD Pty Ltd

Signature: .... I Joliffe

Date:.................................... 8/12/06

Appendix G

Site Boundaries



NOTE: ORIGINAL POSITION OF CREEK AS INDICATED ON THIS PLAN HAS BEEN TRACED FROM SUBJECT DEPOSITED PLANS AND SHOULD BE REGARDED AS APPROXIMATE ONLY.

CURRENT CENTRELINE POSITION OF CREEK ADOPTED FROM PITTWATER COUNCIL SURVEY AUGUST 2004.

PROPOSED LOT AREAS AND DIMENSIONS ARE APPROXIMATE ONLY AND ARE SUBJECT TO FINAL SURVEY.

CALCULATED AREAS ARE BASED ON ORIGINAL CREEK POSITION INDICATED ON DP 5464 TO EXTENT OF DEDICATION AREA OBTAINED FROM PITTWATER COUNCIL PLAN FORWARDED 6TH NOVEMBER 2008.

INFORMATION USED TO CALCULATE AREAS HAVE BEEN DERIVED FROM VARIOUS SOURCES WHICH HAVE NOT BEEN VERIFIED.

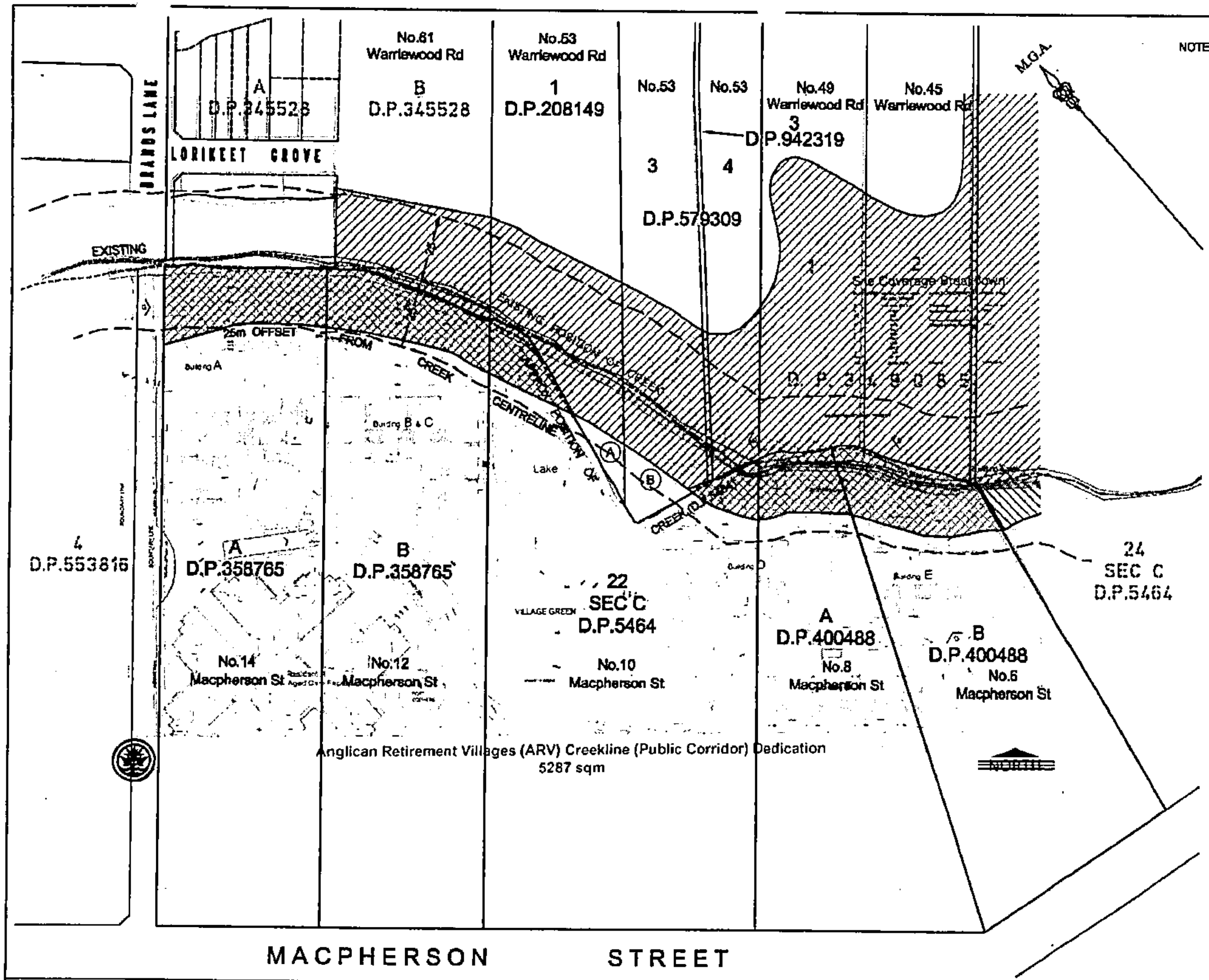
A3

PLAN SHOWING PROPOSED BOUNDARY ADJUSTMENT BETWEEN LOT 22 SEC C DP 5464 LOT 3 DP 579309 & LOT 1 DP 208149
No.10 MACPHERSON ST AND 53 & 53B WARRIEWOOD RD WARRIEWOOD

summit GEOMATIC
REGISTERED CONSULTING SURVEYORS
A.B.N. 71 092 947 601

69 Marion Street
Harris Park
NSW, 2150
Tel : (02) 9891 1490
Fax : (02) 9891 1060
Email : summit-geo@bigpond.com

RATIO: 1 : 1500	SURVEYED: P.N.
LEVEL DATUM: –	DATE: 15/11/2006
CONTOUR INTERVAL: –	REFERENCE: 2644
AZIMUTH: M.G.A.	REVISION: A
SHEET 1 OF 1	CHECKED: A.K.



NOTE: ORIGINAL POSITION OF CREEK AS INDICATED ON THIS PLAN HAS BEEN TRACED FROM SUBJECT DEPOSITED PLANS AND SHOULD BE REGARDED AS APPROXIMATE ONLY.

CURRENT CENTRELINE POSITION OF CREEK ADOPTED FROM PITTWATER COUNCIL SURVEY AUGUST 2004.

INDICATES EXTENT OF AREA ADOPTED FOR CALCULATION OF AREAS TABLED BELOW.

(A)	LOT 1	DP 208149	216 m²
(B)	LOT 3	DP 579309	384 m²
	TOTAL		600 m²

AREAS FROM ORIGINAL CREEK POSITION INDICATED ON DP 5464 TO EXTENT OF DEDICATION AREA OBTAINED FROM PITTWATER COUNCIL PLAN FORWARDED 6TH NOVEMBER 2006.
ALL AREAS ARE APPROXIMATE ONLY AND ARE SUBJECT TO FINAL SURVEY.
INFORMATION USED TO CALCULATE AREAS HAVE BEEN DERIVED FROM VARIOUS SOURCES WHICH HAVE NOT BEEN VERIFIED.

A3

PLAN SHOWING LOCATION OF CORRIDOR DEDICATION AND ORIGINAL CREEK POSITION
No.6–14 MACPHERSON STREET, WARRIEWOOD
LOT A & B D.P.358765, LOT 22 SEC C D.P.5464 LOT A & B D.P.400488

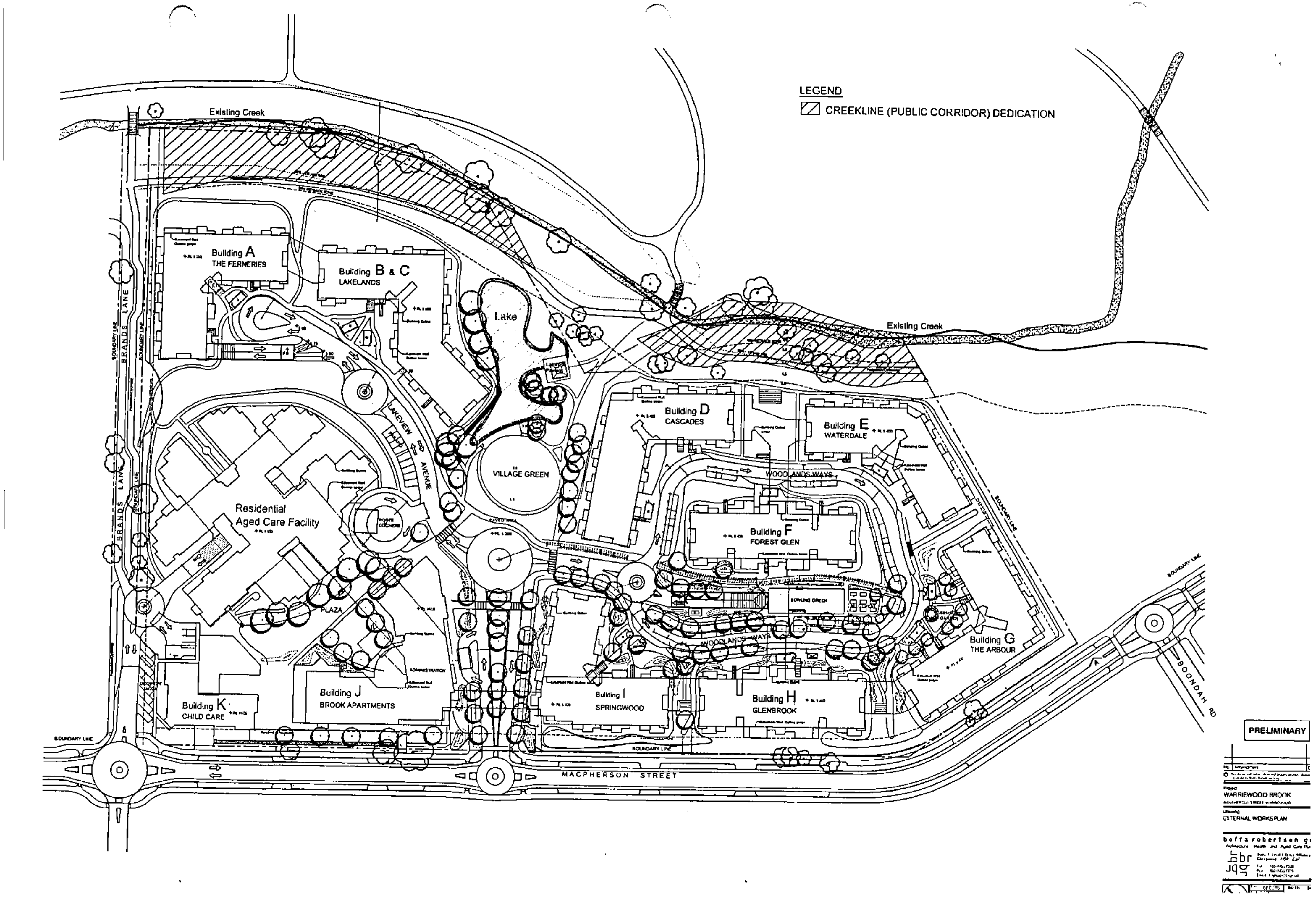
summit GEOMATIC
REGISTERED CONSULTING SURVEYORS
A.B.N. 71 092 947 601

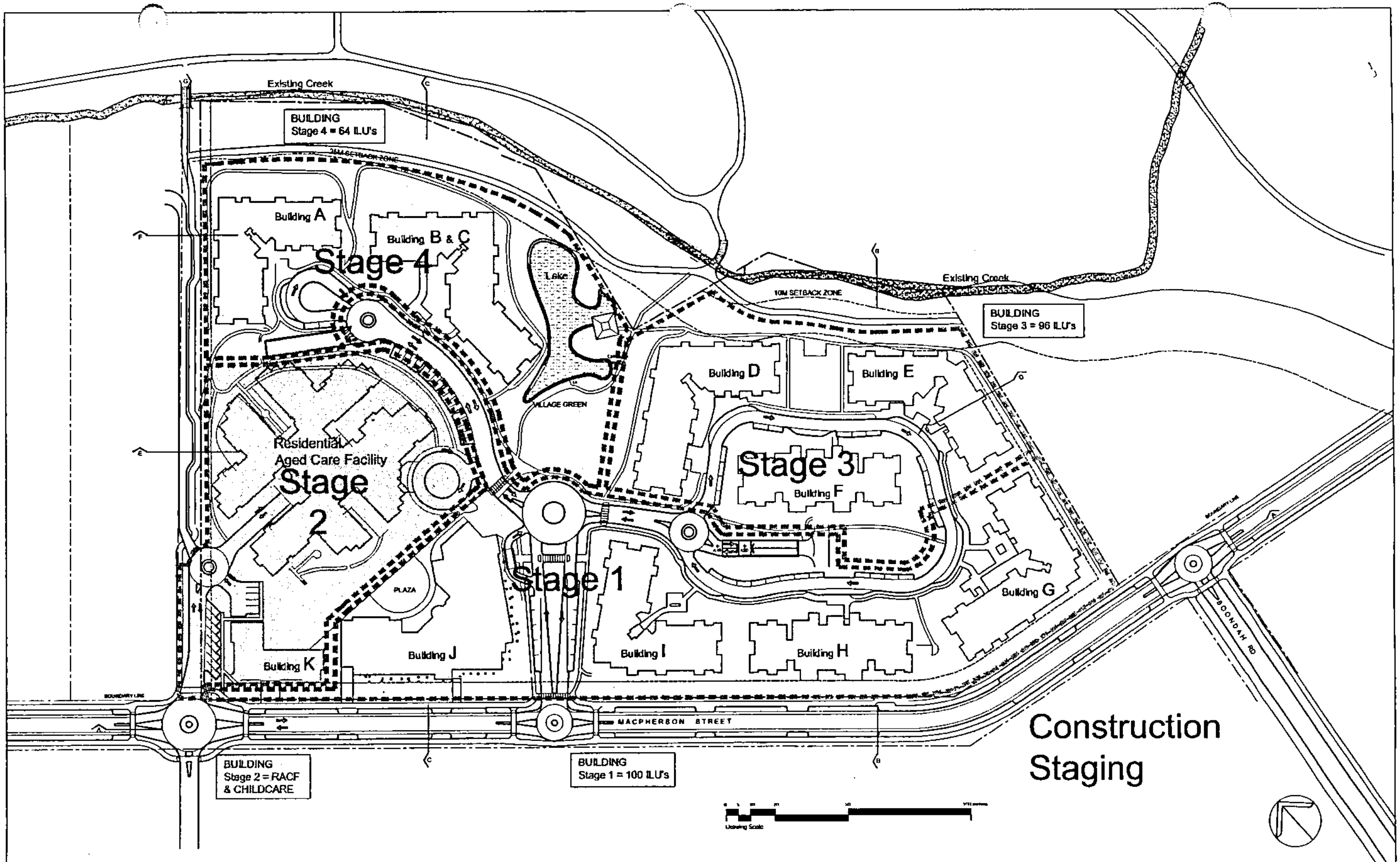
69 Marion Street
Harris Park
NSW, 2150
Tel : (02) 9891 1490
Fax : (02) 9891 1060
Email : summit-geo@bigpond.com

RATIO: 1 : 1500	SURVEYED: P.N.
LEVEL DATUM: –	DATE: 09/11/2006
CONTOUR INTERVAL: –	REFERENCE: 1981
AZIMUTH: M.G.A.	REVISION: B
SHEET 1 OF 1	CHECKED: A.K.

Appendix H

Proposed Development Footprint (SK19 Rev G)


LEGEND
CREEKLINE (PUBLIC CORRIDOR) DEDICATION
Existing Creek
Existing Creek
Building A
THE FERNERIES
Building B & C
LAKELANDS
Lake
VILLAGE GREEN
LAKEVIEW AVENUE
Building D
CASCADES
Building E
WATERDALE
WOODLANDS WAYS
Building F
FOREST GLEN
BOWLING GREEN
WOODLANDS WAYS
Building G
THE ARBOUR
Residential
Aged Care Facility
PLAZA
ADMINISTRATION
Building J
BROOK APARTMENTS
Building K
CHILD CARE
Building I
SPRINGWOOD
Building H
GLENBROOK
BRANDS LANE
BOUNDARY LINE
MACPHERSON STREET
BOONDAH RD
PRELIMINARY
WARRIEWOOD BROOK
EXTERNAL WORKS PLAN
boffa robertson



ANGLICAN RETIREMENT VILLAGES

event PROJECT MANAGEMENT

boffa robertson group
Architecture, Health and Aged Care Planning
bbr
rgg
Suite 3, 764 Pacific Highway,
Killara, NSW 2071

ANGLICAN RETIREMENT VILLAGES

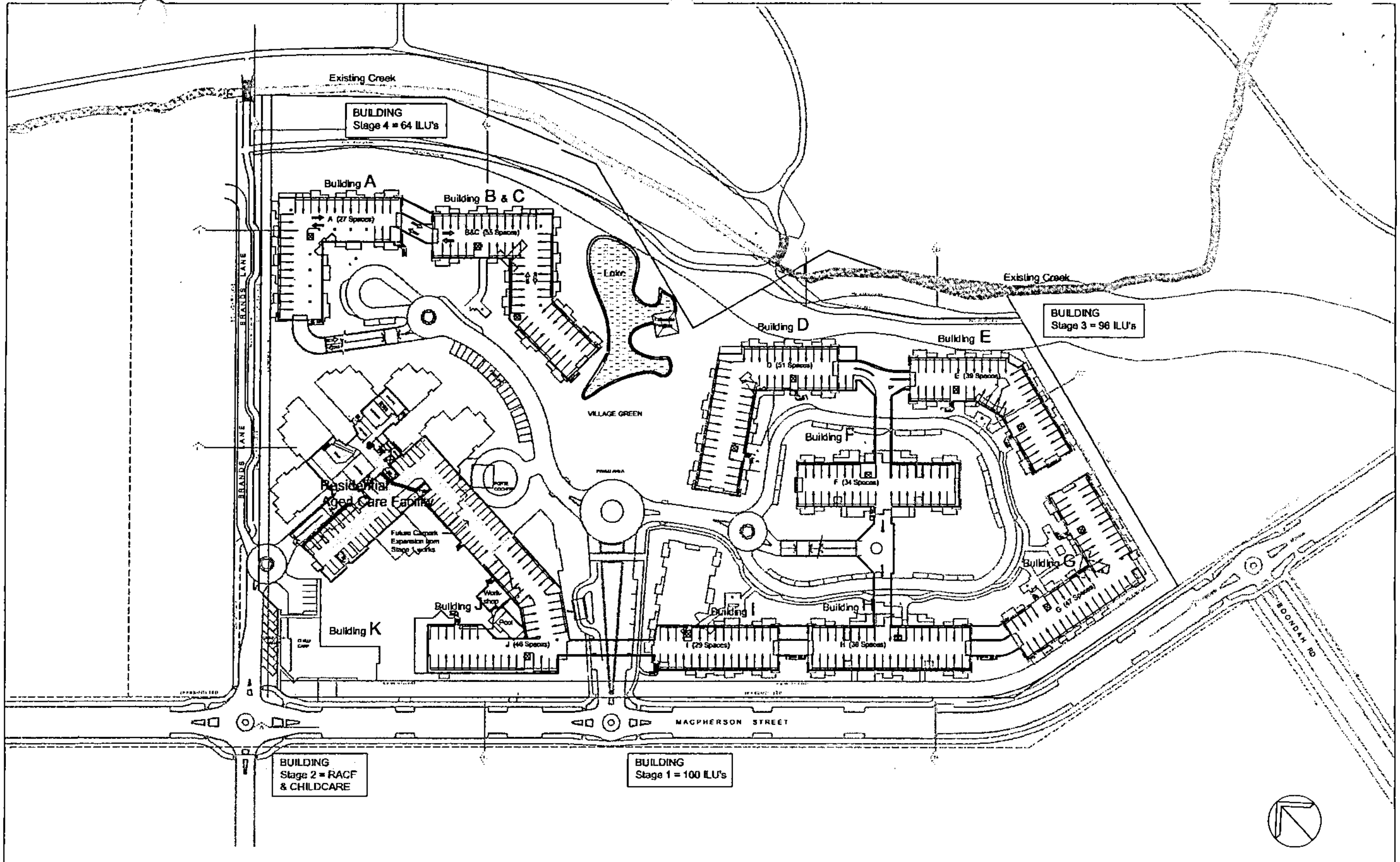
WARRIEWOOD RETIREMENT VILLAGE

WARRIEWOOD DEVELOPMENT APPLICATION
CONSTRUCTION STAGING PLAN

0439/DA19

C

C:\Projects 2004\0439 - Warriewood Seniors Living\BUILT-FORM DA\A18-19-Staging Plans.dwg, 25/07/2006 3:57:04 PM



ANGLICAN RETIREMENT VILLAGES

event PROJECT MANAGEMENT

boffa robertson group
Architecture, Health and Aged Care Planning
Suite 3, 494 Pacific Highway,
Killara, NSW 2071

ANGLICAN RETIREMENT VILLAGES

WARRIEWOOD RETIREMENT VILLAGE

WARRIEWOOD DEVELOPMENT APPLICATION
BASEMENTS CONSTRUCTION
STAGING PLAN

0439/SK12 A

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Appendix I

Stormwater Management Concept Plan

Event Project Management

Warriewood Retirement Village
6-14 Macpherson Street
Warriewood

Acid Sulphate Soils Management Plan

September 2005

GHD | LMA | GHD LongMac
Consulting geotechnical engineers and geologists

1 September 2005

Event Project Management
Suite 2, Building 8 - 49 Frenchs Forest Road
Frenchs Forest NSW 2086

Our ref: 21/13577/16/AW499

Attn: Mr Craig Fyall

Dear Sir,

Warriewood Retirement Village 6-14 MacPherson Street, Warriewood
Acid Sulphate Soils Management Plan

We are pleased to present herein our Acid Sulphate Soils Management Plan (ASSMP) for the above proposed development.

We note that the general subsurface conditions over the site typically comprise a surficial layer of variable fill and topsoil underlain by alluvial and residual soils over weathered sandstone and shale bedrock. The alluvial soils, where present below the site groundwater table, have been identified as Potential Acid Sulphate Soils (PASS), and are of concern for the potential development of Acid Sulphate Soil (ASS) conditions on exposure or drainage. These soils are variable in nature and range in thickness from non-existent in the southern part of the site, to over 10m thick in the northern part.

The factual results of our geotechnical field investigations and laboratory testing are presented, together with comments and recommendations on PASS issues, in our earlier geotechnical report of June 2005 (ref: AW250).

This current report addresses strategy and procedures to manage the impact of PASS soils on proposed development of the site.

Please do not hesitate to contact us should you have any queries in regard to this report.

Yours faithfully
GHD-LongMac

Bob Batchelder
Senior Geotechnical Engineer

Reviewed by

Peter Stone
Geotechnical Group Director

GHD LongMac
A division of GHD Pty Ltd
ABN 39 008 488 373

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1-3	Mr Craig Fyall	Event Project Management
4	Paul Sancandi	GHD (Sydney)
5	Margrit Colenbrander	GHD LongMac (Library)
6	Bob Batchelder	GHD LongMac (Unbound Master)

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Document History

Revision No.	Revision Date	Description
0	1/09/05	Initial issue

Issued by: ....

Date: 1/9/05

Contents

Attachments

1. Introduction

This report presents the Acid Sulphate Soils Management Plan (ASSMP) for the proposed retirement village development at 6-14 MacPherson Street, Warriewood.

We understand that the proposed development will comprise eleven, one to three storey, buildings (A to K) with basement car parks and a Residential Aged Care Facility (RACF) building, as shown in the provided architectural drawings. A review of the supplied drawings revealed that the ground floor levels for the various buildings will be at RL 5.0m, while the basement car parks will be some 2.5m-3.0m below the ground floor (i.e. RL 2.0-2.5m nominally). The basement excavations will therefore extend to about 1m to 7m below the existing ground level.

The presence of Potentially Acid Sulphate Soil (PASS) conditions was identified in our geotechnical report for the site dated 21 June 2005 (ref:AW250).

The main objectives of the ASSMP were to:

- Denote the extent of the PASS affected subsurface strata.
- Develop a strategy to address impacts of the development on such soils.
- Provide methodologies for:
  - prevention of exposure of PASS soils where practical,
  - assessment and treatment of excavated PASS materials,
  - management of ground and surface waters,
  - monitoring,
  - disposal; and
  - contingency measures.

This ASSMP has been developed broadly in accordance with the procedures and methodologies described within the guidelines given in the Acid Sulphate Soils Management Advisory Committee of 1998 (ASSMAC guidelines) document.

This report should be read in conjunction with the abovementioned geotechnical report.

2. Site Setting and Conditions

2.1 Site Setting

The subject site is located in an irregularly shaped but broadly trapezoidal parcel of land having a maximum length of approximately 370m on the north western – south eastern direction and 240m on the north eastern – south western direction. It is bounded to the south west by MacPherson Street, to the north east by Narrabeen Creek, to the north west by Brands Lane and adjoins an allotment on the south east (refer Figure 2, attached extract from the geotechnical report).

Access to the site is via Macpherson Street from the south west. Residential developments, comprising single to two storey residences, are present within medium distance from the site. Two nurseries were present at the time of the investigation at the north west and south east boundary lots.

Existing ground surface levels vary from RL 9m (southern corner) to RL 3.5-4.0m (eastern and northern corners) AHD. The vegetation is concentrated on the south-eastern half of the site and in proximity of the Narrabeen Creek. This comprises thick bush, sparse eucalyptus trees, palms and other native trees. Existing development at the time of the investigation comprised numerous glasshouses and some residential freestanding buildings.

Sandstone bedrock exposures at the southern site corner and the gentle sloping of the site towards the northern direction suggest the presence of residual soils overlying shallow bedrock at the southern part of the site.

2.2 Regional Geology and PASS Conditions

Geologically, the site is underlain by Quaternary Alluvium comprising sand, peat, silt and clay as shown on the 1:100,000 scale Geological Series Sheet for Sydney (9130, Edition 1, 1983). The Newport Formation within the Narrabeen Group underlies the alluvium at depth and typically comprises interbedded laminite, shale and sandstone with minor claystone beds.

The site lies within an area of high probability for occurrence of potentially acid sulphate soil (PASS) conditions in alluvial sediments, beneath the filled terrain/water table, as shown on DLWC Acid Sulphate Soil Risk Map for Hornsby/Mona Vale (Edition 1, June 1995).

2.3 Stratigraphy and Water Table

Our recent subsurface investigation (ref:AW250), describes the highly variable stratigraphic conditions over the site. In broad terms, the basic stratigraphy comprises a surface layer of uncontrolled fill of variable thickness (up to approximately 2m) over most parts of the site overlying soils of alluvial origin in areas of the site having existing ground levels below approximately RL 5m (AHD) and residual soils in areas above RL 5m. The alluvial soils are underlain by residual soils and weathered bedrock.

Alluvial soil thickness isopach contours, estimated by interpretation of the test hole investigation results, are shown in Figure 2 (Attachment). These contours indicate a thickness of alluvium ranging from non-existent in the south to in excess of 10m in the north west.

The position of the site water table, as recorded during the geotechnical investigation, ranged from some 0.8m to 2.5m depth below the ground surface (RL1.5 to RL3).

2.4 Alluvial Soil Unit

The composition and nature of the alluvial soil unit is variable. It comprises inter-layered poorly graded sands, clays, sandy clays and clayey sands. The consistency of these inter-layered strata is also variable ranging from soft/loose to very stiff/very dense.

The alluvial soil unit can be sub-divided into sub-units in terms of classification and behaviour. These sub-units are described as follows:

- Soft to firm clays and sandy clays with bands of loose sand and stiff/very stiff clays (Unit 2.1). The clays within this sub-unit are typically low to medium plastic. These soils were encountered at various levels such as immediately below the site fill material (from RL 3m to RL 1m approximately), overlying the residual soils varying from RL –4m to RL –6m and in-between the sandy horizons (RL 0 to RL –2m). The locations of this sub-unit can be seen in the geotechnical section (Figure 4).
- Dense and very dense clayey/silty sands and sands (Unit 2.2). This sandy sub-unit was encountered from RL 1.0m approximately and at RL –2.5m to RL –3.5m. Its thickness was typically about 1m.
- Firm to stiff sandy clays of low to medium plasticity (Unit 2.3). This sub-unit sometimes underlies sub-units 2.1 and 2.2 and can be up to some 4m thick.

3. PASS Testing Conducted

PASS testing conducted to date includes indicator testing for sample screening purposes, comprising measurement of pH in distilled water before and after oxidisation, using a strong oxidising agent (30% hydrogen peroxide), to indicate PASS (oxidised pH<3). A total of 22 PASS screening tests was undertaken on soil samples recovered from within 4 boreholes (LM3 ,LM6 ,LM7, LM8) and 5 test pits (TP11, TP15, TP17, TP23, TP25), during the geotechnical investigation.

PASS conditions were indicated by the screening test results, within the clayey/silty sand, and clay alluvium beneath the water table. 10 samples, selected on the basis of the screening tests and for coverage purposes, were subjected to the more definitive Peroxide Oxidisation Combined Acidity and Sulphate (POCAS) suite of tests.

The results of these tests are summarised in the attached Tables 3A & 3B (Indicator Tests) and Table 4 (POCAS Tests).

The soil pH test results (refer attached Tables 3A, 3B) indicated that there were acidic conditions existing on the site (pH 4.0 to pH 6.4). However, no Actual Acid Sulphate Soils (pH < 4.0) were recorded in the testing.

The results of the POCAS testing (attached Table 4) confirmed this assessment.

4. ASSMP Strategy

4.1 General

PASS conditions occur naturally in coastal areas, but do not cause a problem unless exposed to air e.g, by excavation or by lowering of the water table. PASS conditions form under anaerobic (oxygen deficient) conditions, where iron in the sediments combines with sulphate in seawater to form pyrite. Pyrite is stable until exposed to a combination of oxygen and moisture, where it forms sulphuric acid, often significantly decreasing the pH and forming acidic conditions.

Apart from increase in chemical attack to buried concrete and steel, acidic conditions can release metals previously bound in the soil, and in particular aluminium which, in sufficient concentration, is a known toxicant to marine life. Moreover, iron is also released which can result in the production of iron flocs even at some distance from.the site. Such flocs can smother vegetation and clog pumps/filtration units.

4.2 Trafficking

Trafficking of the exposed surface of the alluvium, where beneath/near the water table (e.g., at the floor level of the basement excavations in Domain B), should be avoided as far as practical, in order to minimise disturbance to PASS strata. This aspect will require careful planning for the construction of the basement floor slabs in the soft soil areas.

4.3 Building Foundation System

For Domain B, where extensive variable alluvial soils will be encountered, piled foundation systems taken to the weathered bedrock stratum are preferable from a PASS management perspective.

Both non-displacement (bored or continuous flight augered) piles and driven piles are considered technically feasible for the proposed development. However, driven piles will minimise any disturbance to the underlying PASS strata, and minimise the need to treat/dispose of spoil.

Consideration should be given to the use of 'acid resistant' construction materials, as a contingency against site acidification.

4.4 Excavations

4.4.1 Basements

The proposed basement car park construction will involve excavation down to about RL 2.0m to RL 2.5m i.e., up to about 1.0m below the currently recorded water table. In situations where extensive soft ground conditions are encountered, such soft materials are likely to be over-excavated for a further nominal depth of 0.5m to 1.0m and replaced by appropriate fill, in order to provide a stable working base for construction.

4.4.2 Services

In regard to services, it is expected that most would be located within a metre below the current ground surface, thus generally near/above the current water level. However, for any deeper service lines, care will need to be exercised in order to prevent the service line backfill becoming a conduit to drain water and in order to manage any excavated PASS material.

Typically, where such deeper service lines cannot be relocated, regular water sealing zones should be included within the trench e.g., 5m lengths of bentonite/cement-sand mix (of lower permeability than the surrounding clays) compacted around the service line at say 20m intervals. The final position of such sealing zones should be reviewed by a PASS engineer.

4.4.3 PASS Spoil Management Options

The basement excavations within PASS areas should be staged, in order to limit the amount of PASS material exposed at any one time. This should decrease the risk of site acidification in the event of a heavy/extended rainfall period.

The spoil from excavations within the PASS alluvium (below the site groundwater table) will require either:

- Treatment and disposal to a landfill (subject to meeting other 'non-PASS' geochemical criteria). The classification for the treated PASS material is expected to be 'solid waste'.
- Treatment and re-use on site.
- Burial beneath the long-term groundwater level, within 24 hours of excavation, or at such shorter time as on-site testing may determine.

If a suitable site for reburial is available, this would likely be far more cost effective than to dispose of the PASS as solid waste (mixing costs, landfill charges, EPA charges, transport etc.). We note that a large subaqueous disposal site that may be able to receive this material untreated (subject to certain conditions/requirements) exists on the south coast (Shell Harbour).

We consider that treatment by neutralisation and re-use of PASS on site as 'non-structural' fill will typically be the most cost effective means of handling the excavated PASS material, should material balance considerations allow this.

Should significant volumes of treated PASS material be considered for off-site disposal, landfill operators and the EPA should be contacted as necessary in order to determine appropriate fees and charges for this material, which is understood to be classified as 'solid waste' under the EPA guidelines. Moreover, it will be necessary to ensure that there is sufficient capacity within an appropriate licensed landfill (or a subaqueous facility), to accept this material.

It may also be possible to have the PASS material treated off-site, subject to enquiries with various specialist waste management companies. This is likely more expensive than on-site treatment.

We would be pleased to assist with the above enquiries/arrangements, if desired.

4.5 Soils Testing and Treatment

The following describes procedures for on-site neutralisation of the PASS materials. Should untreated disposal to a subaqueous facility be available, only Section 4.5.2 applies. However, reporting, supervision and testing requirements would need to be negotiated/implemented for this untreated option.

4.5.1 Performance Criteria

The following performance criteria must be met for soils treated by neutralisation :

1. The neutralising capacity of the treated soil must exceed the Total Potential Acidity (TPA) of the untreated soil i.e., the existing acidity plus potential acidity on exposure of the soil (refer attached Table 4). For pure fine-ground agricultural lime ($CaCO_3$) as the additive, this corresponds to approximately 1.5kg of additive per kg of TPA (H_2SO_4/tonne), inclusive of a minimum treatment Factor of Safety (FOS) of 1.5 e.g., at LM6 in the attached Table 4, the recorded TPA of 44 kg H_2SO_4/tonne would require 66kg of aglime per tonne of soil.
2. The post-neutralisation pH of the soil shall be between 5.5 and 8.5, and the TPA shall be less than 0.5 (kg H_2SO_4 /tonne of soil).

4.5.2 Phase 1 Soil Testing

Testing of the (basement) area to be excavated shall be conducted at approximate 30m grid spacings ahead of the excavation, in order to determine the depth/TPA relationship. Samples shall be taken at 0.5m depth intervals (or on change in strata) from approximately 0.5m above the water table to at least 0.5m below the planned excavation depth.

The level of the water table shall be determined by monitoring (refer Section 4.6).

This testing will enable planning for separation of PASS and non-PASS materials, and for treatment of the PASS to be excavated. A margin of 0.2m of soil adjacent to the PASS should be included for contingency purposes.

4.5.3 Neutralisation Treatment

An area, or a number of suitable areas shall be selected on the site in order to provide treatment pads for the PASS. The size of the area/s will need to take cognisance of the amount of PASS. The treatment methodology will need to match the excavation rate.

A maximum temporary stockpiling period of overnight (18 hours) should be allowed for untreated PASS.

The treatment pad area should be formed by:

- Compaction of a 0.3m thick non-PASS clay/sandy clay layer to at least 95% of Standard Density and within 2% of the Optimum Moisture Content.
- A 0.5m deep and 0.5m wide trench shall be excavated around the perimeter of the treatment pad area and the base of this trench shall be lined with a minimum 50mm thickness mixture of 50% pure fine ground agricultural lime (aglime) and 50% coarse sand. The excavated soil from this trench shall be used to create nominally

compacted (track rolled) bunds on the external side of the trench. The trenches shall lead to a sedimentation sump, from which any collected water can be tested and treated/released (refer Section 4.6).

- A guard layer of sand containing the aglime shall be placed over the treatment area as a contingency against acidification of PASS prior to mixing. The amount of aglime in the guard layer shall be 20% of the amount required to treat all the acidity from the overlying soils to be placed on the pad, but not less than 5 kg/m^2.
- Mixing of the aglime on the pad area shall be conducted at the abovementioned rates with 150mm to 250mm thick layers of loose PASS, utilising rotary hoeing techniques (or equivalent), in order to produce a homogeneous product.
- The treated soil shall be nominally compacted (track rolled), prior to addition of the next layer.

4.5.4 *Phase 2 Soil Testing*

Field verification testing comprising pH and peroxide indicator testing shall be conducted on the treated product at of one test per 50m^3. A laboratory 'TPA' test shall be conducted on every fifth test sample for correlation purposes.

The verification trigger levels for the treated PASS are, soil pH less than 5.5, peroxide (indicator test) oxidised pH less than 3, or TPA greater than 0.5kg H_2SO_4 /tonne of soil.

Should the testing indicate insufficient treatment of the soil, further aglime shall be added to the layer being tested, or to subsequent layers (if the subject layer is buried) in order to compensate.

4.6 Water Management Considerations

4.6.1 *Basement Car Parking*

As stated within the PASS assessment comments of our geotechnical report, in order to minimise the potential for acidification of the site (within PASS areas), the existing site ground water levels should be maintained and permanent basement dewatering options should be avoided.

Given the potential presence of groundwater above the basement floor level, we consider that the basement car parks should be designed as fully tanked structures in order to minimise any ingress of groundwater into the basements, and to reduce any potential impacts of on the level of the permanent groundwater table.

As a contingency measure against minor water seepage that may permeate through any imperfections in the perimeter walls and basement slabs, internal drainage sumps with intermittent pumping to discharge, should be installed within tanked structures.

4.6.2 Construction Dewatering

Depending upon the prevailing conditions at the time of earthworks, it is probable that groundwater seepage will be intercepted by the basement excavations. Accordingly, the construction planning will need to allow for some form of dewatering system in certain areas of basement excavation.

Surface water should be excluded from the excavations by the use of diversion drains.

Where a dewatering system might be required, such a system must take cognisance of the PASS nature of the site conditions and avoid any significant decrease in the site groundwater levels.

Similarly, with any deep services within PASS areas, the strategy is to avoid lowering of the surrounding groundwater levels. Accordingly, where a dewatering system might be required, such a system must take cognisance of the PASS nature of the site conditions and avoid any significant decrease in the site groundwater levels.

4.6.3 Monitoring and Release

Monitoring of the groundwater should be conducted for water level, pH and conductivity during construction (weekly basis) and for 2 years post construction (quarterly basis).

The positions of monitoring piezometers will be determined on site by an experienced consultant. These locations will be commensurate with the site construction activities and should be installed around basement zones within PASS areas, prior to excavation.

Should the monitored water levels outside the excavation area drop by greater than 0.5m during construction, then advice should be sought from a PASS engineer regarding the need to re-charge the groundwater outside the excavation.

Trenches backfilled with coarse sand to fine gravel size limestone, should be available as a contingency measure, for installation on the up-gradient and down-gradient sides of the excavation, to a minimum of 0.5m below basement level, in areas where (unexpectedly) low pH conditions (pH<5) are recorded within the monitoring piezometers. These trenches shall be more permeable than the surrounding ground. Such trenches may require periodic maintenance, by replacement of the limestone sand/gravel, if (unexpected) long term use is required.

Any water collected from within the excavations, and from the dewatering, shall be pumped to a sedimentation sump, where it shall be tested for pH and conductivity, and treated by dosing with hydrated lime if required, prior to release. Typically the pH of the released water should be within pH 6 to pH 8, and conductivity less than 1dS/m or equivalent to the surrounding surface water (if this has a higher conductivity).

Potential options for release of site groundwater/surface waters include:

- Release of water to Narrabeen Creek, subject to licence approval and conditions.
- Release to stormwater system, subject to permit.
- Release to sewer, subject to permit.

We note that a licence to release water to Narrabeen Creek will be dependent on the relevant water quality guidelines and on the background quality of the creek water.

Site water quality considerations are discussed in our Phase 2 Environmental Site Assessment of July 2005 (ref: 2113577/20.R001). We note from this report that there are marginally elevated levels of some metals and that the groundwater pH recorded ranged from 5.3 to 6.7 (acidic).

Attachments

(Extracts from Geotechnical Report)

Table 3A	PASS Indicator Results – Boreholes
Table 3B	PASS Indicator Results – Test Pits
Table 4	POCAS Results
Figure 2	Alluvial Soil Thickness Isopachs
Figure 3	Geotechnical Section G1

PASS Indicator Tests - BOREHOLES

TABLE 3A

Test Hole No.	Sample Depth (m)	Soil Description	Approximate Depth to Water Table (m)	Soil pH (2:1 Mixture)	
				Distilled Water (pH_F)	Hydrogen Peroxide (pH_{FOX})
LM3	0.5-0.95	Wet, dark grey/brown SAND with silt (alluvium)	0.5	5.5	3.5
LM3	2-2.45	Wet, light grey SAND with clay (alluvium)	0.5	5.3	3.3
LM3	3.5-3.95	Moist, light grey with orange mottle CLAY with sand (alluvium)	0.5	5.1	3.5
LM6	1.3-1.5	Moist, dark grey CLAY with sand (alluvium)	1.5	6.1	3.7
LM6	3.5-3.6	Wet, grey SAND (alluvium)	1.5	5.8	**3.0**
LM6	5.5-5.95	Wet, dark grey clayey SAND (alluvium)	1.5	4.3	**0.9**
LM6	8-8.45	Wet, dark grey clayey SAND + sandy CLAY lenses (alluvium)	1.5	5.0	**1.4**
LM6	10-10.2	Wet, dark grey clayey SAND + sandy CLAY lenses (alluvium)	1.5	4.8	**1.1**
LM7	3.5-3.9	Wet, light grey with orange mottle clayey SAND (alluvium)	1.5	4.6	**3.0**
LM7	5-5.45	Wet, light grey with orange mottle clayey SAND (alluvium)	1.5	4.0	**1.4**
LM8	3.5-3.95	Wet, light grey - orange mottle clayey SAND + clay lenses (alluvium)	2.0	5.3	3.2
LM8	5-5.45	Wet, light grey - orange mottle clayey SAND + clay lenses (alluvium)	2.0	5.5	3.8
LM8	8-8.45	Moist, grey sandy CLAY (alluvium)	2.0	6.2	3.9

1.

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PASS Indicator Tests – TEST PITS

TABLE 3B

Test Hole No.	Sample Depth (m)	Soil Description	Approximate Depth to Water Table (m)	Soil pH (2:1 Mixture)	
				Distilled Water (pH_F)	Hydrogen Peroxide (pH_{FOX})
TP11	2.2	Wet, grey SAND (alluvium)	1.6	6.4	4.3
TP11	2.5	Wet, dark grey clayey SAND (alluvium)	1.6	5.6	4.2
TP15	2.0	Wet, dark brown sandy SILT (alluvium)	1.7	5.7	**2.8**
TP15	2.4	Moist, dark grey/brown CLAY (alluvium)	1.7	5.7	3.7
TP17	1.9	Moist, dark grey CLAY (alluvium)	1.7	5.3	3.5
TP17	2.7	Wet, dark grey clayey SAND (alluvium)	1.7	6.4	4.1
TP23	2.5	Moist, black CLAY (alluvium)	2.0	5.4	**2.6**
TP25	1.8	Very moist, grey sandy CLAY (alluvium)	1.7	5.6	3.6
TP25	2.1	Moist, dark grey CLAY (alluvium)	1.7	5.4	3.8

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POCAS Test Results vs ASSMAC Guideline Limits

TABLE 4

Analyte	ASSMAC * Guideline Limits		Testhole Depth (m)									
	For < 1000 tonnes disturbed	For > 1000 tonnes disturbed	LM3 (2-2.45)	LM6 (1.3-1.5)	LM6 (3.5-3.6)	LM6 (5.5-5.95)	LM7 (3.5-3.9)	LM8 (3-3.95)	TP23 (2.5)	TP17 (1.9)	TP15 (2.0)	TP11 (2.5)
TPA (kgH_2SO_4/T)	3.0	0.9	0.9	**2.8**	<0.5	**44**	**1.0**	0.9	**4.4**	**12**	**9.3**	0.6
S_{pos} (%)	0.1	0.03	0.008	**0.14**	0.016	**1.3**	<0.005	0.006	0.046	0.17	0.16	<0.005
TSA (kgH_2SO_4/T)	1.8	0.9	0.6	**2.0**	<0.5	**41**	0.7	0.6	**1.5**	**7.7**	**7.0**	<0.5
TAA (kgH_2SO_4/T)	-	-	<0.05	0.9	<0.5	2.3	<0.5	<0.5	2.9	4.7	2.3	0.5
MATERIAL TYPE			SAND	CLAY	SAND	Clayey SAND	Clayey SAND	Clayey SAND	CLAY	CLAY	SILT	Clayey SAND

NOTES:

*Limit (Trigger Level) below which it is not necessary to prepare an acid sulphate soil management plan.

TPA = Total Potential Acidity
S_{pos} = Sulphur in TSA
TSA = Total Sulphidic Acidity
TAA = Total Actual Acidity (= TPA – TSA)

ASSMAC Acid Sulphate Soil Manual NSW Acid Sulphate Soil Management Advisory Committee published by NSW Agriculture August 1998

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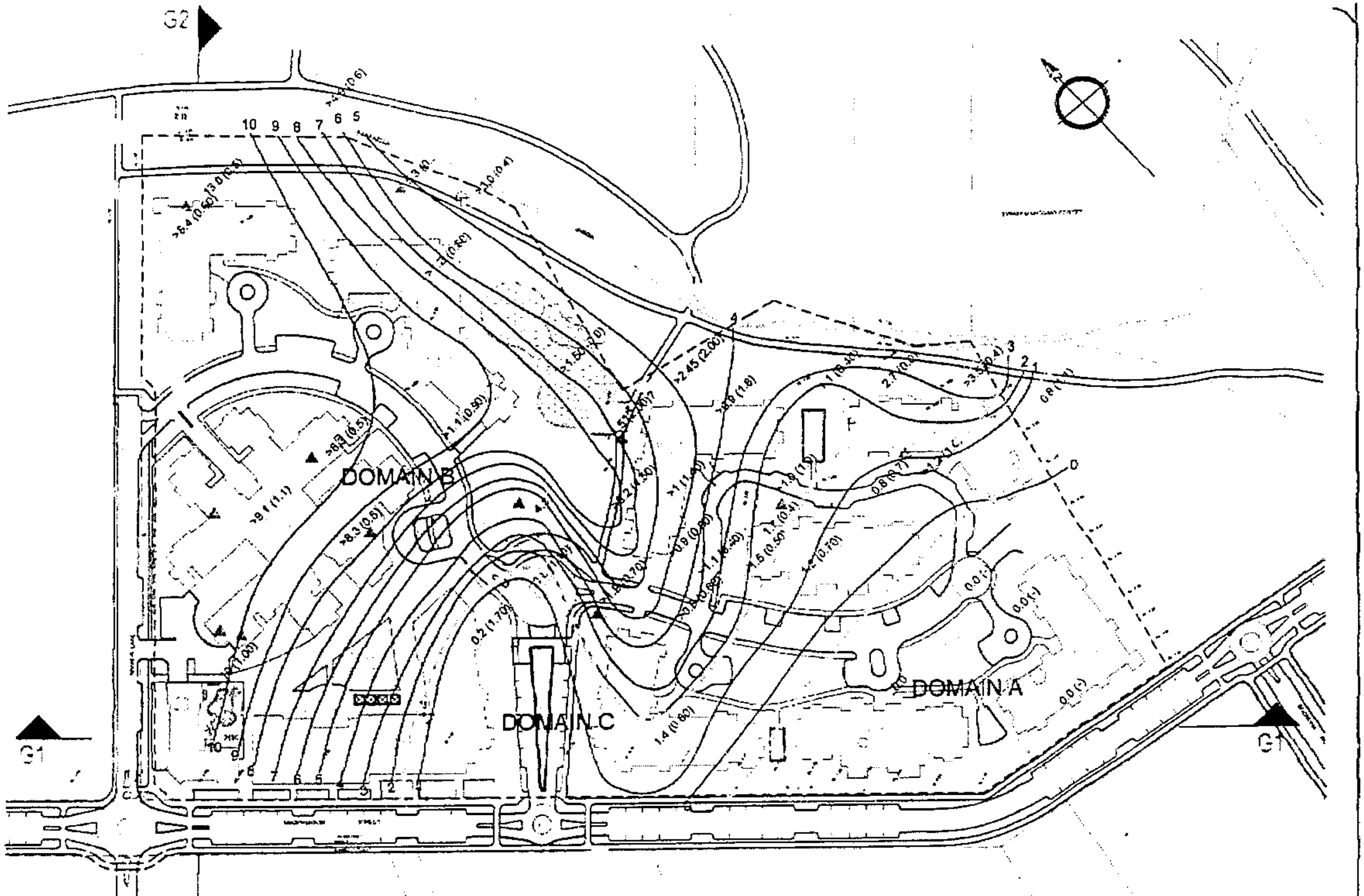

LEGEND

BOREHOLE

TEST PIT

CPTU TESTING LOCATION

PAVEMENT INVESTIGATION BOREHOLE

ALLUVIUM THICKNESS (TOP DEPTH)

INTERPOLATED ALLUVIAL SOIL THICKNESS ISOPACH

DOMAIN BOUNDARY

NOTES:

1. ISOPACHS OF ALLUVIAL SOIL THICKNESS HAVE BEEN ESTABLISHED BY INTERPOLATION OF DISCRETE DATA AT THE TEST LOCATIONS AND REPRESENT AN IDEALISED INTERPRETATION OF DATA BETWEEN TEST HOLE LOCATIONS. GIVEN THE SEDIMENTARY ENVIRONMENT, VARIABILITY OF SUBSURFACE CONDITIONS SHOULD BE EXPECTED AWAY FROM THE TEST HOLE LOCATIONS. THIS INEVITABLE VARIABILITY, TOGETHER WITH THE INTERPRETATIVE NATURE OF BOREHOLE LOGGING AND CONE RESULTS, MUST BE ACKNOWLEDGED WHEN ASSESSING THE DATA PRESENTED HEREIN. THE ISOPACHS ARE THEREFORE INTENDED FOR GUIDE PURPOSES ONLY.
2. REFER DRAWING NO. 4 & 5 FOR INTERPRETED STRATIGRAPHIC PROFILES ALONG SECTIONS G1 AND G2.

1:1500 for A3 Size Print

REFERENCE: BASE PLAN PROVIDED BY EVENT PROJECT MANAGEMENT, DRAWING No. 04149-MP-01, ISSUE 1.

GHD
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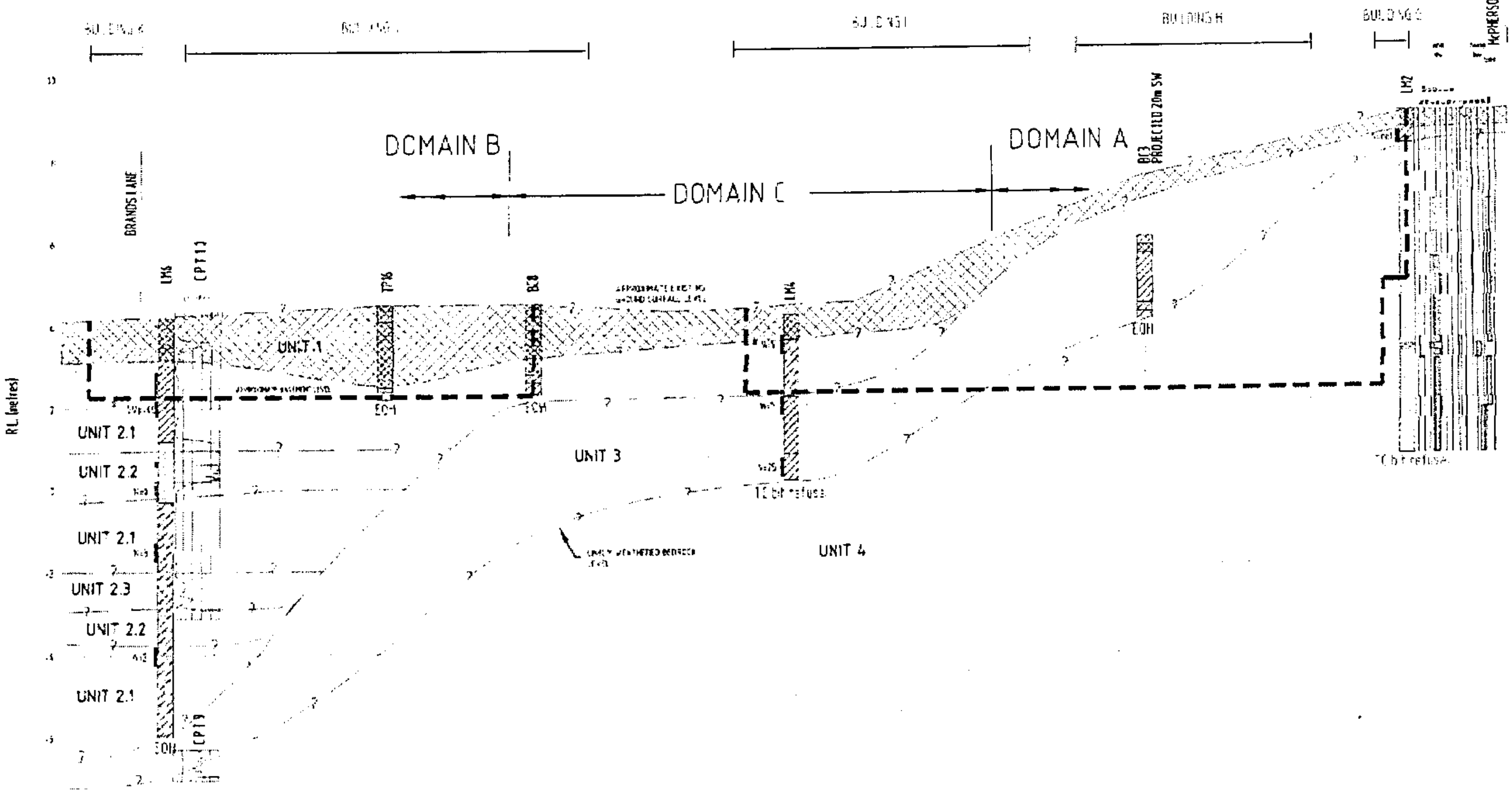
WARRIEWOOD RETIREMENT VILLAGE GEOTECHNICAL INVESTIGATION

ALLUVIAL SOIL THICKNESS ISOPACHS

Designed:	SP
Drawn:	NM
Checked:	Date: 27/5/05
File name:	21135771 6_F02.DWG

Figure No:	2
Job No:	21/13577/16
Scale:	AS SHOWN



LEGEND

TOPSOIL

UNIT 1 - FILL

UNIT 2.1 - ALLUVIAL (soft and firm clay and sandy clay)

UNIT 2.2 - ALLUVIAL (dense and very dense clayey sand and sand)

UNIT 2.3 - ALLUVIAL (firm to stiff clay and sandy clay)

UNIT 3 - RESIDUAL SOILS

UNIT 4 - WEATHERED BEDROCK

DISTANCE (metres)

10 TO 1 VERTICAL EXAGGERATION

(1:100 for A3 Size Plot VERTICAL)

(1:1000 for A3 Size Plot HORIZONTAL)

NOTES

1. THE INFERRED GEOTECHNICAL SECTION IS AN IDEALISATION OF GEOLOGICAL INTERPOLATION AND EXTRAPOLATION OF DISCRETE BOREHOLE DATA. THE INTERPRETATION SHOWN DOES NOT NECESSARILY IMPLY THE ACTUAL CONTACT BETWEEN THE GEOLOGICAL UNITS.
2. LOGS ARE SHOWN HERE FOR GENERAL GUIDANCE ONLY. REFER TO TESTHOLE SHEETS FOR SPECIFIC INFORMATION. IN THE EVENT OF DISCREPENCIES BETWEEN LOGS ON THIS FIGURE AND THE LOG SHEETS, THE LATTER HAVE PRECEDENCE.
3. REFER TO STANDARD SHEETS FOR SYMBOLS AND ABBREVIATIONS.
4. REFER TO TEXT OF THE REPORT FOR DESCRIPTION OF UNITS.
5. RL OF BOREHOLE COLLAR HEIGHTS ESTIMATED FROM SURVEY PLANS SUPPLIED.

©

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WARRIEWOOD RETIREMENT VILLAGE
GEOTECHNICAL SECTION G1

Designed	SP
Drawn	MD
Checked:	Date: 2/1/05
File name: 2113577_F04.DWG	

Figure No:	4
Job No:	21/13577
Scale:	AS SHOWN

Anglican Retirement Villages

8-14 Macpherson Street, Warriewood, NSW

"Upfront" Asbestos Validation Report

March 2006

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Katherine Karlikoff	Andrew Hogan		Andrew Hogan		2/3/06
1	Katherine Karlikoff	Andrew Hogan	ABH	Andrew Hogan	ABH	10/3/06

Contents

Table Index

Appendices

List of Abbreviations

A list of the common abbreviations used in this report is provided below.

- ANZECC – Australian and New Zealand Environment and Conservation Council
- B(a)P – Benzo (a) pyrene
- BTEX – Benzene, Toluene, Ethyl-benzene and Xylene
- DEC – NSW Department of Environment & Conservation
- DIPNR – NSW Department of Infrastructure Planning and Natural Resources
- DLWC – NSW Department of Land and Water Conservation, now incorporated into the Department of Infrastructure Planning and Natural Resources DIPNR
- DQOs – Data Quality Objectives
- EPA – NSW Environment Protection Authority, now incorporated into the Department of Environment and Conservation (DEC)
- HIL – Health Based Soil Investigation Level
- NEPC – National Environment Protection Council
- NHMRC – National Health and Medical Research Council
- NSW EPA – New South Wales Environmental Protection Agency
- OCP – Organochlorine Pesticide
- PAH – Polycyclic Aromatic Hydrocarbon
- PBIL – (Provisional) Phytotoxicity-Based Investigation Levels
- PCB – Polychlorinated Biphenyl
- PQL - Practical Quantitation Limit
- QA/QC - Quality Assurance/Quality Control
- RPD - Relative Percentage Difference
- TCLP – Toxicity Characteristic Leaching Procedure
- TPH - Total Petroleum Hydrocarbons
- UCL_{avg} – Upper Confidence Limit of the arithmetic average contaminant concentration

Executive Summary

GHD Pty Ltd (GHD) was commissioned by Anglican Retirement Villages (ARV) to undertake a comprehensive program of soil sampling and analysis, to evaluate the nature and extent of asbestos within soils at the site known as 8-14 Macpherson Street Warriewood, herein referred to as "the site". The site is identified as Lot 22 (Section A and B) DP 358765, Lot 22 Section C DP5464 and Lot 24 Section A DP400488, and covers an area of approximately 56,000m^2.

The site is largely vacant, only a small portion of 10 MacPherson Street is currently occupied by a residential dwelling. The site was formerly used as a nursery, market garden (greenhouses), and for residential purposes.

Previous works have included a comprehensive site contamination assessment[1], which culminated in the production of a Remediation Action Plan (RAP)[2]. The current works are the first step in implementing the site RAP.

GHD understands it is proposed that the site be redeveloped as a retirement village (residential setting).

It should be noted that the proposed development also encompasses the adjoining property (6 Macpherson Street). However, this property has been subject to recent remediation and validation works by a third-party (Hayes Environmental Consulting), and does not form part of the current commission.

Based on the results of the current study, the following conclusions are made:

- Based on the site inspections undertaken during the current study, and that conducted by GHD in previous investigations, GHD estimate that there is approximately 12,348m^3 or 27,165 tonnes of asbestos containing material (fill) currently present on the site.

  It should be noted that these estimates do not include those areas of the site that could not be investigated during the current site investigation, that is, areas where buildings, dense vegetation, or underground services were present on the site.
- The asbestos contaminated soil was identified in scattered areas across the site, but appeared most prevalent in the northern portion of Number 10 Macpherson Street.
- On the basis of an analysis of remediation options presented in the Remediation Action Plan (GHD, 2005), GHD have considered that either (1) excavation and off-site disposal or (2) on-site management of asbestos-bearing soils would be viable from a technical, policy, health and timing perspective for remediation of the site. The determining factor in selecting the preferred option is therefore the cost implications associated with each remediation strategy. The term "cost" is taken as

[1] Phase 2 Environmental Assessment, 6-14 Macpherson Street, Warriewood (GHD, July 2005).

[2] Remediation Action Plan, 8-14 Macpherson Street, Warriewood (GHD, September 2005).

both the capital cost associated with actual remediation works, plus longer-term cost implications (such as maintenance costs and land value implications).

- The costs estimates incurred for both options have been based on the results of the current asbestos quantification exercise and are estimated at:
  - 1/ The **Excavation and Offsite Disposal Option** cost is estimated in the order of **$2.6 million (excl. GST).**

    It must be noted that should ARV decide to proceed with the 'excavation and off-site disposal' option, the cost of the remediation does not include those areas of the site that were not able to be investigated for the presence of asbestos (as noted in **Section 4**). Nor are the costs associated with de-watering the excavations (and disposal of water to sewer) included in the estimated cost of this remediation option (should this be required).
  - 2/ The **Onsite Management Option of all asbestos bearing waste** is estimated in the order of **$720,000 (excl. GST).**

    It must be noted that should ARV decide to proceed with the 'on-site management of asbestos-bearing soil' option, the cost of the potential depreciation in land value is not included in the cost estimate for this remediation option, nor is the cost of any ongoing maintenance of the 'cap'.

Please note that all volumes, weights and associated cost estimates provided herein should be viewed as strictly indicative, and are subject to an inherent degree of uncertainty.

Furthermore, cost estimates do not include Australian GST, which would be payable on all works at a rate of 10%.

1. Introduction and Objectives

1.1 Introduction

GHD Pty Ltd (GHD) was commissioned by Anglican Retirement Villages (ARV) to undertake a comprehensive program of soil sampling and analysis, to evaluate the nature and extent of asbestos within soils at the site known as 8-14 Macpherson Street Warriewood, herein referred to as "the site". The site is identified as Lot 22 (Section A and B) DP 358765, Lot 22 Section C DP5464 and Lot 24 Section A DP400488, and covers an area of approximately 56,000m^2.

The site is largely vacant, only a small portion of 10 MacPherson Street is currently occupied by a residential dwelling. The site was formerly used as a nursery, market garden (greenhouses), and for residential purposes.

Previous works have included a comprehensive site contamination assessment[3], which culminated in the production of a Remediation Action Plan (RAP)[4]. The current works are the first step in implementing the site RAP.

GHD understands it is proposed that the site be redeveloped as a retirement village (residential setting).

It should be noted that the proposed development also encompasses the adjoining property (6 Macpherson Street). However, this property has been subject to recent remediation and validation works by a third-party (Hayes Environmental Consulting) and does not form part of the current commission.

1.2 Background

GHD has undertaken the following investigations at the site:

- "Warriewood Due Diligence, Stormwater Management, Water Sewer, Geotechnical and Contamination Assessments" was completed in February 2004. This included a Phase 1 Environmental Site Assessment which identified a variety of current and past land uses, including market gardening, materials storage, joinery and boat repairing.
- GHD was subsequently engaged to undertake the "Limited (preliminary) Phase 2 Contamination Assessment, 6-14 Macpherson Street, Warriewood". The primary objective was to assess the likelihood of significant areas of gross contamination within the fill material present at the site, and the extent of contamination across those parts of the site that may have previously been subject to potentially contaminating activities.

  Results of the soil analyses undertaken indicated that in general, the site's fill material and underlying soils did not appear subject to gross, widespread chemical

[3] Phase 2 Environmental Assessment, 6-14 Macpherson Street, Warriewood (GHD, July 2005).

[4] Remediation Action Plan, 8-14 Macpherson Street, Warriewood (GHD, September 2005).

contamination that would preclude the site's redevelopment as a retirement village. However, the site was noted to have been subjected to extensive filling. Fill material generally comprised building rubble in a soil matrix.

- Further to the limited Phase 2 Investigation, ARV engaged GHD to undertake supplementary investigations to satisfy Council's requirements for a "Phase 2 Environmental Site Assessment- 6-14 Macpherson Street, Warriewood" in July, 2005. This investigation incorporated additional soil sampling, to supplement the previously completed assessments, such that a NSW EPA compliant sampling grid was undertaken across the site. Soils sampled and collected from 26 pits excavated to a maximum depth of 2 metres, 18 surface sampling locations, and 20 boreholes drilled for geotechnical purposes were analysed for a range of parameters. Two groundwater monitoring wells were installed, and samples were extracted from these groundwater monitoring wells.

  The analytical results indicated that the soils did not appear contaminated from a chemical perspective. However, asbestos-bearing fibro sheeting was found to be present within the building rubble in all of the four samples analysed for asbestos.

- Further to the above investigations, GHD completed a "Remediation Action Plan (RAP), 8-14 Macpherson Street, Warriewood" in September 2005. The RAP defined the remediation procedures that shall be employed, as well as the required site clean-up criteria.

Whilst testing to date has identified asbestos only in some localised areas, it is reasonable to assume that further asbestos may be present, in as-yet unidentified locations within the fill matrix.

Therefore, the primary issue of concern at the site is the potential presence of asbestos within the soil (fill) matrix in areas of the site.

The techniques and technologies available to remediate asbestos bearing soils are limited, and include:

- Excavation and off-site disposal (to landfill); or
- On-site management of the asbestos bearing soil, beneath an appropriate "cap".

The determining factor in selecting the preferred option is therefore the cost implications associated with each strategy. The term "cost" is taken as both the capital cost associated with actual remediation works, plus longer-term cost implications (such as maintenance costs and land value implications).

However, prior to estimating "costs", a comprehensive program of "Upfront" Site Validation for asbestos was proposed (as part of the RAP) to provide a more comprehensive illustration of the nature and extent of the asbestos bearing fill. Thereby, reasonable volumetric estimates can be made, and these in turn will be used to estimate the cost of each remediation strategy. A cost comparison of the various remediation options will assist in selecting the preferred remediation strategy.

This report therefore details the findings of the "Upfront" validation program necessary to meet the objectives as set out in **Section 1.3.**

1.3 Objectives

The objectives of the 'Upfront' asbestos validation program were to:

- Confirm whether asbestos is more widespread within the fill matrix, (or alternatively confined to occasional incidences in the areas already defined);
- Permit the formulation of reasonably reliable (albeit indicative) estimates regarding the total volume of asbestos bearing fill; and
- Provide indicative cost estimates for the two available remediation strategies (as per the RAP (GHD, 2005)). That is, remediation of the site via (1) excavation and offsite disposal of asbestos contaminated material, and (2) onsite management of asbestos contaminated material. The cost estimates will assist in selecting the preferred remediation option.

2. Scope of Work

Works undertaken comprised of the following:

- Undertaking a review of previous reports conducted by GHD;
- A comprehensive walkover of the site:
  - Noting any areas difficult to access (due to overgrown vegetation or other);
  - Noting any areas where site buildings were present (i.e abandoned residential dwellings and market gardens); and
  - Marking any areas of the site where underground services were present and therefore excavation could not be conducted. This was conducted with the assistance of a professional cable locator and 'dial-before-you-dig' search results;
- A program of soil sampling comprising:
  - The excavation of 160 testpits to a nominal depth of 0.1m into natural, undisturbed ground using a backhoe.
  - Collection of soil samples at the surface (0-0.1m), 0.5m, 1m, and at each subsequent metre of fill until natural material (or the groundwater table) was encountered. Additional soil samples were collected from any fill matrix where evidence of fibro was noted;
- Laboratory analysis of representative soil samples (for asbestos only). Testing included the surface (0-0.1m) sample from each test pit, in addition to various deeper samples across the site.
- Implementation of a field and laboratory Quality Assurance (QA) program; and
- Preparation of a report presenting the results of the investigation, summary testpit log table, results of the laboratory testing program, an assessment of the incidence of asbestos contamination across the site, and therefore cost comparisons of the two remediation strategies (as per the RAP (GHD, 2005)).

3. Site Information

3.1 Site Identification

The site is located at 8 to 14 Macpherson Street, Warriewood and consists of a number of parcels of land. The site location is shown on **Figure 1, Appendix A,** and the details of each lot are summarised in **Figure 2, Appendix A** and below in **Table 3.1.**

Table 3.1 Site Identification Summary

Street Address (Warriewood)	8 Macpherson Street	10 Macpherson Street	12 Macpherson Street	14 Macpherson Street
Geographical Co-Ordinates	341967E 6270881N	341911E 6270931N	341859E 6271008N	341823E 6271050N
Site Area (m2)	9,946m^2	17,964m^3	14,151m^2	14,625m^2
Title Identifier (Lot/DP Number)	Lot 24 Section A DP400488	Lot 22 Section C DP5464	Lot 22 Section B DP358765	Lot 22 Section A DP358765
Land Use Zoning	1(b) Non Urban	1(b) Non Urban	1(b) Non Urban	1(b) Non Urban
Local Government Area	Pittwater	Pittwater	Pittwater	Pittwater
County	Cumberland	Cumberland	Cumberland	Cumberland
Parish	Narrabeen	Narrabeen	Narrabeen	Narrabeen

A more detailed description of the site and its surroundings is provided in **Section 3.2.**

3.2 Site Conditions and Surrounding Environment

3.2.1 Site Description

A brief site description is included below. For further details refer to the Phase 1 Environmental Assessment report (GHD 2004)[5].

8 Macpherson Street

The majority of the lot comprises cleared land with a brick single storey house and associated shed in the southeast corner of the lot. A shed was noted to the north east of the house and appeared to be constructed of corrugated iron.

[5] *Warriewood Due Diligence, Stormwater Management, Water, Sewer, Geotechnical and Contamination Assessments.* GHD Pty Ltd, February 2004.

It appears that parts of the site may have been used for market gardening purposes. A number of steel drums and polystyrene cases were noted to the west of the overgrown garden area.

10 Macpherson Street

This portion of the overall site was approximately rectangular in shape except for the northern boundary, which was irregular in shape and approximately follows the Narrabeen Creek alignment (**Figure 2**).

A small house, set back from Macpherson Street, was located approximately half way from the eastern and western site boundary.

A bitumen road existed to the east of the house and progresses north to approximately the middle of the lot. Building rubble, tryes and other uncontrolled fill material was evident on the northern section of the site with this material also noted on the creek embankment.

12 Macpherson Street

This lot was also approximately rectangular in shape with an irregular shaped northern boundary. The northern section of the lot appeared to be used for storing materials including steel, timber, shipping containers, demountable sheds etc. A number of sheds constructed from corrugated iron were also evident on the northern half of the lot. Further sheds and storage of equipment and material was noted across the middle of the site. A number of sheds and a shipping containers were noted on the southern section of the site. The southern area of the site was bare earth used for parking of buses. A house was located on the southeast corner of the site.

14 Macpherson Street

The northern area of the lot was bare earth. To the south of this area greenhouses were evident and were all joined together to form one large greenhouse. The greenhouses and agricultural area covered approximately 30% of this lot.

Three large sheds and three additional large greenhouses were noted further to the south. These structures covered approximately 20% of the lot. A number of cars and other material were noted in these three greenhouses. The three sheds were used for timber storage and as a joinery.

To the south of the three large sheds was a concrete, bitumen and unsurfaced hardstand area. Large sheds were noted to the east and south of this hardstand area. A house and yard was present on the southern section of the site.

3.2.2 Surrounding Land Uses

Narrabeen Creek generally forms the northern site boundary with site use further to the north generally for residential purposes. To the east the surrounding site use consisted of a nursery and then Narrabeen Creek. To the south was Macpherson Street with low-density residential use further to the south. To the west was Brands Lane with a nursery further to the west.

3.2.3 Topography

Generally the site was relatively flat, except for number 8 which slopes downward from south to north (towards Narrabeen Creek).

3.2.4 Hydrology

Surface water runoff on the site was governed by localised slope gradients. A number of drainage paths were evident across the site. Generally the site was relatively flat, however surface water flow most probably drains to Narrabeen Creek, which flows along the north-eastern site boundary.

3.2.5 Geology

The Geological Survey of NSW, *Sydney 1:100,000 Geological Series Sheet*[6] identifies that the site is underlain by Quaternary alluvium comprising sand, peat, silt and clay. The Newport Formation within the Narrabeen Group appears to underlie the alluvium at depth. This typically comprises interbedded laminate, shale and sandstone with minor claystone beds.

The *1:100,000 Soil Landscape* plan for Sydney (9130, 1989) indicates that the landform consists of Warriewood 'Swamp' landscape on the north-west section and disturbed terrain.

3.2.6 Hydrogeology

The Principal Groundwater Resources of Australia Map 1:5,000,000 (Department of Minerals and Energy, 1975) indicated that the groundwater quality is usually suitable for most purposes but yield generally inadequate for town supplies, industrial use and irrigation purposes.

A search of DLWC (now the Department of Infrastructure, Planning and Natural Resources (DIPNR)) records shows eleven groundwater bores are located within a 2 km radius of the site (**Figure 3.1**). Summary bore data is provided in **Table 3.2**.

[6] NSW Department of Mineral Resources, 1983, Edition 1.

Bores 2km radius at Cnr of Macpherson Street and Brands Lane
Warriewood dated 04/02/2004

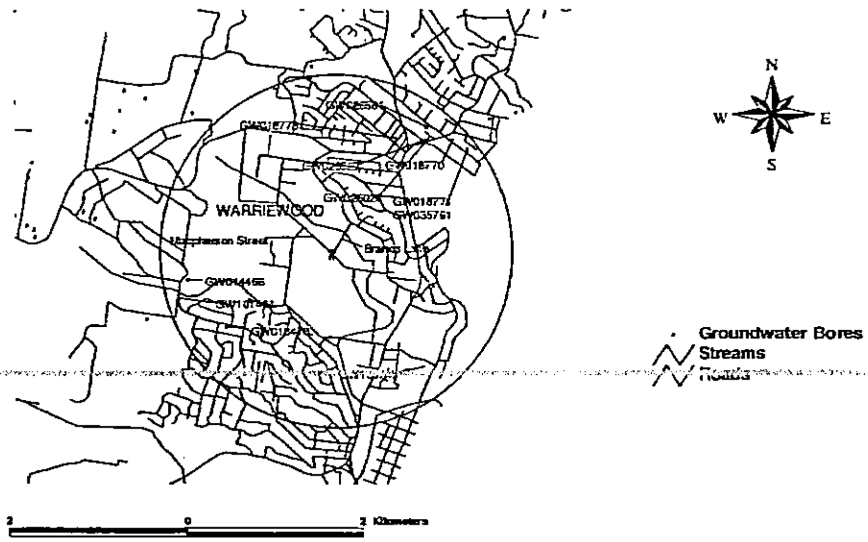

Figure 3.1 Registered groundwater bores within a 2 kilometre radius of the site.

Table 3.2 Summary of DLWC bore data

Bore Identification	Direction from Site	Depth to Groundwater (m)	Date Installed	Beneficial Use
GW013478	Southwest	Nil [a]	1958	Domestic
GW014466	West	16.4	1960	Domestic
GW018770	Northeast	3.6	1960	Waste Disposal
GW018771	Northeast	Nil [a]	1960	Waste Disposal
GW018778	North	21.3	1960	Waste Disposal
GW026026	Northeast	2.4	1966	General Use Domestic
GW026027	Northeast	4.5	1966	General Use Domestic
GW026581	Northeast	2.4	1967	Waste Disposal
GW035791	Northeast	Nil [a]	1960	Waste Disposal
GW100749	Southeast	2.0	1995	Irrigation Recreation
GW101494	West	14.9	1997	Irrigation Recreation
GW013478	Southwest	Nil [b]	Nil [b]	Nil [b]

[a] – No water bearing zone recorded on the drillers log provided by DIPNR.

[b] – No information provided by DIPNR.

3.2.7 Acid Sulphate Soils

Information included on the 1:25,000 Acid Sulphate Soil Risk Map for Hornsby/Mona Vale – Edition One[7] identifies sections of the site as high risk areas. Soil sampling and analysis conducted in previous reports indicated Potential Acid Sulphate Soil (PASS) existed on the site. Further sampling was conducted during a previous investigation with the details of the analytical results included in "Geotechnical Site Assessment, 6-14 Macpherson Street, Warriewood" (GHD reference: AW250). This report should be referred to for greater details on PASS on the site.

[7] Department of Land and Water Conservation, 1995

4. Site Inspection

The site appeared to be similar to that described during the Phase 2 Contamination Assessment (as described in **Section 3.2.1**). The site's vegetation generally ranged from sparsely vegetated to over grown vegetation. The buildings on the site consisted of disused greenhouses, steel framed sheds and brick residential premises.

During the initial site walkover, portions of the site that were inaccessible to the excavator were noted.

The portions of the site that were not investigated due to access restrictions include:

- areas where access was not possible due to overgrown vegetation;
- areas where site buildings were present, these included abandoned/derelict greenhouse, steel framed sheds and brick houses, and a single residential house that was occupied during the investigations;
- areas where cable location and dial-before-you-dig plans identified services on or beneath the site; and
- A triangular portion of land on the northeastern end of 10 Macpherson Street, Warriewood (approximately 1600m^2), which was not investigated, as per an instruction received from ARV.

Therefore, there are some portions of the site where the presence of asbestos materials within the fill could not be investigated.

These areas are denoted in **Figure 2, Appendix A**.

5. Sampling and Analysis Plan

5.1 Rationale for Sampling Plan

Works undertaken in the Phase 2 Contamination Assessment (GHD, 2005) comprised an "EPA-compliant" sampling grid across the site (in accordance with the "minimum grid based sampling locations required for site characterisation", as per the NSW EPA *Sampling Design Guidelines*), with the exception of where access restrictions were encountered.

However, the EPA- compliant sampling grid is designed to detect a contaminant "hotspot" with a given diameter, and cannot be reliably applied to the identification of fibro associated with indiscriminate waste disposal.

The total site area is approximately 58,000m², which (although the site is not square) equates to dimensions of roughly 240m x 240m.

GHD considered it reasonable to supplement the existing sampling grid via the completion of additional testpits on a 20m x 20m grid across the site (which equates to an additional 144 test pits).

In addition, an allowance was made for an additional 16 pits within the northern portion of Numbers 10 and 12 Macpherson Street (where fibro has been identified in preceding GHD investigations), to assist in the delineation of any additional asbestos in these areas.

As such, GHD have excavated a total of 160 testpits across the site during this current investigative round.

5.2 Soil Investigation Program

A total of 160 testpits were excavated across the site. Each pit was extended to approximately 0.1m into natural material, or to a point immediately below the groundwater table whereupon the test pits collapsed. The location of each test pit is shown on **Figure 2 (Appendix A)**.

Soil samples were collected at each location at the surface (0-0.1m), 0.5m, 1m and at 1m intervals thereafter until pit completion. Additional samples were collected from any strata in which evidence of fibro was noted.

Between one and three samples per test pit location, or 294 samples in total, were submitted for asbestos analysis. Samples submitted for analysis included:

- One surface sample (0-0.1m) from each of the 160 test pits; and
- Various deeper samples across the site, especially targeting those test pits that exhibited evidence of fibro during field works.

5.3 Laboratory Program

The laboratory analysis for asbestos in soil samples was carried out by SGS Laboratories Pty Ltd, a NATA registered laboratory for the analysis undertaken.

6. Quality Assurance

6.1 Analytical Data Quality Objectives

The purpose of establishing data quality objectives is to ensure the field investigations and analyses are undertaken in a way that enables the collection and reporting of reliable data on which to base the site assessment.

The data quality objectives (DQOs) for sampling techniques and laboratory analysis of collected soil samples defines the acceptable level of error required for this investigation. The data quality objectives were assessed by reference to data quality indicators as follows:

- **Data Representativeness** –expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples in an appropriate pattern across the site, and by using an adequate number of sample locations to characterise the site. Consistent and repeatable sampling techniques and methods are utilised throughout the sampling.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study. If there is insufficient valid data, as determined by the other data quality objectives, then additional data are required to be collected.
- **Comparability** - is a qualitative parameter expressing the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples, ensuring analysing laboratories use consistent analysis techniques and reporting methods. Comparability is achieved by ensuring that precision and accuracy objectives are met.

6.2 Field Program

6.2.1 Field Quality Assurance

All fieldwork was conducted in general accordance with GHD's Standard Field Operating Procedures, which ensured all environmental samples were collected by a set of uniform and systematic methods, as required by GHD's Quality Assurance (QA) system. Key requirements of these procedures are listed below:

- The use of new disposable gloves for the collection of each sample, and the use of dedicated sampling bags provided by the laboratory. The sample was obtained from the centre of the excavator bucket to ensure that the sample was not compromised (that is, that cross contamination did not occur);

- Soil samples were immediately transferred to appropriate sample bags for the required laboratory analysis. All sample bags were clearly labelled with a sample number, sample location, sample depth, sample date and job number; and
- Chain-of-custody forms were completed and forwarded to the testing laboratory, along with the relevant soil samples.

7. Validation Criteria

7.1 Objectives of Remediation Work

The purpose of this investigation was purely to better define the nature and extent of asbestos bearing fill, thereby permitting reasonable volumetric estimates of asbestos contaminated fill to be formulated (to assist in selecting the preferred remediation technique).

Based on communications with ARV, it is understood that remediation and validation works must ensure that the site is suitable (from an environmental and human health perspective) for redevelopment as a retirement village.

The two available remediation options are:

- Excavation and offsite disposal; and
- Onsite management of asbestos materials beneath a suitable 'cap'.

The determining factor in selecting the preferred option is based on the most cost effective strategy, based on both capital costs associated with actual remediation works, in addition to longer term cost implications (maintenance and land value implications).

7.2 Asbestos Clean-Up Criteria

The soil validation criteria that must be met will be the Health Based Soil Investigation Level- Exposure Setting "A" (Standard Residential) (HIL A) presented in the National Environmental Protection (Assessment of Site Contamination) Measure, National Environmental Protection Council (NEPC), 1999 (NEPM). These are mostly the same as the criteria set in the Guidelines for the NSW Site Auditors Scheme, NSW EPA, 1998. However, no asbestos guideline is presented in the NEPM.

There are currently no national or NSW guidelines for asbestos in soil. Enhealth is currently considering guidelines for asbestos in a non-occupational environment, including asbestos in soil. The NSW DEC (formerly the NSW EPA) has advised that asbestos is a human health issue and not an environmental issue. On the advice of the NSW Department of Health, the NSW DEC has advised NSW Site Auditors (Site Auditors Meeting 1 March 2000) that "no asbestos in the soil at the surface is permitted". That is, no friable asbestos should be present within the near surface soils, nor should there be any potential exposure route by which persons may become exposed to friable asbestos within the soil matrix.

8. Results

8.1 General

GHD has conducted several contamination investigations at the site. Previous investigations have indicated that the soils did not appear contaminated from a chemical perspective. However, asbestos fibro sheeting was detected within the fill in isolated areas, and was envisaged to be present in as-yet unidentified locations within the fill matrix prior to the current investigation. Therefore, the primary issue of concern at the site is the presence of asbestos within the (fill) matrix across areas of the site.

Asbestos identification is the primary subject of concern in this investigation.

The following sections present the results of the current "Upfront" Validation assessment undertaken at the site from the 4th to the 6th, and 9th to the 12th of January 2006, incorporating those asbestos soil results gathered from previous investigations conducted by GHD at the site.

A discussion of the results obtained during the current investigation is provided in **Section 8.2** below.

A summary table of the testpit logs is included in **Appendix B, Table A**.

All analytical laboratory reports and associated chain-of-custody documents are included in **Appendix C**.

8.2 Field Observations

8.2.1 Surface Observations

The site was generally covered by thin to dense vegetative cover, consisting of both a mixture of overgrown weeds, grass and trees/shrubs. Isolated areas on the northern portion of 12 and 14 Macpherson Street appeared to be free of vegetative cover.

8.2.2 Subsurface Observations

A summary of test pit logs for all sampling locations for the current investigation are presented in **Appendix B**.

The subsurface soil profile can generally be described as consisting of silty sand, gravely sand or sandy clay fill from the surface to a depth of approximately 1.5m below the ground surface (bgs), beneath which a layer of natural grey sand (to approximately 2.5m bgs) exists, which is followed by sandy clay or peaty clay.

The fill material across the site varied, and contained demolition type material including road base, asphalt, ash material, terracotta, brick cobbles, tiles, concrete, fibro and sandstone boulders.

The locations in which visible fibro was noted within the fill matrix are shown on **Figure 2 (Appendix A)**.

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8.3 Analytical Results

The results of the analysis of asbestos in soil across the site during all investigations completed to date is described below. A graphical summary of these investigations and results are shown in **Figure 3, Appendix A**.

8.3.1 Preliminary Phase 2 Environmental Site Assessment

During the Preliminary Phase 2 Environmental Site Assessment conducted by GHD (August, 2004) three (3) soil samples were analysed for asbestos. No asbestos fibres were detected in any of the three (3) soil samples analysed for asbestos.

See **Figure 2, Appendix A** for the location of the soil samples analysed for asbestos (BH 5-2.0m, BH7-0.2m and BH8-1.0m).

8.3.2 Phase 2 Environmental Site Assessment

During the Phase 2 Environmental Site Assessment conducted by GHD (July, 2005) four (4) soil samples were analysed for asbestos. Asbestos was detected in each of the four samples (within either cement sheeting or tiles).

See **Figure 3** for the location of the soil samples (TP5-1.5AC, TP6-1.0AC, TP7-0.5tile and TP15-1.3AC). The asbestos was detected within material located in the northern section of 10 Macpherson Street.

8.3.3 Current "Upfront" Validation Investigation

During the current "Upfront" Validation Investigation, 160 testpits were excavated across the site.

294 samples were analysed for the presence of asbestos, of which twenty-one (21) samples detected asbestos fibres and one (1) sample detected synthetic mineral fibres.

A general summary of the locations at which asbestos was detected across the site was as follows:

- 14 Macpherson Street: Asbestos was detected in near surface soils along the north eastern and south western portion of 14 Macpherson Street;
- 12 Macpherson Street: Asbestos was detected at up to 1.2m below ground surface (bgs) across the north eastern portion of 12 Macpherson Street, and up to 2m bgs in the centre of 12 Macpherson Street.
- 10 Macpherson Street: Asbestos was detected at up to 2m bgs at one testpit location and at the surface (0.1m) in another location in the north eastern portion of 10 Macpherson Street. It should also be noted also that fibro was widespread throughout the fill matrix in the northern portion of Number 10. This fibro may be reasonably assumed to contain asbestos.
- 8 Macpherson Street: No asbestos was detected in any sample analysed for asbestos.

9. Estimated Volume/Weight of Asbestos Contaminated Material.

9.1 Methodology and Assumptions

In order to select the preferred remediation strategy to address asbestos within the fill at the site, the general extent of asbestos contamination within the fill matrix needs to be determined. Based on the extent of asbestos contamination at the site, an indicative estimate of the total volume of asbestos contaminated soil can be formulated, which in turn is converted into an indicative weight (from which disposal costs can be estimated).

A graphical summary of the results of these investigations are shown in **Figure 3**. A table showing the calculated (indicative) volumes and weights of asbestos containing material across the site are shown in **Appendix B, Table B**.

Disposal costs for the asbestos containing fill material will be largely dependant upon the volume and resultant weight of the material, together with the waste classification of this material.

In formulating cost estimates for the disposal of the asbestos contaminated material, GHD has made a number of assumptions relating to these factors (ie. the volume/weight and waste classification). The methodology and assumptions pertaining to these factors are described below:

9.1.1 Physical Composition

The asbestos bearing fill material at the site is varied in nature, and generally consists of sandy clay, silty sand or gravely sand with demolition waste throughout.

During the Phase 2 Environmental Site Assessment, laboratory analysis was conducted on representative soil samples from the fill material on the site for the following chemical parameters:

- Heavy metals (Ar, Cd, Cr, Cu, Pb, Hg, Ni, Zn) 62 samples analysed;
- Total Petroleum hydrocarbons (TPH) 6 samples analysed;
- Benzene, toluene, ethylbenzen and xylene (BTEX) 6 samples analysed;
- Polycyclic aromatic hydrocarbons (PAH) 7 samples analysed; and
- Organochlorine Pesticides (OCPs) 41 samples analysed.

The results of the initial review of the analytical soil results indicate that if fill material was to be excavated and disposed of off site, it would nominally be classified as industrial waste (under the provisions of the NSW EPA 'Waste Guidelines[8]). This 'industrial' waste classification is only owing to two individual samples with lead concentrations exceeding the solid waste classification. The two lead concentrations

[8] NSW EPA (1999) Environmental Guidelines: Assessment, Classification and Management of Liquid and non-liquid Wastes.

that exceed 'solid' waste classification are 110mg/kg (TP15-1.3) and 170mg/kg (SS28 0.05-0.1m).

However, the NSW EPA (1995), "*Contaminated Sites: Sampling Design Guidelines*", indicate that the calculated 95% UCL_{avg}[9] concentrations for each parameter can be compared to the relevant waste classification criteria (instead of relying solely on individual sample data).

Use of the 95% UCL is appropriate only when:

- No single concentration within the data set exceeds 250% of the respective criteria for each parameter; and
- The standard deviation of the data set not to exceed 50% of the respective criteria for each parameter.

It is important to note that the 95% UCL_{avg} concentration is only calculated on waste material within the same strata and described as material of similar composition.

The 95% upper confidence limit (UCL) for lead within the fill material across the site was 40mg/kg, which is well below the maximum concentration for classification as 'solid waste'. Therefore, the fill material on the site would classify as solid waste (NSW EPA, 1999) on the basis of chemical (metal and PAH) contamination concentrations as reported within the Phase 2 Environmental Site Assessment (GHD, 2005).

Finally, if the material is to be disposed of off site, it must be sent to a 'Solid Waste, Class 1' landfill licensed to accept asbestos wastes.

Therefore, for cost estimating purposes, it is assumed that the material may be disposed to a landfill which accepts 'Solid Waste, Class 1' (containing asbestos).

Waste Classification summary is shown in **Appendix B, Table C.**

9.2 Volume Estimation

GHD excavated 160 test pits across the site, for each of these testpits:

- The material encountered was logged according to depth (which included making a note of the location and depth of where asbestos containing material was potentially present);
- The location of the testpit was noted on a site map (in addition, GPS coordinates were noted);
- Soil samples were collected from the surface (0-0.1m), 0.5m, 1m, every 1m through until 0.1m into natural ground, and from any additional fill matrix in which evidence of fibro was noted.

294 soil samples were analysed from different locations and depths across the site. A surface soil sample was analysed from each testpit, along with selected deeper soil samples.

[9] UCL = Upper Confidence Limit on the mean contaminant concentration.

The location, and therefore volume of asbestos was compiled using the results of the current asbestos laboratory reports, historical asbestos investigation results, and visual observations made during the current investigation.

At each location on the site where fill material containing asbestos was noted, the volume of asbestos bearing soil was estimated via the following equation:

Asbestos Contaminated Soil Volume = Maximum Depth x Length x Width

GHD consider the use of this equation to be conservative, as it assumes that each area containing asbestos contamination is:

- a regular cube or rectangular prism;
- the depth of contamination across the entire area extends to the maximum depth in which the asbestos was either noted within the test pit logs, or as determined in the laboratory report at any individual sample location; and
- the lateral extent of asbestos bearing material is assumed to extend 50% of the distance to the nearest asbestos free sample location.

Furthermore, GHD has assumed that asbestos is present at all locations where fibro was observed, regardless of whether asbestos was reported by the laboratory within soil samples collected from these locations.

This may therefore result in the over-estimation of some individual contamination volumes.

However, for the purposes of the current exercise, it was considered prudent to produce conservative volumetric estimates, to minimise the potential for a gross under-estimation of overall disposal costs. This is particularly applicable given that portions of the site could not be investigated for the presence of asbestos, as detailed in **Section 4.**

The estimated volume of asbestos containing material was calculated at approximately 12,348m^3. A summary, by location, of the total volume of asbestos containing material across the site is shown in **Appendix B, Table B** and is shown graphically in **Figure 4, Appendix A.** It should be noted that this volumetric estimate is strictly indicative only.

9.3 Mass Estimation

For each individual location where asbestos was found within the soil material on the site the volume was converted into an appropriate mass using a bulking density of 2.2 tonnes per m^3.

Based on application of the volumetric estimates provided above, the estimated total mass of the asbestos containing material on the site was approximately 27,165 tonnes. A break up, by location, of the total mass of asbestos containing material across the site is shown in **Appendix B, Table B.**

<u>Again, it should be noted that the these mass estimations do not include that material where the status of asbestos contamination could not be investigated (as detailed in **Section 4**) and that of potentially asbestos containing material extending below the</u>

groundwater table (which could not be determined, as test pits generally collapsed below the water table).

10. Cost Comparison of Remediation Strategies

On the basis of an analysis of remediation options identified during the Remediation Action Plan (GHD, 2005), GHD have considered that either (1) excavation and off-site disposal or (2) on-site management of asbestos-bearing soils would be viable from a technical, policy, health and timing perspective. The determining factor in selecting the preferred option is therefore the cost implications associated with each remediation strategy. The term "cost" is taken as both the capital cost associated with actual remediation works, plus longer-term cost implications (such as maintenance costs and land value implications).

The capital costs of remediation is a direct function of the volume of asbestos bearing material present at the site, and the distribution of that material.

It must be noted that should ARV decide to proceed with the 'excavation and off-site disposal' option, the cost of de-watering the excavations as needed (and disposal of water to sewer) are not included in the cost estimate.

However, should ARV decide to proceed with the 'on-site management of asbestos-bearing soil' option, the cost of the potential depreciation in land value can not be included in the cost estimated for this option.

Furthermore, for both remediation options, the cost of the remediation does not include those areas of the site that were not able to be investigated for the presence of asbestos within the soil fill (as noted in **Section 4**).

10.1 Option 1: Excavation and Offsite Disposal

This option involves excavating and disposing of all asbestos bearing soils to a 'solid waste, class 1' landfill. The excavations shall be validated for asbestos (at a density of one sample per 100m^2), and subsequently the excavations shall be filled with 'clean' (validated) compactable material.

10.1.1 Cost Estimations (Removal and Disposal Costs)

Based upon the total (estimated) mass of the material present at the site, an estimate of the total cost of haulage and disposal of asbestos contaminated materials (excluding those areas not investigated as detailed in **Section 4**) is provided in **Table 10.1**, below.

Please note that the costs provided below have been formulated based upon indicative unit prices supplied by Enviropacific Pty Ltd, a contracting firm experienced in remediation works of this nature.

The unit rates adopted for the current exercise were as follows ($AUD ex GST):

- Removal & Disposal of Soil (as 'solid waste, Class 1') $75/tonne
- Set up and preliminaries $20,000 per set up

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Table 10.1 Summary of Estimates (Excavations, Haulage & Disposal Costs) and Set Up

Waste Composition	Estimated Weight (Tonnes)	Estimated Cost Disposal ($AUD ex GST)
Asbestos containing material (to be disposed of to a solid waste, Class 1 landfill)	27,165 tonnes	$2,037,375
Set up and Preliminaries	-	$20,000

Please note that the cost estimates presented in **Table 10.1** are for site establishment, excavations, loading, haulage and disposal of contaminated materials only. GHD consider that additional allowances should be made for:

- Validation of excavations formed from excavation works for asbestos at a rate of 1 sample per 100m^2 (107 samples for asbestos), and validation of the 'clean' material to be used to fill the excavations (10 samples for TPH, BTEX, asbestos, metals, OCP/PCB). An allowance of $10,000 should be made for laboratory analysis costs.
- Filling excavations (created by excavation and disposal of asbestos contaminated material) with 'clean' (validated) material. It is envisaged that 13,000m^3 of 'clean' material will be required. This material may cost in the order of $195,000 to purchase the material and deliver it to site, plus another $260,000 for backfill and compaction.
- A part time site foreman, to mark out the areas containing asbestos impacted material for the waste contractor, and to oversee the project. It is envisaged that $20,000 may be a reasonable allowance in this regard.
- Air monitoring for occupational health and safety purposes (asbestos monitoring would be recommended). An allowance of $7,000 would seem reasonable for air monitoring.
- In addition, should ARV decide to investigate currently inaccessible areas of the site following removal of buildings (or other) from the site, no allowance have been made for the remediation and validation of any as yet unidentified asbestos contaminant "hotspots".
- De-watering the excavations will be changed at cost plus 10% on an 'as needed' basis.

The total cost for the 'excavation and offsite disposal option' is envisaged to be approximately $2.6 million (excluding GST), see **Appendix B, Table D** for a breakdown summary of the costs incurred.

10.2 Option 2: Onsite Management of Asbestos Contaminated Soil (beneath a suitable 'cap')

The 'Onsite Management of Asbestos Contaminated Soil beneath a suitable cap' option involves consolidating the asbestos contaminated soil within defined areas, and then 'capping' those areas, to preclude potential exposure to asbestos.

The results of the 'Upfront' Validation Assessment indicate that the asbestos contaminated material is scattered across the site. The asbestos contamination varies from being confined to the surface soils, to that of contamination extending to the deeper soil profile.

An option for consolidating this asbestos contaminated soil across the site involves relocating asbestos impacted material from scattered shallow areas (Areas 1-8, 10 and 11 on **Figure 4**) to a central 'pit' (to be dug on the northern portion of 10 Macpherson Street). Following the excavation of the asbestos contaminated soil from Areas 1-8, 10 and 11, the areas will be validated for asbestos at a density of one sample per $100m^2$. Following validation of these area, the excavations will be back filled using clean soil derived from elsewhere onsite.

The areas of the site where deeper asbestos contaminated soil were identified (Area 9, 12 and 13) would be managed onsite to minimise the costs incurred, that is:

- The surface 0.5m of material within **'Area 9'** resulted in 'clean' (asbestos free) material, below which asbestos contaminated soil was detected. Therefore the surface 0.5m of material shall be excavated and stockpiled inorder to lay a geofabric 'barrier' at a depth of 0.5m, followed by which the stockpiled 'clean' material will be replaced as a 'capping' layer.
- Asbestos contaminated soil was detected within the shallow soils within **'Areas 12 and 13' (Figure 4)**. The top 0.5m of asbestos contaminated soil from within Areas 12 and 13 will therefore be excavated and disposed offsite to a 'Solid Waste, Class 1' landfill. A geofabric barrier will be placed ontop of the remaining asbestos contaminated soil (at a depth of 0.5m bgs), and a 0.5m thick 'capping' barrier will be placed on top of the geofabric in these areas. The 'capping' over 'Areas 12 and 13' involves covering the areas with a non-biodegradable geofabric layer, followed by 0.4m in thickness of compactable, 'hard standing', 'clean' material, on top of which 0.1m in thickness of clean 'topsoil' capping material will be placed to minimise potential for erosion of the 'cap'. All 'capping' material shall be validated for a range of analytes before importation to the site.

As an alternative to a soil 'cap', alternative caps (such as concrete slabs) may be considered. However, these options have not been priced herein.

The Area references referred to are shown in **Figure 4, Appendix A**. The methodology for this option is shown in **Figure 5, Appendix A.**

10.2.1 Cost Estimations (Capping and Onsite Management)

Based upon the areas of the site that have exhibited asbestos contamination **(Appendix A, Figure 3)** within the soils, an estimate of the areas requiring capping has been possible. Areas 12 and 13 shall be capped with 0.5m of clean material over a marker layer (as per the RAP, see above).

Again, the costs provided below have been formulated based upon indicative unit prices supplied by Enviropacific Pty Ltd, a contracting firm experienced in remediation works of this nature.

The unit rates adopted for the current exercise were as follows ($AUD ex GST):

- Purchase and delivery of hard standing 'capping' material $15/m^3
- Purchase and delivery of 'topsoil' material $30/m^3
- Purchase and set down of non-biodegradable geofabric marker layer $1/m^2
- Excavation and relocation of material via a backhoe $75/hour
- Setup on site and preliminaries $20,000/ per setup

Table 10.2 Summary of Estimates (Purchase, delivery and compaction of 'capping' material for Areas 9, 12 and 13- geofabric, 'capping and topsoil layer) and Setup On Site.

Waste Composition	Estimated Area/Volume (m^2 or m^3)	Estimated Cost Purchase, Delivery and Compaction ($AUD ex GST)
Geofabric Marker Layer (to cover Areas 9, 12, 13 and the 'pit')	5,600m^2	$5,600
'Capping' Material (0.4m thickness) (Areas 12 & 13)	1,950m^3	$29,250
'Topsoil' Material (0.1 thickness) (Areas 12 and 13)	500m^3	$15,000
Site set up and preliminaries	-	$20,000

Please note that the cost estimates presented in **Table 10.2** are for the purchase, delivery and compaction of 'capping' materials and geofabric only. GHD consider that additional allowances should be made for:

- Relocating and excavating of materials (contaminated and otherwise) onsite. It is estimated that an allowance should be made for 200 hours of onsite work, costing an estimated $15,000 (based on a cost of $75/hour), plus an additional $200,000 for compaction of material across the site.
- Validation of the hard standing 'capping' and 'topsoil' material (10 samples for TPH, BTEX, asbestos, metals, O CP/PCB). An allowance of $3000 should be made for laboratory analytical costs.
- An allowance should be made for the disposal of 5280 tonnes of asbestos contaminated material from Areas 12 and 13 to a 'Solid Waste Class 1' landfill. The costs incurred with haulage and disposal of this material should be approximately $400,000.
- An allowance should be made for a part time site foreman to over see the site works and take validation samples of the 'capping material'. It is envisaged that an allowance of $10,000 may be a reasonable allowance in this regard.

- Air monitoring for occupational health and safety purposes (asbestos monitoring would be recommended). An allowance of $7,000 would seem reasonable for air monitoring.
- It is envisaged that a site management plan will be required to ensure the integrity of the cap is maintaining, and to detail the procedures to be followed should the 'cap' be damaged or should subsurface works be required. It is envisaged that the cost of this ongoing site management plan will be $10,000.

The total cost for the 'onsite management of asbestos contaminated soil beneath a suitable cap' option is envisaged to be approximately $720,000 (excluding GST), see **Appendix B, Table D** for a breakdown summary of the costs incurred.

Please note that this does not take into account possible adverse impacts on land value, associated with retaining asbestos on-site, nor any ongoing maintenance necessary to ensure the integrity of the cap.

It should be noted that GHD have suggested a 'capping' material consisting of a mixture of a hard standing material and topsoil. However, should ARV wish to cover the asbestos contaminated portions of the site by buildings, buildings will suffice as a 'cap', and therefore the costs of the 'capping' material will not be incurred.

10.3 Required Timeframe

It is envisaged that approximately eight (8) weeks would likely be required to complete either remediation option, that is either excavation and offsite disposal of asbestos contaminated material or 'capping' the contaminated areas of the site followed by onsite management of the 'capped' contamination.

This timeframe does not include any allowance for time taken in obtaining licenses or any site-specific approvals that may be required.

11. Conclusions and Recommendations

Based on the results of the current study, the following conclusions are made:

- Based on the site inspections undertaken during the current study, and that conducted by GHD in previous investigations, GHD estimate that there is approximately 12,348m^3 or 27,165 tonnes of asbestos containing material (fill) currently present on the site.

  It should be noted that these estimates do not include those areas of the site that could not be investigated during the current site investigation, that is, areas where buildings, dense vegetation, or underground services were present on the site.

- The asbestos contaminated soil was identified in scattered areas across the site, but appeared most prevalent in the northern portion of Number 10 Macpherson Street.

- On the basis of an analysis of remediation options presented in the Remediation Action Plan (GHD, 2005), GHD have considered that either (1) excavation and off-site disposal or (2) on-site management of asbestos-bearing soils would be viable from a technical, policy, health and timing perspective for remediation of the site. The determining factor in selecting the preferred option is therefore the cost implications associated with each remediation strategy. The term "cost" is taken as both the capital cost associated with actual remediation works, plus longer-term cost implications (such as maintenance costs and land value implications).

- The costs estimates incurred for both options have been based on the results of the current asbestos quantification exercise and are estimated at:

  - 1/ The <u>**Excavation and Offsite Disposal Option**</u> cost is estimated in the order of **$2.6 million (excl. GST).**

    It must be noted that should ARV decide to proceed with the 'excavation and off-site disposal' option, the cost of the remediation does not include those areas of the site that were not able to be investigated for the presence of asbestos (as noted in **Section 4**). Nor are the costs associated with de-watering the excavations (and disposal of water to sewer) included in the estimated cost of this remediation option (should this be required).

  - 2/The <u>**Onsite Management Option of all asbestos bearing waste**</u> is estimated in the order of **$720,000 (excl. GST).**

    It must be noted that should ARV decide to proceed with the 'on-site management of asbestos-bearing soil' option, the cost of the potential depreciation in land value is not included in the cost estimate for this remediation option, nor is the cost of any ongoing maintenance of the 'cap'.

Please note that all volumes, weights and associated cost estimates provided herein should be viewed as strictly indicative, and are subject to an inherent degree of uncertainty.

Furthermore, cost estimates do not include Australian GST, which would be payable on all works at a rate of 10%.

12. Limitation of this Report

This report has been prepared for use by the client, Anglican Retirement Villages who has commissioned the works in accordance with the project brief only, and has been based on information provided by the client. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent and experienced person with experience in environmental investigations, before being used for any other purpose. GHD accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced, or amended in any way without prior approval by the client or GHD, and should not be relied upon by any other party, who should make their own independent inquiries.

The extent of sampling of soils and subsequent analysis has been necessarily limited, and has been targeted towards areas where contamination is considered to be most likely, based on the knowledge of the site history and visual observation. This approach maximises the probability of identifying contaminants; however, it may not identify contamination that occurs in unexpected locations or from unexpected sources. Furthermore, GHD is not able to conclude on the status of soil in areas inaccessible to the GHD due to overgrown vegetation, underground services, existing site buildings or other.

Soil, rock and aquifer conditions are often variable, resulting in non-homogenous contaminant distributions across a site. Contaminant concentrations have been identified at chosen sample locations; however, conditions between sample locations can only be inferred on the basis of the estimated geological and hydrogeological conditions and the nature and extent of identified contamination. Boundaries between zones of variable contamination are often indistinct, and have been interpreted based on available information and the application of professional judgement. The accuracy with which the subsurface conditions have been characterised depends on the frequency and methods of sampling and the uniformity of subsurface conditions and is therefore limited by the scope of works undertaken.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. This report does not assess the contamination status of the groundwater beneath the site, and therefore no conclusion is made regarding the contamination status of the groundwater.

Should information become available regarding conditions at the site including previously unknown sources of contamination, GHD reserves the right to review the report in the context of the additional information.

13. References

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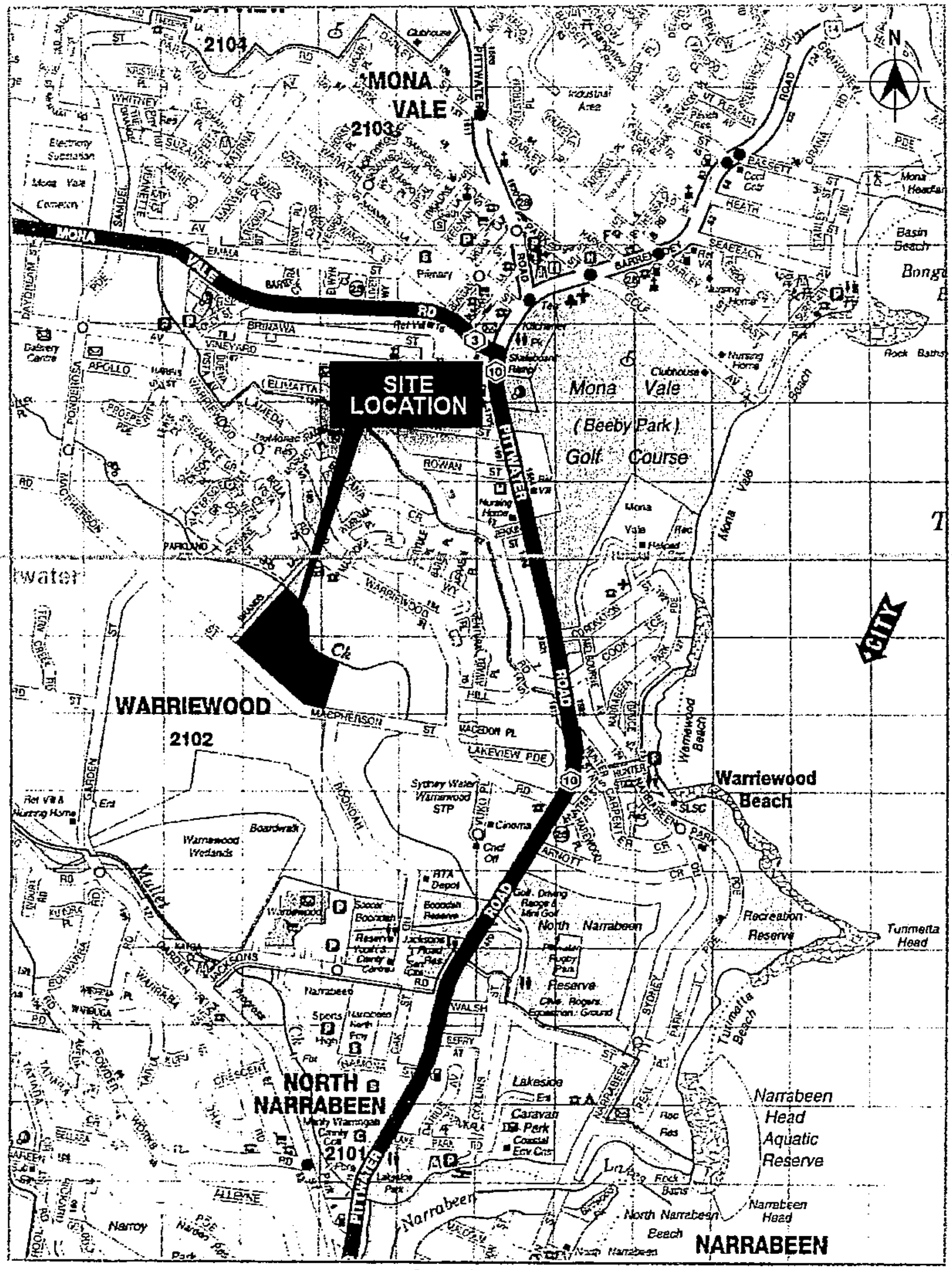
Appendix A

Figures



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0 500 1000m

Approximate Scale

GHD CLIENTS | PEOPLE | PERFORMANCE

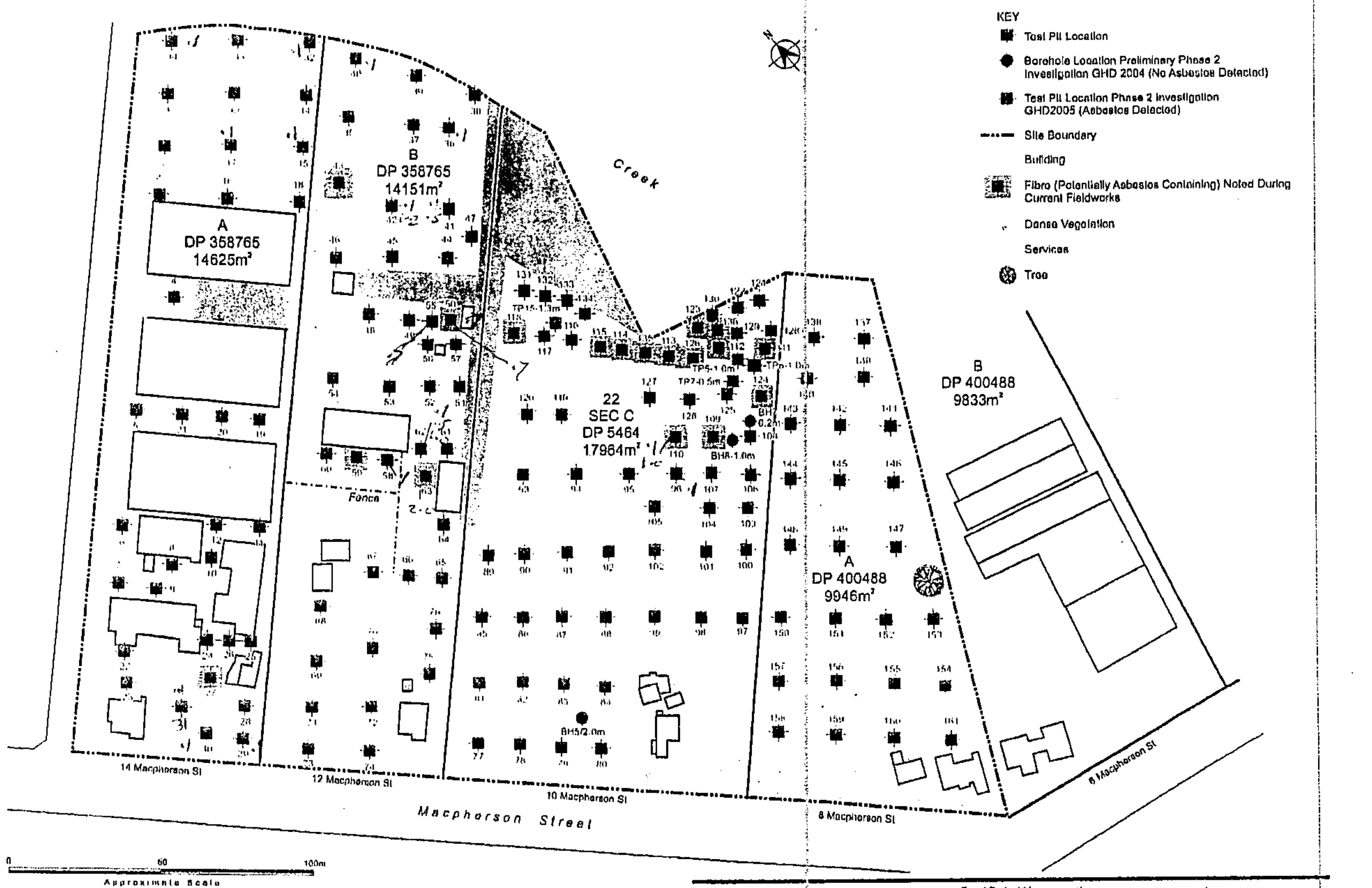
Event Project Management
"Upfront" Validation Assessment,
8-14 Macpherson St, Warriewood, NSW

Site Location

job no	21-14407
file ref	2114407_LTN_01.cdr
scale	as shown
date	9 February 2006

Figure 1

57 Herbert Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E atnmail@ghd.com.au W www.ghd.com.au



GHD CLIENTS | PEOPLE | PERFORMANCE

Event Project Management
"Upfront" Validation Assessment,
8-14 Macpherson St, Warriewood, NSW

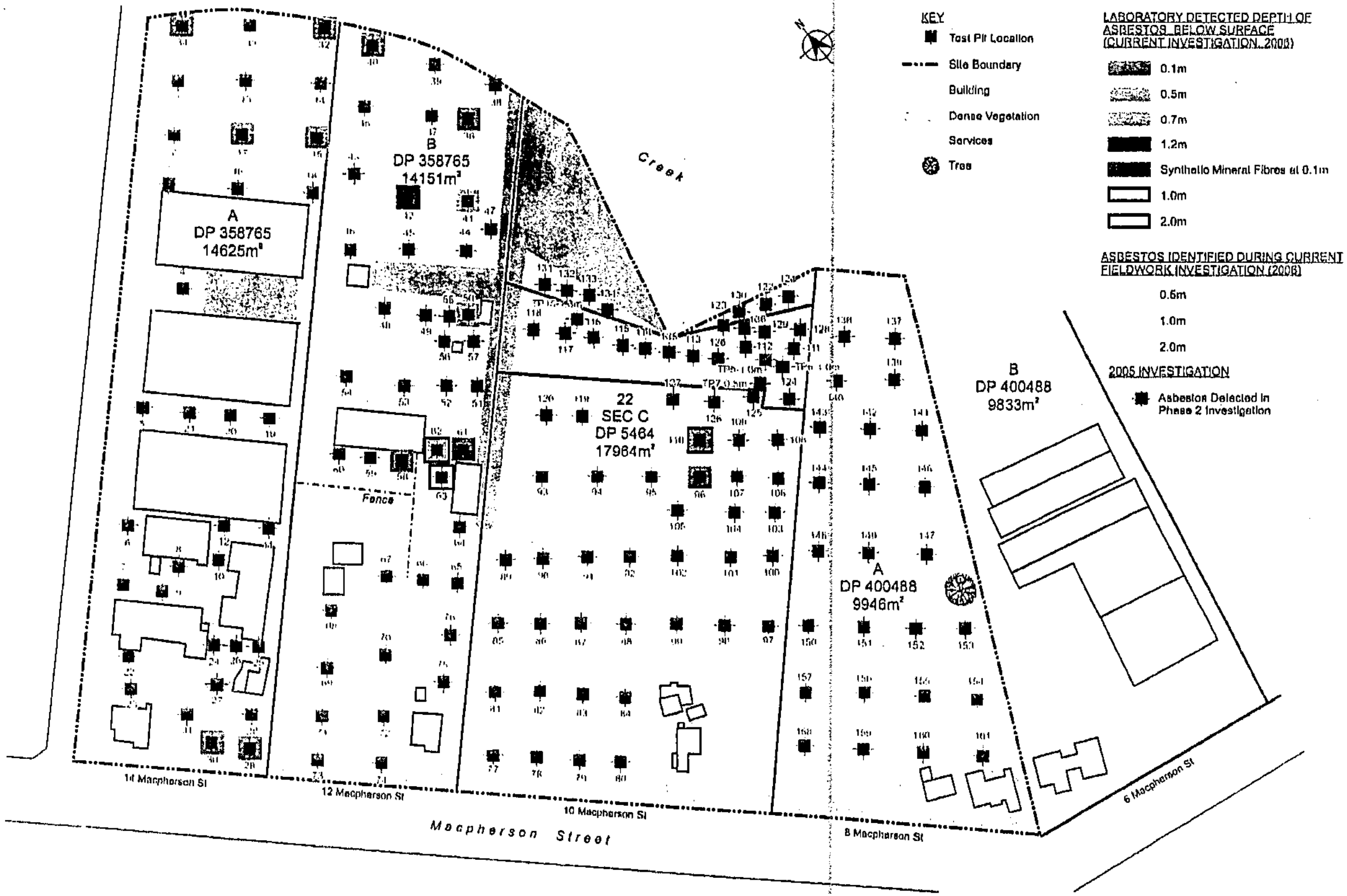
job no	21-14407
file ref	2114407_LTN_02.cdr

Site Layout & Sampling Locations

scale | as shown date | 9 February 2006

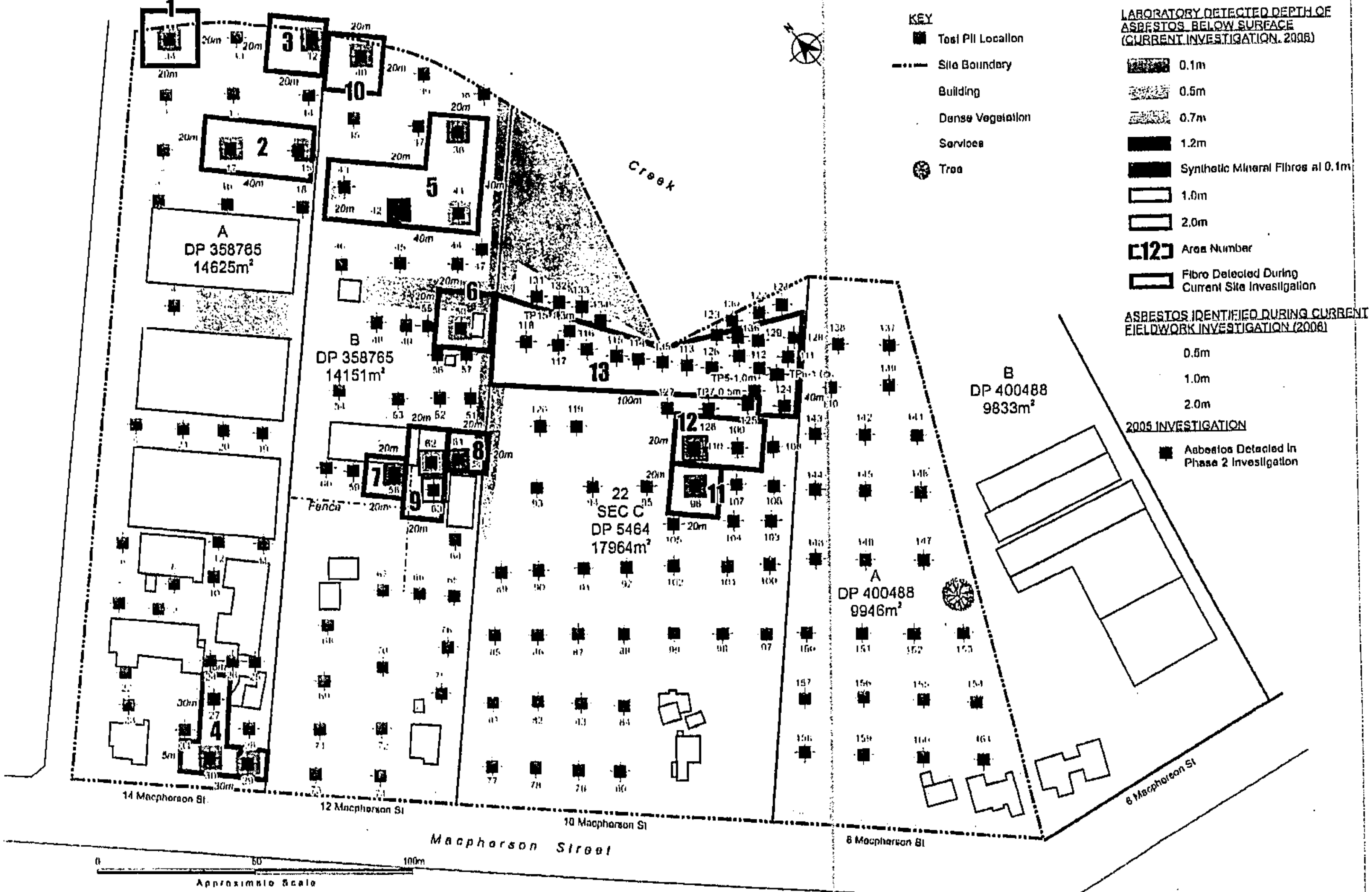
Figure 2

57 Herbert Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E atmmail@ghd.com.au W www.ghd.com.au



GHD CLIENTS | PEOPLE | PERFORMANCE	Event Project Management "Upfront" Validation Assessment, 8-14 Macpherson St, Warriewood, NSW	job no	21-14407
		file ref	2114407_LTN_03.cdr
	Asbestos Noted in Laboratory Result (Current & Previous Investigations)		Figure 3
	scale |	date	9 February 2008

57 Herbert Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E stnmail@ghd.com.au W www.ghd.com.au



GHD CLIENTS | PEOPLE | PERFORMANCE

Evont Project Management
"Upfront" Validation Assessment,
8-14 Macpherson St, Warriewood, NSW
Locations of Asbestos Identified During Current & Previous Investigations - Showing Area/Volume Estimates

scale | as shown | date | 0 February 2008

job no | 21-14407
file ref | 2114407_LTN_04.cdr

Figure 4

57 Herbert Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E atnmail@ghd.com.au W www.ghd.com.au

AREAS 1-8, 10 & 11

Excavate a 'pit' in the northern 'clean' section of 10 Macpherson Street. 'Pit' should be 1m deep & 50x50m in area

Stockpile excavated material to the side

Excavate asbestos contaminated material from Area 1-8,10 & 11 and place in 'pit'

Take validation samples (for asbestos) from Area 1-8,10 & 11

Ensure Areas 1-8, 10 & 11 pass asbestos validation

Lay geofabric across 'pit' at depth of 0.5m bgs

Use half of the 'clean' material from the 'pit' excavation fill to backfill Areas 1-8, 10 & 11 (post validation)

'Cap' the pit of buried asbestos/contaminated material with the remaining 'clean' material that was stockpiled

AREA 9

Area 9 is already 'capped' as the material on the surface 0-0.5m is 'clean'

Excavate surface 0.5m material and stockpile to side of Area 9

Lay geofabric across Area 9 at a depth of 0.5m from the surface

Relay stockpiled 'clean' material to 'cap' Area 9

AREA 12 & 13

Excavate top 0.5m of material from Area 12 & 13

Lay geofabric at a depth of 0.5m from surface across Areas 12 & 13

Validate 'cap' material

'Cap' excavation with 0.4m thickness of 'hardstand' material, followed by 0.1m thickness of 'topsoil' on the surface

Dispose of excavated asbestos-contaminated material off site as 'Solid Waste, Class 1' material

GHD CLIENTS | PEOPLE | PERFORMANCE

Event Project Management
"Upfront" Validation Assessment,
8-14 Macpherson St, Warriewood, NSW

job no | 21-14407
file ref | 2114407_LTN_05.cdr

Methodology for Onsite Management of Asbestos Contaminated Soil

date | 15 February 2006

Figure 5

57 Herbert Street Artarmon NSW 2064 T 61 2 9462 4700 F 61 2 9462 4710 E atnmail@ghd.com.au W www.ghd.com.au

Appendix B

Table A- Test Pit Log Summary

Table B- Estimates of Asbestos Volumes and Mass

Table C- Waste Classification and 95% UCL calculation

Table D- Comparison of Costs Associated with Remediation Options.

Table A- Testpit Log Summary
2114407- Warrlewood
G:\Projects\21\14407 - Warrlewood Asbestos\Fieldwork\[TestpitLog.xls]Sheet3

Site Address	14 Macpherson St	12 Macpherson St	10 Macpherson St	8 Macpherson St
Lot/ DP	Lot 22, Section A DP358765	Lot 22 Section B DP358765	Lot 22, Section C, DP5464	Lot 24, Section A, DP 400488
Area	14625m²	14151m²	17964m²	9946m²
	TP1-TP34	TP35-TP76	TP77-TP136	TP137-TP160
Number of Spatially located Testpits	34	36	46	24
Number of Targeted Testpits (Additional)	0	6	14	0
General Description of Testpits	Black/brown/grey silty sand or gravely sand till between approximately 1.0m-1.5n . Natural (black/dark brown) peaty clay, low plasticity, wet, soft, organic material present was present below the fill. Trace terracotta roof tiles, timber, brick pieces and sandstone boulders present within the fill.	Black/grey/white silty sand, sandy clay or gravelly sand fill is present from the surface to approximately 1-1.5m. This is followed by natural grey poorly graded sand at approximately 1.5-2.5m, underwhich is brown/black peaty clay. Extensive waste materials such as building material (bricks, tiles and concrete), wires and wood was located between the surface and 1-2m depth.	Black/grey/white/black silty sand, sandy clay or gravelly sand fill is present from the surface to a a depth between 1.0m and 2.5m. Natural brown/grey sand follows for approximately 0.5m from somewhere between approximately 1.0m to 2.5m. Sandy clay (brown/orange/grey) is located from 1.5m to 3.0m. Extensive building rubble (bricks, concrete, tiles) were located in the majoirty of pits throughout the fill.	Fill consisting of brown silty sand extended from the surface to approximately 0.6m depth. This fill was followed by brown (with red mottling in areas) sandy/silty clay from 0.6m to approximately 1.3m depth. Grey clay (with red mottling) followed from approximately 1.3m depth. Trace fill was only located from the surface to 0.1m depth in Testpit 138.
	Sheets of fibro (potentially asbestos containing) were noted in TP27 at between 0.1-0.5m.	Sheets of fibro (potentially asbestos containing) were noted in: TP43-0.0-1.0 and TP50-0.7-1.1m (amongst building rubble), TP59-0.1m (A single piece of fibro observed), TP63-1.0-2.8m (Fibro bonded to cement).	Sheets of fibro (potentially asbestos containing) were noted in: Testpits TP109 to TP115, TP118, TP123-TP124, TP129, TP130, TP135 and TP136.	No evidence of potential asbestos containing material was sighted.

Table B- Estimates of Asbestos Volumes and Weights Across the Site.
2114407- Warriewood
G:\Projects\21\14407 - Warriewood Asbestos\Fieldwork\[TestpitLog.xls]Sheet3

Location Reference of Map	Site Address		14 Macpherson St	12 Macpherson St	10 Macpherson St	8 Macpherson St	Total Volume Across Site (m^3)	Total Weight Across Site (t)
	Total Area		$14625m^2$	$14151m^2$	$17964m^2$	$9946m^2$		
	Dimensions =Depth x (length x width)	Area (m^2)	Volume					
1	0.1 x (20x20)	400	40	-	-	-	40	88
2	0.1 x (20 x 40)	800	80	-	-	-	80	176
3	0.1 x (20 x 20)	400	40	-	-	-	40	88
4	0.1 x (30 x 5) + 0.5 x (30 x 5)	300	90	-	-	-	90	198
5	0.1 x (20 x20) + 1.2 (20 x 20) + 0.5 (20 x 20) + 1.0 (20	1600	-	1120	-	-	1120	2464
6	0.7 x (5 x 5)	25	-	18	-	-	18	38.5
7	0.1 x (20 x 20)	400		40			40	88
8	0.1 x (20 x20)	400		40			40	88
9	1 x (20 x 20) + 2 x (20 x 20)	800		1200			1200	2640
10	0.1 x (20 x 20)	400	-	40	-	-	40	88
11	0.1 x (20 x 20)	400	-	-	40	-	40	88
12	2 x (20 x 20) + 2 x (20 x 20)	800			1600		1600	3520
13	2 x (4000)	4000	-	-	8000	-	8000	17600
	Total Volume	10725	250	2458	9640	0	12348	27165

Conversion: 2.2 t of soil is equal to $1m^3$

Table C -Summary Waste Classification- Metals and PAH

2114407- Warriewood

All Units in mg/kg (SCC). mg/L (TCLP)

G:\Projects\2114407 - Warriewood Asbestos\Fieldwork\[Soil Waste Classification.xls]Waste Class

Inert Waste - CT1 [1]		10.0	2.0	1[illegible]
Solid Waste - CT2 [2]		[illegible]	[illegible]	[illegible]
Industrial Waste - CT3 [3]		400.0	80.0	40
BC1	19/04/05	ND	ND	[illegible]
BC2	19/04/05	ND	ND	1
BC6	19/04/05	ND	ND	[illegible]
BC7	19/04/05	7	ND	1
BC8	19/04/05	4	ND	1
TP1/0.1	15/03/05	ND	ND	7
TP2/0.1	15/03/05	3	ND	1
TP3/1.75	15/03/05	4	ND	6
TP4/0.1	15/03/05	ND	ND	1
TP4/0.5	15/03/05	7	ND	2
TP5/0.1	15/03/05	ND	ND	8
TP8/0.1	15/03/05	ND	ND	3
TP8/1.5	15/03/05	ND	ND	4
TP10/0.1	16/03/05	ND	ND	3
TP11/0.1	16/03/05	ND	ND	1
TP12/0.1	16/03/05	ND	ND	1
TP13/0.1	16/03/05	ND	ND	1
TP14/0.3	16/03/05	ND	ND	9
TP14/0.5	16/03/05	ND	ND	6
TP15/0.1	16/03/05	4	ND	1
TP15/1.3	16/03/05	23	0.9	2
TP16/0.1	16/03/05	ND	ND	4
TP17/0.1	16/03/05	4	ND	5
TP18/0.1	16/03/05	3	ND	4
TP19/0.3	16/03/05	ND	ND	8
TP20/0.1	16/3/05	4	ND	4
TP21/0.1	16/3/05	ND	ND	6
TP22/0.1	17/3/05	ND	ND	9
TP22/1.0	17/3/05	6	ND	5
TP23/0.1	17/3/05	ND	ND	5
TP24/0.1	17/3/05	ND	ND	7
TP25/0.1	17/3/05	ND	ND	5
TP26/0.1	17/3/05	3	ND	14
SS15 0.05-0.1	17/3/05	4	ND	12
SS16 0.05-0.1	17/3/05	ND	ND	5
SS17 0.05-0.1	17/3/05	ND	ND	6
SS18 0.05-0.1	17/3/05	ND	ND	5
SS19 0.05-0.1	17/3/05	ND	ND	4
SS20 0.05-0.1	17/3/05	ND	ND	20
SS21 0.05-0.1	17/3/05	24	ND	13
SS22 0.05-0.1	17/3/05	6	ND	10
SS23 0.05-0.1	17/3/05	ND	ND	3
SS24 0.05-0.1	17/3/05	3	ND	15
SS25 0.05-0.1	17/3/05	ND	ND	8
SS26 0.05-0.1	17/3/05	ND	2	13
SS27 0.05-0.1	17/3/05	4	ND	17
SS28 0.05-0.1	17/3/05	ND	ND	7
SS29 0.05-0.1	17/3/05	ND	ND	31
SS30 0.05-0.1	17/3/05	ND	ND	9
SS31 0.05-0.1	17/3/05	7	ND	17
SS32 0.05-0.1	17/3/05	6	ND	8

(1) Contaminant Threshold 1 - without TCLP

(2) Contaminant Threshold 2 without TCLP

(3) Contaminant Threshold 3 - without TCLP

(4) SCC - Specific Contaminant Concentration, TCLP - Toxicity Characteristic Leaching Procedure

(5) Maximum total concentration, when SCC & TCLP results are used together, as listed in Table A4 of the NSW EPA Environmenta

(6) Maximum leachable concentration when SCC & TCLP results are used together, as listed in Table A4 of the NSW EPA Environm

(7) TCLP results are in mg/L

Inert Waste - CT1	Sample concentration exceeds CT1 for disposal as Inert Waste without TCL
Solid Waste - CT2	Sample concentration exceeds CT2 for disposal as Solid Waste without TCL
Industrial Waste - CT3	Sample concentration exceeds CT3 for disposal as Industrial Waste without

Entered: Katharine Karkoff

Checked: Andrew Hogan

Table D- Comparison of Costs Associated with Differing Site Remediation Options
2114407- Warriewood
G:\Projects\21\14407 - Warriewood Asbestos\Fieldwork\[TestpitLog.xls]Sheet3

Area References (Figure 4)	Summary of Estimates Associated with Differing Site Remediation Options	Cost ($)	per unit	Amount Required	Units	Total Cost ($) excl. GST
	Option 1: Costs Associated with Excavation and Offsite Disposal Option					
	Disposing of asbestos contaminated material to a 'Solid Waste' landfill (27,165tonnes, 2.2t/m3)	75	per tonne	27,165	tonnes	2037375
	Validating of excavations formed from excavation works for asbestos at a rate of 1 sample per 100m2 (107 samples)	-	-	107	samples	7000
	Filling excavations with clean, compactable material (12,348m3 insitu, allow for 13,000m3 of material)	15	per m^3	13,000	m^3	195000
Areas 1-13	Backfill and compaction of 'clean' filled excavations.	20	per m^3	13,000	m^3	260,000
	Validating material that is filling the excavations (10 samples)	300	per sample	10	samples	3000
	Air monitoring during site activities	7000	per 4 weeks	1	lot of 4 wks	7000
	Onsite Set up and preliminaries	20,000	per set up	1	set up	20000
	Site forman (to mark out areas containing asbestos and over see project).	20000	per 4 weeks	1	lot of 3 wks	20000
						2549375
	Option 2: Costs Associated with Onsite Management of Asbestos Contaminated Soil					
	Excavate a 'pit' in the northern section of 10 Macpherson Street. The 'pit' should be 1m deep and 60m by 60m in area.	75	per hour	35	hours	2625
	Excavate 'asbestos' contaminated material from Areas 1-8, 10 and 11, and relocated to be buried in the 'pit'.	75	per hour	35	hours	2625
Areas 1-8, 10 and 11	Take validation samples from Areas 1-8, 10 and 11 prior to backfilling (6,125m^2, 62 samples)	50	per sample	62	samples	2600
	Lay geofabric on top of the compacted asbestos contaminated material (4300m^2)	1	per m2	4300	m2	4300
	Use 'half' the clean material stockpiled from the 'pit' to backfill Areas 1-8, 10 and 11 (post validation).	75	per hour	27	hours	2025
	"Cap" the 'pit' with asbestos contaminated material with the remaining 'clean' fill that was originally excavated from the 'pit'.	75	per hour	27	hours	2025
	Excavate the top 0.5m of 'clean' material and stockpile to the side of Area 9	75	per hour	16	hours	1200
Area 9	Lay Geofabric across Area 9 (800m2)	1	per m2	800	m2	800
	Relay stockpiled 'clean' material in Area 9.	75	per hour	20	hours	1500
	Excavate top 0.5m of asbestos contaminated material from Area 12 and 13 (2400 m^3 or 5280 t)	75	per hour	40	hours	3000
	Lay geofabric across Area 12 and 13 (4800m^2)	1	per m2	4800	m2	4800
Area 12 and 13	'Cap' excavation with 0.4m of ' Clean' hardstanding material (Approx. 1950m^3)	15	per m3	1950	m3	29250
	Cap' excavation with 0.1m of 'Clean' topsoil material (ontop of hardstanding material) (Approx. 500m^3)	30	per m3	500	m3	15000
	Dispose of excavated asbestos contaminated material to a 'Solid Waste, Class 1' landfill (5280 t)	75	per tonne	5280	tonnes	396000
	Collect validation samples from imported 'capping' material (10 Samples for TPH, BTEX, metals, asbestos and OCP).	300	per sample	10	samples	3000
	Setup onsite and preliminaries	20,000	per set up	1	set up	20000
	Compaction of filled excavations acros the site	200,000	for compaction of site	1	site	200000
Across entire Site	Air monitoring during site activities	7000	per 4 weeks	1	lot of 4 wks	7000
	Ongoing Site Management Plan	10000	per report	1	report	10000
	Site forman (to mark out areas containing asbestos and over see project).	10,000	based on 5 day supervision	1	lot of 5days	10000
						717750

Appendix C

Chain-of-Custody Documentation and Laboratory Reports

SGS

20 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference:	2114407, Warriewood
Report Number:	42407
Attention:	Andrew Hogan

Dear Andrew

The following samples were received from you on the date indicated.

Samples: Qty.	105 Soil Samples
Date of Receipt of Samples:	13/01/06
Date of Receipt of Instructions:	13/01/06
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

42407-46,52,101: 1mm length fibre bundle handpicked, found loose in soil.
42407-92: 2mm length fibre bundle found loose in soil.
42407-95: 1-3mm length fibre bundles found in plaster fragment.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Edward Ibrahim
Approved Signatory

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42407-1	TP1-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-2	TP1-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-4	TP1-1.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-5	TP2-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-8	TP3-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-9	TP3-1.0	-	04/01/06	20g Sand	No asbestos detected
42407-12	TP4-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-13	TP4-0.5	-	04/01/06	20g Sand	No asbestos detected
42407-14	TP4-1.0	-	04/01/06	20g Sand	No asbestos detected
42407-16	TP5-0.1	-	04/01/06	20g Sand & Clay	No asbestos detected
42407-17	TP5-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-19	TP6-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-20	TP6-0.5	-	04/01/06	20g Sand & Clay	No asbestos detected
42407-21	TP6-1.0	-	04/01/06	20g Sand, Soil & Clay	No asbestos detected
42407-22	TP7-0.1	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-25	TP8-0.1	-	04/01/06	20g Rocks, Sand & Clay	No asbestos detected
42407-28	TP9-0.1	-	04/01/06	20g Clay, Rocks & Dust	No asbestos detected
42407-29	TP9-0.5	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-31	TP10-0.1	-	04/01/06	20g Sand, Clay & Rocks	No asbestos detected
42407-32	TP10-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42407-33	TP10-1.0	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-34	TP11-0.1	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-37	TP12-0.1	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-38	TP12-0.5	-	04/01/06	20g Gravel & Rocks	No asbestos detected
42407-40	TP13-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-43	TP14-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-44	TP14-1.0	-	04/01/06	20g Sand	No asbestos detected
42407-46	TP15-0.1	-	04/01/06	20g Sand & Soil	Chrysotile asbestos detected
42407-47	TP15-0.7	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-49	TP16-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-50	TP16-0.5	-	04/01/06	20g Sand & Clay	No asbestos detected
42407-52	TP17-0.1	-	04/01/06	20g Sand & Soil	Chrysotile asbestos detected
42407-56	TP18-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-57	TP18-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-59	TP19-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-60	TP19-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-62	TP20-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-63	TP20-0.5	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-65	TP21-0.1	-	04/01/06	20g Sand, Soil & Clay	No asbestos detected
42407-66	TP21-0.5	-	04/01/06	20g Sand, Clay & Soil	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42407-68	TP22-0.1	-	04/01/06	20g Sand & Soil	No asbestos detected
42407-71	TP23-0.1	-	04/01/06	20g Sand, Rocks & Plant Matter	No asbestos detected
42407-72	TP23-0.5	-	04/01/06	20g Sand, Clay, Brick Fragments & Plants	No asbestos detected
42407-74	TP24-0.1	-	04/01/06	20g Sand, Soil & Plant Matter	No asbestos detected
42407-75	TP24-0.5	-	04/01/06	20g Clay, Rocks & Sand	No asbestos detected
42407-76	TP24-1.0	-	04/01/06	20g Clay & Rocks	No asbestos detected
42407-79	TP25-0.1	-	04/01/06	20g Cement Mixture, Sand & Clay	No asbestos detected
42407-80	TP25-0.5	-	04/01/06	20g Clay (Lumps)	No asbestos detected
42407-83	TP26-0.1	-	04/01/06	20g Cement Mixture & Rocks	No asbestos detected
42407-87	TP27-0.1	-	04/01/06	20g Soil, Rocks & Clay	No asbestos detected
42407-88	TP27-0.5	-	04/01/06	20g Clay	No asbestos detected
42407-89	TP28-0.1	-	04/01/06	20g Sand & Clay	No asbestos detected
42407-90	TP28-0.5	-	04/01/06	20g Sand, Clay, Rocks & Plant Matter	No asbestos detected
42407-92	TP29-0.1	-	04/01/06	20g Clay, Sand & Soil	Chrysotile asbestos detected
42407-95	TP30-0.1	-	04/01/06	20g Sand, Clay & Soil	Chrysotile asbestos detected
42407-96	TP30-0.5	-	04/01/06	20g Clay, Rocks & Plant Matter	No asbestos detected
42407-98	TP31-0.1	-	05/01/06	20g Soil, Rocks, Plant Matter & Sand	No asbestos detected
42407-99	TP31-0.5	-	05/01/06	20g Clay, Sand & Plant Matter	No asbestos detected
42407-101	TP32-0.1	-	05/01/06	20g Sand & Soil	Chrysotile asbestos detected
42407-102	TP32-0.5	-	05/01/06	20g Sand & Soil	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42407-104	TP33-0.1	-	05/01/06	20g Sand	No asbestos detected

Method ID	Methodology Summary
SASB-002	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques. Accreditation does not cover the identification of Synthetic Mineral Fibre.

Result Codes

[INS]	Insufficient Sample for this test	[HBG]	Results not Reported due to High Background Interferance
[NR]	Not Requested	*	Not part of NATA Accreditation
[NT]	Not tested	[N/A]	Not Applicable

Result Comments

ASBESTOS NB. Even after disintegration of certain bulk samples (vinyl tiles and bituminous type materials), the detection, of fibres may be difficult when using Polarised Light Microscopy and Dispersion Staining Techniques. This may be due to the matrix of the sample (uneven distribution), or fine fibres that are difficult to detect and positively identify.

NATA Accreditation No. 2562

Quality Control Protocol

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch.
A duplicate is prepared at least every 20 samples.
Terms and conditions are available from www.au.sgs.com

NATA
WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
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NATA Accredited laboratory No. 2562 (4354)

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 67 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No.	2114407	Phone No.	9462 4810
Project Name	Wanlawood	Fax No.	9462 4710
Project Manager	Andew Hogen/ Katherine Karlikoff		

Sent to Lab:	SGS		
Address:	Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036	Attention:	SGS
Fax:	8686 1364	Phone:	9666 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 1 of 1

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP1-0.1 1	4/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP1-0.5 2	4/1/2006	1	250ml Soil		1	N			x														
TP1-1.0 3	4/1/2006	1	250ml Soil		1	N																	
TP1-1.5 4	4/1/2006	1	250ml Soil		1	N			x														
TP2-0.1 5	4/1/2006	1	250ml Soil		1	N			x														
TP2-0.5 6	4/1/2006	1	250ml Soil		1	N																	SGS
TP2-1.0 7	4/1/2006	1	250ml Soil		1	N																	Received 13/1/06
TP3-0.1 8	4/1/2006	1	250ml Soil		1	N			x														By [signature]
TP3-1.0 9	4/1/2006	1	250ml Soil		1	N			x														Time 10:30 am
TP3-2.0 10	4/1/2006	1	250ml Soil		1	N																	Samples intact yes/no
TP3-3.0 11	4/1/2006	1	250ml Soil		1	N																	Ice/Cooler Pack yes/no
TP4-0.1 12	4/1/2006	1	250ml Soil		1	N			x														Comments 42407
TP4-0.5 13	4/1/2006	1	250ml Soil		1	N			x														
TP4-1.0 14	4/1/2006	1	250ml Soil		1	N			x														
TP4-2.0 15	4/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		[signature]	SGS	13/1/06	10:20	[signature]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wanlawood Asbestos\COC.xls]1.1-4

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 — Telephone: (02) 9462 4700 — Fax: (02) 9462 4710 — ABN 39 008 488 373

Project No. 2114407 — Phone No. 9462 4610
Project Name Warriewood — Fax No. 9462 4710
Project Manager Andrew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2030
Fax: 8666 1304
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 2 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP5-0.1 16	4/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP5-0.5 17	4/1/2006	1	250ml Soil		1	N			x														
TP5-1.0 18	4/1/2006	1	250ml Soil		1	N			[illegible]														
TP6-0.1 19	4/1/2006	1	250ml Soil		1	N			x														
TP6-0.5 20	4/1/2006	1	250ml Soil		1	N			x														
TP6-1.0 21	4/1/2006	1	250ml Soil		1	N			X		As per conversation with Katherine 13/1/06 this to replace TP5-1.0 which was not received												
TP7-0.1 22	4/1/2006	1	250ml Soil		1	N			x														
TP7-0.5 23	4/1/2006	1	250ml Soil		1	N																	
TP7-1.0 24	4/1/2006	1	250ml Soil		1	N																	
TP8-0.1 25	4/1/2006	1	250ml Soil		1	N			x														
TP8-0.5 26	4/1/2006	1	250ml Soil		1	N																	
TP8-1.0 27	4/1/2006	1	250ml Soil		1	N																	
TP9-0.1 28	4/1/2006	1	250ml Soil		1	N			x														
TP9-0.5 29	4/1/2006	1	250ml Soil		1	N			x														
TP9-1.0 30	4/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		[illegible]	SGS	13/1/06	10.20AM	[illegible]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]2.5-9

GHD Pty Ltd 67 Harbour Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1384
Attention: SGS
Phone: 9660 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 3 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP10-0.1 31	4/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP10-0.5 32	4/1/2006	1	250ml Soil		1	N			x														
TP10-1.0 33	4/1/2006	1	250ml Soil		1	N			x														
TP11-0.1 34	4/1/2006	1	250ml Soil		1	N			x														
TP11-0.5 35	4/1/2006	1	250ml Soil		1	N																	
TP11-1.0 36	4/1/2006	1	250ml Soil		1	N																	
TP12-0.1 37	4/1/2006	1	250ml Soil		1	N			x														
TP12-0.5 38	4/1/2006	1	250ml Soil		1	N			x														
TP12-1.0 39	4/1/2006	1	250ml Soil		1	N																	
TP13-0.1 40	4/1/2006	1	250ml Soil		1	N			x														
TP13-0.5 41	4/1/2006	1	250ml Soil		1	N																	
TP13-1.0 42	4/1/2006	1	250ml Soil		1	N																	
TP14-0.1 43	4/1/2006	1	250ml Soil		1	N			x														
TP14-1.0 44	4/1/2006	1	250ml Soil		1	N			x														
TP14-15 45	4/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		[signature]	SGS	13/1/06	10:30AM	[signature]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]3.10-14

GHD

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andrew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1304
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 4 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP15-0.1 46	4/1/2006	1	250ml Bot		1	N			x														1. - Asbestos
TP15-0.7 47	4/1/2006	1	250ml Bot		1	N			x														
TP15-1.1 48	4/1/2006	1	250ml Bot		1	N																	
TP16-0.1 49	4/1/2006	1	250ml Bot		1	N			x														
TP16-0.5 50	4/1/2006	1	250ml Bot		1	N			x														
TP16-1.5 51	4/1/2006	1	250ml Bot		1	N																	
TP17-0.1 52	4/1/2006	1	250ml Bot		1	N			x														
TP17-0.5 53	4/1/2006	1	250ml Bot		1	N																	
TP17-1.0 54	4/1/2006	1	250ml Bot		1	N																	
TP17-1.5 55	4/1/2006	1	250ml Bot		1	N																	
TP18-0.1 56	4/1/2006	1	250ml Bot		1	N			x														
TP18-0.5 57	4/1/2006	1	250ml Bot		1	N			x														
TP18-1.5 58	4/1/2006	1	250ml Bot		1	N																	
TP19-0.1 59	4/1/2006	1	250ml Bot		1	N			x														
TP19-0.5 60	4/1/2006	1	250ml Bot		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		[illegible]	SGS	13/1/06	10:20AM	[illegible]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Moirnville, NSW 2036
Attention: SGS
Fax: 8660 1394 Phone: 8660 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 5 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP19-1.0 61	4/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP20-0.1 62	4/1/2006	1	250ml Soil		1	N			x														
TP20-0.5 63	4/1/2006	1	250ml Soil		1	N			x														
TP20-1.5 64	4/1/2006	1	250ml Soil		1	N																	
TP21-0.1 65	4/1/2006	1	250ml Soil		1	N			x														
TP21-0.5 66	4/1/2006	1	250ml Soil		1	N			x														
TP21-1.5 67	4/1/2006	1	250ml Soil		1	N																	
TP22-0.1 68	4/1/2006	1	250ml Soil		1	N			x														
TP22-0.5 69	4/1/2006	1	250ml Soil		1	N																	
TP22-1.2 70	4/1/2006	1	250ml Soil		1	N																	
TP23-0.1 71	4/1/2006	1	250ml Soil		1	N			x														
TP23-0.5 72	4/1/2006	1	250ml Soil		1	N			x														
TP23-1.5 73	4/1/2006	1	250ml Soil		1	N																	
TP24-0.1 74	4/1/2006	1	250ml Soil		1	N			x														
TP24-0.5 75	4/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY					RECEIVED BY				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		[illegible]	[illegible]	13/1/06	10:30AM	[illegible]
RELINQUISHED BY					**RECEIVED BY**				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

File REF.: G:\Projects\2114407 - Warriewood Asbestos\COO.xls]5.10-24

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Attention: SGS
Fax: 8566 1364 Phone: 8606 1426

Date Required: 5 days
Date Submitted: 13/1/2008
Page 6 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP24-1.0 76	4/1/2008	1	250ml Soil		1	N			x														1. - Asbestos
TP24-1.5 77	4/1/2008	1	250ml Soil		1	N																	
TP24-2.0 78	4/1/2008	1	250ml Soil		1	N																	
TP25-0.1 79	4/1/2008	1	250ml Soil		1	N			x														
TP25-0.5 80	4/1/2008	1	250ml Soil		1	N			x														
TP25-1.0 81	4/1/2008	1	250ml Soil		1	N																	
TP25-2.0 82	4/1/2008	1	250ml Soil		1	N																	
TP26-0.1 83	4/1/2008	1	250ml Soil		1	N			x														
TP26-0.5 84	4/1/2008	1	250ml Soil		1	N																	
TP26-1.0 85	4/1/2008	1	250ml Soil		1	N																	
TP26-2.0 86	4/1/2008	1	250ml Soil		1	N																	
TP27-0.1 87	4/1/2008	1	250ml Soil		1	N			x														
TP27-0.5 88	4/1/2008	1	250ml Soil		1	N			x														
TP28-0.1 89	4/1/2008	1	250ml Soil		1	N			x														
TP28-0.5 90	4/1/2008	1	250ml Soil		1	N			x														

RELINQUISHED BY					RECEIVED BY				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2008	am		[illegible]	SGS	13/1/08	10:20	[illegible]

RELINQUISHED BY					RECEIVED BY				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

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GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Attention: SGS
Fax: 8600 1004 Phone: 8600 1420

Date Required: 5 days
Date Submitted: 13/1/2008
Page 7 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP28-1.0 91	4/1/2008	1	250ml Soil		1	N																	1. - Asbestos
TP29-0.1 92	4/1/2008	1	250ml Soil		1	N			x														
TP29-0.5 93	4/1/2008	1	250ml Soil		1	N																	
TP29-1.0 94	4/1/2008	1	250ml Soil		1	N																	
TP30-0.1 95	4/1/2008	1	250ml Soil		1	N			x														
TP30-0.5 96	4/1/2008	1	250ml Soil		1	N			x														
TP30-1.5 97	4/1/2008	1	250ml Soil		1	N																	
TP31-0.1 98	5/1/2008	1	250ml Soil		1	N			x														
TP31-0.5 99	5/1/2008	1	250ml Soil		1	N			x														
TP31-1.5 100	5/1/2008	1	250ml Soil		1	N																	
TP32-0.1 101	5/1/2008	1	250ml Soil		1	N			x														
TP32-0.5 102	5/1/2008	1	250ml Soil		1	N			x														
TP32-1.0 103	5/1/2008	1	250ml Soil		1	N																	
TP33-0.1 104	5/1/2008	1	250ml Soil		1	N			x														
TP33-0.5 105	5/1/2008	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2008	pm		[signature]	SGS	13/1/08	10:30am	[signature]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\(COC.xls)7.28-33

SGS

19 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference: 2114407, Warriewood
Report Number: 42408

Attention: Andrew Hogan

Dear Andrew

The following samples were received from you on the date indicated.

Samples: Qty.	105 Soil Samples
Date of Receipt of Samples:	13/01/06
Date of Receipt of Instructions:	13/01/06
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.
Please see report comments for Asbestos comments.
Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Approved Signatory

SGS Australia Pty Ltd ABN 44 000 964 278
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42408-2	TP34-0.1	-	05/01/06	20g Soil, Sand	Chrysotile asbestos detected
42408-3	TP34-0.5	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-4	TP34-1.5	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-5	TP35-0.1	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-8	TP36-0.1	-	05/01/06	20g Soil, Sand	Chrysotile asbestos detected
42408-9	TP36-0.5	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-12	TP37-0.1	-	05/01/06	20g Cement Mixture	No asbestos detected
42408-13	TP37-0.5	-	05/01/06	20g Sand, Clay, Rocks	No asbestos detected
42408-15	TP38-0.1	-	05/01/06	20g Soil, Sand, Plant Matter	No asbestos detected
42408-16	TP38-0.5	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-18	TP39-0.1	-	05/01/06	20g Soil, Sand, Cement Mixure	No asbestos detected
42408-19	TP39-0.5	-	05/01/06	20g Soil, Sand	No asbestos detected
42408-21	TP40-0.1	-	05/01/06	20g Soil, Sand	Crocidolite asbestos detected
42408-24	TP41-0.1	-	05/01/06	20g Soil, Sand, Clay	Chrysotile asbestos detected
42408-25	TP41-0.5	-	05/01/06	20g Sand, Cement mixture	Chrysotile asbestos detected
42408-27	TP42-0.1	-	05/01/06	20g Sand, Clay, Rocks	Chrysotile asbestos detected
42408-29	TP42-1.2	-	05/01/06	20g Soil, Sand	Crocidolite asbestos detected

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SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42408-31	TP43-0.1	-	05/01/06	20g Soil, Sand, Clay, Rocks	No asbestos detected
42408-32	TP43-0.5	-	05/01/06	20g Soil, Sand, Plant matter	No asbestos detected
42408-33	TP43-1.0	-	05/01/06	20g Sand, Clay	No asbestos detected
42408-34	TP44-0.1	-	05/01/06	20g Sand, Clay	No asbestos detected
42408-38	TP45-0.1	-	05/01/06	20g Sand, Clay, Rocks	No asbestos detected
42408-39	TP45-0.5	-	05/01/06	20g Sand, Clay, Rocks	No asbestos detected
42408-42	TP46-0.1	-	05/01/06	20g Sand, Clay	No asbestos detected
42408-45	TP47-0.1	-	05/01/06	20g Sand,, Rocks, Bitumen	No asbestos detected
42408-48	TP48-0.1	-	05/01/06	20g Cement mixture	No asbestos detected
42408-49	TP48-0.5	-	05/01/06	20g Cement mixture	No asbestos detected
42408-51	TP49-0.1	-	05/01/06	20g Cement mixture	No asbestos detected
42408-52	TP49-0.5	-	05/01/06	20g Cement mixture	No asbestos detected
42408-54	TP50-0.1	-	05/01/06	20g Cement mixture, Rocks	No asbestos detected
42408-55	TP50-0.7	-	05/01/06	20g Cement mixture	Chrysotile asbestos detected Crocidolite asbestos detected Amosite asbestos detected
42408-56	TP50-1.1	-	05/01/06	20g Cement mixture	No asbestos detected
42408-57	TP50-2.5	-	05/01/06	20g Sand, Clay	No asbestos detected
42408-58	TP51-0.1	-	05/01/06	20g Sand, Cement mixture	No asbestos detected
42408-60	TP51-1.0	-	05/01/06	20g Cement mixture	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42408-62	TP52-0.1	-	05/01/06	20g Cement mixture, Rocks	No asbestos detected
42408-65	TP53-0.1	-	05/01/06	20g Cement Mixture, Rocks	No asbestos detected
42408-66	TP53-0.5	-	05/01/06	20g Sand, Cement mixture	No asbestos detected
42408-69	TP54-0.1	-	05/01/06	20g Rocks, Cement mixture	No asbestos detected
42408-73	TP55-0.1	-	05/01/06	20g Rocks, Sand, Cement mixture	No asbestos detected
42408-74	TP55-0.5	-	05/01/06	20g Rocks, Sand, Cement mixture	No asbestos detected
42408-76	TP56-0.1	-	05/01/06	20g Rocks, Sand, Cement mixture	No asbestos detected
42408-79	TP57-0.1	-	05/01/06	20g Sand, Rocks, Cement mixture	No asbestos detected
42408-82	TP58-0.1	-	05/01/06	2og Soil, Rocks	Chrysotile asbestos detected
42408-85	TP59-0.1	-	05/01/06	20g Soil, Clay, Rocks	No asbestos detected
42408-86	TP59-0.5	-	05/01/06	20g Sand, Clay, Rocks	No asbestos detected
42408-87	TP59-1.0	-	05/01/06	20g Sand, Clay, Rocks	No asbestos detected
42408-88	TP60-0.1	-	05/01/06	20g Sand	No asbestos detected
42408-89	TP60-0.5	-	05/01/06	20g Rocks, Sand, Clay	No asbestos detected
42408-91	TP61-0.1	-	06/01/06	20g Sand, Soil, Plant matter	Fibres consistent with Synthetic mineral fibre*
42408-92	TP61-0.5	-	06/01/06	20g Soil, Sand, Clay	No asbestos detected
42408-94	TP62-0.1	-	06/01/06	20g Soil, Sand, Rocks	Chrysotile asbestos detected
42408-95	TP62-0.5	-	06/01/06	20g Sand, Soil, Rocks	Chrysotile asbestos detected
42408-96	TP62-1.0	-	06/01/06	20g Sand, Soil, Rocks	Chrysotile asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42408-97	TP63-0.1	-	06/01/06	20g Sand, Soil, Clay	No asbestos detected
42408-99	TP63-1.0	-	06/01/06	20g Sand, Soil	No asbestos detected
42408-100	TP63-2.0	-	06/01/06	20g Sand, Soil	Chrysotile asbestos detected
42408-101	TP63-3.0	-	06/01/06	20g Soil, Clay, Rocks	No asbestos detected
42408-102	TP64-0.1	-	06/01/06	20g Soil	No asbestos detected

Method ID	Methodology Summary
SASB-002	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques. Accreditation does not cover the identification of Synthetic Mineral Fibre.

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Accreditation
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

ASBESTOS NB. Even after disintegration of certain bulk samples (vinyl tiles and bituminous type materials), the detection, of fibres may be difficult when using Polarised Light Microscopy and Dispersion Staining Techniques. This may be due to the matrix of the sample (uneven distribution), or fine fibres that are difficult to detect and positively identify.
42408-2,82,96: 1-2mm length fibre bundles found loose in soil.
42408-8: 1mm length fibre bundles found loose in soil, handpicked.
42408-21: 4mm length fibre bundle found loose in soil.
42408-24: 2-3mm length fibre bundles found loose in soil, plaster fragments.
42408-25: 2mm length fibre bundles found loose in sample.
42408-27 1mm length fibre bundles found loose in sample.
42408-29: 2mm length fibre bundles found loose in soil.
42408-55: 2-4mm length fibre bundles found loose in sample, cement sheet fragments.
42408-94,95,100: 1-3mm length fibre bundles in a cement sheet fragments

NATA Accreditation No. 2562

Quality Control Protocol

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch.
A duplicate is prepared at least every 20 samples.
Terms and conditions are available from www.au.sgs.com

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(2)

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No.	2114407	Phone No.	9462 4810
Project Name	Warriewood	Fax No.	9462 4710
Project Manager	Andew Hogan/ Katherine Karlkoff		

Sent to Lab:	SGS		
Address:	Botany Industrial Park, Gate 3 Denison St		
	Matraville, NSW 2036	Attention:	SGS
Fax:	9086 1364	Phone:	9086 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 8 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP33-1.2 1	6/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP34-0.1 2	6/1/2006	1	250ml Soil		1	N			x														
TP34-0.5 3	5/1/2006	1	250ml Soil		1	N			x														
TP34-1.5 4	6/1/2006	1	250ml Soil		1	N			x														
TP35-0.1 5	6/1/2006	1	250ml Soil		1	N			x														
TP35-0.5 6	6/1/2006	1	250ml Soil		1	N																	
TP35-1.5 7	6/1/2006	1	250ml Soil		1	N																	SGS
TP36-0.1 8	6/1/2006	1	250ml Soil		1	N			x														Received 13/1/06
TP36-0.5 9	6/1/2006	1	250ml Soil		1	N			x														By [signature]
TP36-1.0 10	6/1/2006	1	250ml Soil		1	N																	Time 10:30 am/pm
TP36-1.5 11	6/1/2006	1	250ml Soil		1	N																	Samples intact yes/no
TP37-0.1 12	6/1/2006	1	250ml Soil		1	N			x														Ice/Cooler Pack yes/no
TP37-0.5 13	6/1/2006	1	250ml Soil		1	N			x														Comments 42408
TP37-1.2 14	6/1/2006	1	250ml Soil		1	N																	
TP38-0.1 15	6/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	am		[signature]	SGS	13/1/06	10:30am	[signature]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\2114407 - Warriewood Asbestos\COC.xls\5.33-66

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 9666 1304
Attention: SGS
Phone: 9668 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 10 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP43-0.1 31	5/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP43-0.5 32	5/1/2006	1	250ml Soil		1	N			x														
TP43-1.0 33	5/1/2006	1	250ml Soil		1	N			x														
TP44-0.1 34	5/1/2006	1	250ml Soil		1	N			x														
TP44-0.5 35	5/1/2006	1	250ml Soil		1	N																	
TP44-1.0 36	5/1/2006	1	250ml Soil		1	N																	
TP44-2.0 37	5/1/2006	1	250ml Soil		1	N																	
TP45-0.1 38	5/1/2006	1	250ml Soil		1	N			x														
TP45-0.5 39	5/1/2006	1	250ml Soil		1	N			x														
TP45-1.5 40	5/1/2006	1	250ml Soil		1	N																	
TP45-2.0 41	5/1/2006	1	250ml Soil		1	N																	
TP46-0.1 42	5/1/2006	1	250ml Soil		1	N			x														
TP46-0.5 43	5/1/2006	1	250ml Soil		1	N																	
TP46-1.0 44	5/1/2006	1	250ml Soil		1	N																	
TP47-0.1 45	5/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10.30am	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]10.42-47

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407
Project Name Warriewood
Project Manager Andow Hogan/ Katherine Kerlikoff
Phone No. 9462 4810
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 8668 1364
Attention: SGS
Phone: 9000 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 11 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP47-0.5 46	5/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP47-1.5 47	5/1/2006	1	250ml Soil		1	N																	
TP48-0.1 48	5/1/2006	1	250ml Soil		1	N			x														
TP48-0.5 49	5/1/2006	1	250ml Soil		1	N			x														
TP48-1.6 50	5/1/2006	1	250ml Soil		1	N																	
TP49-0.1 51	5/1/2006	1	250ml Soil		1	N			x														
TP49-0.5 52	5/1/2006	1	250ml Soil		1	N			x														
TP49-1.3 53	5/1/2006	1	250ml Soil		1	N																	
TP50-0.1 54	5/1/2006	1	250ml Soil		1	N			x														
TP50-0.7 55	5/1/2006	1	250ml Soil		1	N			x														
TP50-1.1 56	5/1/2006	1	250ml Soil		1	N			x														
TP50-2.5 57	5/1/2006	1	250ml Soil		1	N			x														
TP51-0.1 58	5/1/2006	1	250ml Soil		1	N			x														
TP51-0.5 59	5/1/2006	1	250ml Soil		1	N																	
TP51-1.0 60	5/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Kerlikoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10:30am	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\2114407 - Warriewood Asbestos\[COC.xls]11.47.51

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Wardewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 12 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	Soil	PRESERVATION Chill	Acid	Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP51-1.7 61	5/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP52-0.1 62	5/1/2006	1	250ml Soil		1	N			x														
TP52-0.5 63	5/1/2006	1	250ml Soil		1	N																	
TP52-1.1 64	5/1/2006	1	250ml Soil		1	N																	
TP53-0.1 65	5/1/2006	1	250ml Soil		1	N			x														
TP53-0.5 66	5/1/2006	1	250ml Soil		1	N			x														
TP53-1.0 67	5/1/2006	1	250ml Soil		1	N																	
TP53-1.5 68	5/1/2006	1	250ml Soil		1	N																	
TP54-0.1 69	5/1/2006	1	250ml Soil		1	N			x														
TP54-0.5 70	5/1/2006	1	250ml Soil		1	N																	
TP54-1.0 71	5/1/2006		250ml Soil		1	N			— MISSING DID NOT RECEIVE.														
TP54-2.0 72	5/1/2006	1	250ml Soil		1	N																	
TP55-0.1 73	5/1/2006	1	250ml Soil		1	N			x														
TP55-0.5 74	5/1/2006	1	250ml Soil		1	N			x														
TP55-1.0 75	5/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		Sam	SGS	13/1/06	10.30am	Sam
RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF: G:\Projects\21\14407 - Wardewood Asbestos\COO.xls|12.51-55

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 8060 1304
Attention: SGS
Phone: 8066 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 13 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP56-0.1 76	5/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP56-0.5 77	5/1/2006	1	250ml Soil		1	N																	
TP56-1.2 78	5/1/2006	1	250ml Soil		1	N																	
TP57-0.1 79	5/1/2006	1	250ml Soil		1	N			x														
TP57-0.5 80	5/1/2006	1	250ml Soil		1	N																	
TP57-1.2 81	5/1/2006	1	250ml Soil		1	N																	
TP58-0.1 82	5/1/2006	1	250ml Soil		1	N			x														
TP58-0.5 83	5/1/2006	1	250ml Soil		1	N																	
TP58-1.0 84	5/1/2006	1	250ml Soil		1	N																	
TP59-0.1 85	5/1/2006	1	250ml Soil		1	N			x														
TP59-0.5 86	5/1/2006	1	250ml Soil		1	N			x														
TP59-1.0 87	5/1/2006	1	250ml Soil		1	N			x														
TP60-0.1 88	5/1/2006	1	250ml Soil		1	N			x														
TP60-0.5 89	5/1/2006	1	250ml Soil		1	N			x														
TP60-1.7 90	5/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10.30	Sam.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 67 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katharine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St. Mairaville, NSW 2036
Attention: SGS
Fax: 8666 1384 Phone: 8666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 14 of 44

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP61-0.1 91	8/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP61-0.5 92	8/1/2006	1	250ml Soil		1	N			x														
TP61-1.0 93	8/1/2006	1	250ml Soil		1	N																	
TP62-0.1 94	8/1/2006	1	250ml Soil		1	N			x														
TP62-0.5 95	8/1/2006	1	250ml Soil		1	N			x														
TP62-1.0 96	8/1/2006	1	250ml Soil		1	N			x														
TP63-0.1 97	8/1/2006	1	250ml Soil		1	N			x														
TP63-0.5 98	8/1/2006	1	250ml Soil		1	N																	
TP63-1.0 99	8/1/2006	1	250ml Soil		1	N			x														
TP63-2.0 100	8/1/2006	1	250ml Soil		1	N			x														
TP63-3.0 101	8/1/2006	1	250ml Soil		1	N			x														
TP64-0.1 102	8/1/2006	1	250ml Soil		1	N			x														
TP64-0.5 103	8/1/2006	1	250ml Soil		1	N																	
TP64-1.0 104	8/1/2006	1	250ml Soil		1	N																	
TP64-2.0 105	8/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katharine Karlikoff	GHD	13/1/2006	pm		Sam	SGS	13/1/06	10.30am	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|14.61-64

(3)

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590
Telephone: (02) 9462 4700 Fax: (02) 9462 4710

Project No. 2114407
Project Name Wanlewood
Project Manager Andew Hogan/ Katherine Karlikoff
Phone No. 9462 4810
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 0000 1304
Attention: SGS
Phone: 8000 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 15 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP65-0.1 1	6/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP65-0.5 2	6/1/2006	1	250ml Soil		1	N			x														
TP65-1.0 3	6/1/2006	1	250ml Soil		1	N																	
TP65-2.0 4	6/1/2006	1	250ml Soil		1	N																	
TP66-0.1 5	6/1/2006	1	250ml Soil		1	N			x														SGS
TP66-0.5 6	6/1/2006	1	250ml Soil		1	N			x														
TP66-1.0 7	6/1/2006	1	250ml Soil		1	N																	Received 13.1.06
TP66-2.0 8	6/1/2006	1	250ml Soil		1	N																	By
TP66-3.0 9	6/1/2006	1	250ml Soil		1	N																	Time 10:30 am/pm
TP67-0.1 10	6/1/2006	1	250ml Soil		1	N			x														Samples intact yes/no
TP67-0.5 11	6/1/2006	1	250ml Soil		1	N			x														Ice/Cooler Pack yes/no
TP67-1.0 12	6/1/2006	1	250ml Soil		1	N			x														42189
TP67-2.2 13	6/1/2006	1	250ml Soil		1	N																	
TP68-0.1 14	6/1/2006	1	250ml Soil		1	N			x														
TP68-0.5 15	6/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
[illegible]	SGS	13/1/06	10:30am	[illegible]

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wanlewood Asbestos\COC.xls|16.05.66

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407
Project Name Warriewood
Project Manager Andew Hogan/ Katherine Karlkoff
Phone No. 9462 4910
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 16 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP68-1.0 16	6/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP68-2.0 17	6/1/2006	1	250ml Soil		1	N																	
TP69-0.1 18	6/1/2006	1	250ml Soil		1	N			x														
TP69-0.5 19	6/1/2006	1	250ml Soil		1	N			x														
TP69-1.0 20	6/1/2006	1	250ml Soil		1	N			x														
TP69-2.0 21	6/1/2006	1	250ml Soil		1	N			x														
TP69-2.5 22	6/1/2006	1	250ml Soil		1	N																	
TP70-0.1 23	6/1/2006	1	250ml Soil		1	N			x														
TP70-0.5 24	6/1/2006	1	250ml Soil		1	N			x														
TP70-1.0 25	6/1/2006	1	250ml Soil		1	N																	
TP70-2.0 26	6/1/2006	1	250ml Soil		1	N																	
TP70-3.0 27	6/1/2006	1	250ml Soil		1	N																	
TP71-0.1 28	6/1/2006	1	250ml Soil		1	N			x														
TP71-0.5 29	6/1/2006	1	250ml Soil		1	N			x														
TP71-1.0 30	6/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10.30	Sam.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]10.68-71

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 — Telephone: (02) 9462 4700 — Fax: (02) 9462 4710 — ABN 39 008 488 373

Project No. 2114407 — Phone No. 9462 4810
Project Name Warriewood — Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Korlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Attention: SGS
Fax: 8666 1304 — Phone: 9666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 17 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
~~TP71-1.0~~	6/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP71-2.0 31	6/1/2006	1	250ml Soil		1	N																	
TP72-0.1 32	6/1/2006	1	250ml Soil		1	N			x														
TP72-0.5 33	6/1/2006	1	250ml Soil		1	N.			x														
TP72-1.0 34	6/1/2006	1	250ml Soil		1	N			x														
TP72-2.0 35	6/1/2006	1	250ml Soil		1	N																	
TP73-0.1 36	6/1/2006	1	250ml Soil		1	N			x														
TP73-0.5 37	6/1/2006	1	250ml Soil		1	N			x														
TP73-1.0 38	6/1/2006	1	250ml Soil		1	N																	
TP73-2.0 39	6/1/2006	1	250ml Soil		1	N																	
TP73-3.0 40	6/1/2006	1	250ml Soil		1	N																	
TP74-0.1 41	6/1/2006	1	250ml Soil		1	N			x														
TP74-0.5 42	6/1/2006	1	250ml Soil		1	N			x														
TP74-1.0 43	6/1/2006	1	250ml Soil		1	N																	
TP75-0.1 44	6/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Korlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
Sam	SGS	13/1/06	10:30	Sam.

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No.	2114407	Phone No.	9462 4810
Project Name	Wardewood	Fax No.	9462 4710
Project Manager	Andrew Hogan/ Katharina Kazlikoff		

Sent to Lab:	SGS		
Address:	Botany Industrial Park, Gate 3 Denison St		
	Matraville, NSW 2036	Attention:	SGS
Fax:	9666 1384	Phone:	9666 1429

Date Required: 5 days
Date Submitted: 13/1/2006
Page 18 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP75-0.5 45	6/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP75-1.0 46	6/1/2006	1	250ml Soil		1	N																	
TP75-2.0 47	6/1/2006	1	250ml Soil		1	N																	
TP75-3.0 48	6/1/2006	1	250ml Soil		1	N																	
TP76-0.1 49	6/1/2006	1	250ml Soil		1	N			x														
TP76-0.5 50	6/1/2006	1	250ml Soil		1	N																	
TP76-1.0 51	6/1/2006	1	250ml Soil		1	N																	
TP76-2.0 52	6/1/2006	1	250ml Soil		1	N																	
TP76-3.0 53	6/1/2006	1	250ml Soil		1	N																	
TP77-0.1 54	9/1/2006	1	250ml Soil		1	N			x														
TP77-0.5 55	9/1/2006	1	250ml Soil		1	N																	
TP77-1.0 56	9/1/2006	1	250ml Soil		1	N			x														
TP77-2.0 57	9/1/2006	1	250ml Soil		1	N																	
TP77-3.0 58	9/1/2006	1	250ml Soil		1	N																	
TP77-4.0 59	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katharina Kazlikoff	GHD	13/1/2006	am		SAm	SGS	13/1/06	10.30	Sam.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wardewood Asbestos\(COC.xls)18.75-77

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Wardswood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Malmville, NSW 2036
Fax: 9666 1304
Attention: SGS
Phone: 8696 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 19 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP78-0.1 60	9/1/2006	1	250ml Bott		1	N			x														1. - Asbestos
TP78-0.5 61	9/1/2006	1	250ml Bott		1	N																	
TP78-1.0 62	9/1/2006	1	250ml Bott		1	N																	
TP78-2.0 63	9/1/2006	1	250ml Bott		1	N																	
TP79-0.1 64	9/1/2006	1	250ml Bott		1	N			x														
TP79-0.5 65	9/1/2006	1	250ml Bott		1	N			x														
TP79-1.2 66	9/1/2006	1	250ml Bott		1	N																	
TP80-0.1 67	9/1/2006	1	250ml Bott		1	N			x														
TP80-0.5 68	9/1/2006	1	250ml Bott		1	N																	
TP80-1.0 69	9/1/2006	1	250ml Bott		1	N																	
TP80-2.0 70	9/1/2006	1	250ml Bott		1	N																	
TP81-0.1 71	9/1/2006	1	250ml Bott		1	N			x														
TP81-0.5 72	9/1/2006	1	250ml Bott		1	N																	
TP81-1.0 73	9/1/2006	1	250ml Bott		1	N																	
TP82-0.1 74	9/1/2006	1	250ml Bott		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	pm		SAM	SGS	13-1-06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wardswood Asbestos\COC.xls]19.78-82

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Wanlewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 8600 1304
Attention: SGS
Phone: 8086 1420

Date Required: 5 days
Date Submitted: 10/1/2006
Page 20 of 41

Sample No.	Date Sampled	No. of Containers	Container Type/Size	Matrix: Water	Matrix: Soil	Preservation: Chill	Preservation: Acid	Preservation: Other	Analysis Required: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Comments
TP82-0.5 75	9/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP82-1.0 76	9/1/2006	1	250ml Soil		1	N																	
TP82-2.0 77	9/1/2006	1	250ml Soil		1	N																	
TP83-0.1 78	9/1/2006	1	250ml Soil		1	N			x														
TP83-0.5 79	9/1/2006	1	250ml Soil		1	N																	
TP83-1.0 80	9/1/2006	1	250ml Soil		1	N																	
TP83-2.0 81	9/1/2006	1	250ml Soil		1	N																	
TP84-0.1 82	9/1/2006	1	250ml Soil		1	N			x														
TP84-0.5 83	9/1/2006	1	250ml Soil		1	N																	
TP84-1.0 84	9/1/2006	1	250ml Soil		1	N																	
TP85-0.1 85	9/1/2006	1	250ml Soil		1	N			x														
TP85-0.5 86	9/1/2006	1	250ml Soil		1	N																	
TP85-1.0 87	9/1/2006	1	250ml Soil		1	N																	
TP85-3.0 88	9/1/2006	1	250ml Soil		1	N																	
TP88-0.1 89	9/1/2006	1	250ml Soil	"	1	N			x														

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
SAM	SGS	13/1/06	10:30	Sam

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wanlewood Asbestos\[COC.xls]20.82-06

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlkoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Donison St Malraville, NSW 2035
Attention: SGS
Fax: 9009 1364 Phone: 8056 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 21 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP86-0.5 90	9/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP86-1.0 91	9/1/2006	1	250ml Soil		1	N																	
TP86-3.0 92	9/1/2006	1	250ml Soil		1	N																	
TP87-0.1 93	9/1/2006	1	250ml Soil		1	N			x														
TP87-0.5 94	9/1/2006	1	250ml Soil		1	N																	
TP87-1.0 95	9/1/2006	1	250ml Soil		1	N																	
TP87-3.0 96	9/1/2006	1	250ml Soil		1	N																	
TP88-0.1 97	9/1/2006	1	250ml Soil		1	N			x														
TP88-0.5 98	9/1/2006	1	250ml Soil		1	N			x														
TP88-1.0 99	9/1/2006	1	250ml Soil		1	N																	
TP88-2.0 100	9/1/2006	1	250ml Soil		1	N																	
TP89-0.1 101	9/1/2006	1	250ml Soil		1	N			x														
TP89-0.5 102	9/1/2006	1	250ml Soil		1	N			x														
TP89-1.0 103	9/1/2006	1	250ml Soil		1	N																	
TP89-2.8 104	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10:30	Sm.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4730

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\(COC.xls)21.80-89

SGS

20 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference: 2114407, Warriewood
Report Number: 42410

Attention: Andrew Hogan

Dear Andrew
The following samples were received from you on the date indicated.

Samples:	Qty.	104 Soil Samples
Date of Receipt of Samples:		13/01/06
Date of Receipt of Instructions:		13/01/06
Date Preliminary Report Faxed:		Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.
42410-27: 2mm length fibre bundle found loose in soil.
42410-92 & 94: 1-3mm length fibre bondles found in a cement sheet fragment.
Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Approved Signatory

NATA
WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
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NATA Accredited laboratory No. 2562 (4354)

SGS Australia Pty Ltd ABN 44 000 964 278 | Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
—	—				
42410-1	TP90-0.1	-	09/01/06	20g Sand, Clay & Plant Matter	No asbestos detected
42410-2	TP90-0.5	-	09/01/06	20g Sand, Clay & Plant Matter	No asbestos detected
42410-4	TP91-0.1	-	09/01/06	20g Soil, Clay, Sand & Rocks	No asbestos detected
42410-5	TP91-0.5	-	09/01/06	20g Soil, Sand, Clay & Rocks	No asbestos detected
42410-9	TP92-0.1	-	09/01/06	20g Sand & Cement Mixture	No asbestos detected
42410-13	TP93-0.1	-	09/01/06	20g Cement Mixture	No asbestos detected
42410-14	TP93-0.5	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-15	TP93-1.0	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-18	TP94-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-19	TP94-0.5	-	09/01/06	20g Clay, Sand & Rocks	No asbestos detected
42410-22	TP95-0.1	-	09/01/06	20g Rocks, Sand & Clay	No asbestos detected
42410-23	TP95-0.5	-	09/01/06	20g Soil, Sand & Rocks	No asbestos detected
42410-27	TP96-0.1	-	09/01/06	20g Sand, Clay & Rocks	Crocidolite asbestos detected
42410-28	TP96-0.5	-	09/01/06	20g Clay & Rocks	No asbestos detected
42410-32	TP97-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-37	TP98-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-38	TP98-0.5	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-42	TP99-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-44	TP99-1.0	-	09/01/06	20g White Powdery Sand	No asbestos detected
42410-47	TP100-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42410-48	TP100-0.5	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-52	TP101-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-53	TP101-0.5	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-57	TP102-0.1	-	09/01/06	20g Sand & Soil	No asbestos detected
42410-62	TP103-0.1	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-63	TP103-0.5	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-64	TP103-1.0	-	10/01/06	20g Sand	No asbestos detected
42410-66	TP104-0.1	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-70	TP105-0.1	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-71	TP105-0.5	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-74	TP106-0.1	-	10/01/06	20g Sand & Clay	No asbestos detected
42410-78	TP107-0.1	-	10/01/06	20g Gravel (Sand)	No asbestos detected
42410-79	TP107-0.5	-	10/01/06	20g Sand & Soil	No asbestos detected
42410-82	TP108-0.1	-	10/01/06	20g Sand & Clay	No asbestos detected
42410-83	TP108-0.5	-	10/01/06	20g Clay	No asbestos detected
42410-87	TP109-0.1	-	10/01/06	20g Sand, Clay & Plant Matter	No asbestos detected
42410-88	TP109-0.5	-	10/01/06	20g Sand, Rocks, Clay & Plant Matter	No asbestos detected
42410-89	TP109-1.0	-	10/01/06	20g Sand, Soil, Clay & Plaster Fragments	No asbestos detected
42410-90	TP109-2.0	-	10/01/06	20g Sand, Clay & Rocks	No asbestos detected
42410-92	TP110-0.1	-	10/01/06	20g Sand, Clay, Rocks & Plant Matter	Chrysotile asbestos detected Crocidolite asbestos detected

NATA WORLD RECOGNISED ACCREDITATION

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42410-93	TP110-0.5	-	10/01/06	20g Sand, Clay & Rocks	No asbestos detected
42410-94	TP110-1.0	-	10/01/06	20g Sand, Clay & Rocks	Chrysotile asbestos detected
42410-97	TP111-0.1	-	10/01/06	20g Sand, Clay, Rocks, Soil&Plant Matter	No asbestos detected
42410-98	TP111-0.5	-	10/01/06	20g Clay	No asbestos detected
42410-99	TP111-1.0	-	10/01/06	20g Sand, Clay & Rocks	No asbestos detected
42410-102	TP112-0.1	-	10/01/06	20g Sand, Clay & Rocks	No asbestos detected
42410-103	TP112-0.5	-	10/01/06	20g Sand, Clay & Rocks	No asbestos detected

Method ID	Methodology Summary
SASB-002	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques. Accreditation does not cover the Identification of Synthetic Mineral Fibre.

Result Codes

[INS] : Insufficient Sample for this test		[HBG] :	Results not Reported due to High Background Interference
[NR] : Not Requested		* :	Not part of NATA Accreditation
[NT] : Not tested		[N/A] :	Not Applicable

Result Comments

ASBESTOS NB. Even after disintegration of certain bulk samples (vinyl tiles and bituminous type materials), the detection, of fibres may be difficult when using Polarised Light Microscopy and Dispersion Staining Techniques. This may be due to the matrix of the sample (uneven distribution), or fine fibres that are difficult to detect and positively identify.

NATA Accreditation No. 2562

Quality Control Protocol

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch.
A duplicate is prepared at least every 20 samples.
Terms and conditions are available from www.au.sgs.com

NATA
WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
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NATA Accredited laboratory No. 2562 (4354)

GHD

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

Project No. 2114407 Phone No. 9462 4010

Project Name Warriewood Fax No. 9462 4710

Project Manager Andrew Hogan/ Katherine Karlikoff

Sent to Lab: SGS

Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2030

Fax: 9660 1384

Attention: SGS

Phone: 8000 1420

Date Required: 5 days

Date Submitted: 13/1/2006

Page 11 of 11

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP90-0.1 1	9/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP90-0.5 2	9/1/2006	1	250ml Soil		1	N			x														
TP90-1.0 3	9/1/2006	1	250ml Soil		1	N																	
TP91-0.1 4	9/1/2006	1	250ml Soil		1	N			x														
TP91-0.5 5	9/1/2006	1	250ml Soil		1	N			x														
TP91-1.0 6	9/1/2006	1	250ml Soil		1	N																	
TP91-2.0 7	9/1/2006	1	250ml Soil		1	N																	
TP91-3.0 8	9/1/2006	1	250ml Soil		1	N																	
TP92-0.1 9	9/1/2006	1	250ml Soil		1	N			x														
TP92-0.5 10	9/1/2006	1	250ml Soil		1	N																	
TP92-1.0 11	9/1/2006	1	250ml Soil		1	N																	
TP92-2.0 12	9/1/2006	1	250ml Soil		1	N																	
TP93-0.1 13	9/1/2006	1	250ml Soil		1	N			x														
TP93-0.5 14	9/1/2006	1	250ml Soil		1	N			x														
TP93-1.0 15	9/1/2006	1	250ml Soil		1	N			x														

SGS
Rec: 13/1/06
By: [signature]
Time: 10:30 am/pm
Samples intact yes/no
Ice/Cooler Pack yes/no
Comments: 42410

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
[signature]	SGS	13/1/06	10:30 AM	[signature]

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|22.90-93

(1)

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andow Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 9666 1564 Attention: SGS Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 23 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP93-2.0 16	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP93-3.0 17	9/1/2006	1	250ml Soil		1	N																	
TP94-0.1 18	9/1/2006	1	250ml Soil		1	N			x														
TP94-0.5 19	9/1/2006	1	250ml Soil		1	N			x														
TP94-1.0 20	9/1/2006	1	250ml Soil		1	N																	
TP94-2.0 21	9/1/2006	1	250ml Soil		1	N																	
TP95-0.1 22	9/1/2006	1	250ml Soil		1	N			x														
TP95-0.5 23	9/1/2006	1	250ml Soil		1	N			x														
TP95-1.0 24	9/1/2006	1	250ml Soil		1	N																	
TP95-2.0 25	9/1/2006	1	250ml Soil		1	N																	
TP95-3.0 26	9/1/2006	1	250ml Soil		1	N																	
TP96-0.1 27	9/1/2006	1	250ml Soil		1	N			x														
TP96-0.5 28	9/1/2006	1	250ml Soil		1	N			x														
TP96-1.0 29	9/1/2006	1	250ml Soil		1	N																	
TP96-2.0 30	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
SAM	SGS	13/1/06	10.30am	Sam

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|23.03-98

GHD

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 | Telephone: (02) 9462 4700 | Fax: (02) 9462 4710 | ABN 39 008 488 373

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

Project No. 2114407 | Phone No. 9462 4010
Project Name Warriewood | Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 24 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP96-3.0 31	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP97-0.1 32	9/1/2006	1	250ml Soil		1	N			x														
TP97-0.5 33	9/1/2006	1	250ml Soil		1	N																	
TP97-1.0 34	9/1/2006	1	250ml Soil		1	N																	
TP97-2.0 35	9/1/2006	1	250ml Soil		1	N																	
TP97-3.0 36	9/1/2006	1	250ml Soil		1	N																	
TP98-0.1 37	9/1/2006	1	250ml Soil		1	N			x														
TP98-0.5 38	9/1/2006	1	250ml Soil		1	N			x														
TP98-1.0 39	9/1/2006	1	250ml Soil		1	N																	
TP98-2.0 40	9/1/2006	1	250ml Soil		1	N																	
TP98-3.0 41	9/1/2006	1	250ml Soil		1	N																	
TP99-0.1 42	9/1/2006	1	250ml Soil		1	N			x														
TP99-0.5 43	9/1/2006	1	250ml Soil		1	N																	
TP99-1.0 44	9/1/2006	1	250ml Soil		1	N			x														
TP99-2.0 45	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		Sam	SGS	13/1/06	10:30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

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CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590
Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407
Project Name Warriewood
Project Manager Andew Hogan/ Katherine Karlikoff
Phone No. 0402 4910
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9566 1304
Attention: SGS
Phone: 9566 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 25 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP99-3.0 46	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP100-0.1 47	9/1/2006	1	250ml Soil		1	N			x														
TP100-0.5 48	9/1/2006	1	250ml Soil		1	N			x														
TP100-1.0 49	9/1/2006	1	250ml Soil		1	N																	
TP100-2.0 50	9/1/2006	1	250ml Soil		1	N																	
TP100-3.0 51	9/1/2006	1	250ml Soil		1	N																	
TP101-0.1 52	9/1/2006	1	250ml Soil		1	N			x														
TP101-0.5 53	9/1/2006	1	250ml Soil		1	N			x														
TP101-1.0 54	9/1/2006	1	250ml Soil		1	N																	
TP101-2.0 55	9/1/2006	1	250ml Soil		1	N																	
TP101-3.0 56	9/1/2006	1	250ml Soil		1	N																	
TP102-0.1 57	9/1/2006	1	250ml Soil		1	N			x														
TP102-0.5 58	9/1/2006	1	250ml Soil		1	N																	
TP102-1.0 59	9/1/2006	1	250ml Soil		1	N																	
TP102-2.0 60	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10:30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4910
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9000 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 26 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP102-3.0 61	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP103-0.1 62	10/1/2006	1	250ml Soil		1	N			x														
TP103-0.5 63	10/1/2006	1	250ml Soil		1	N			x														
TP103-1.0 64	10/1/2006	1	250ml Soil		1	N			x														
TP103-2.0 65	10/1/2006	1	250ml Soil		1	N																	
TP104-0.1 66	10/1/2006	1	250ml Soil		1	N			x														
TP104-0.5 67	10/1/2006	1	250ml Soil		1	N																	
TP104-1.0 68	10/1/2006	1	250ml Soil		1	N																	
TP104-2.0 69	10/1/2006	1	250ml Soil		1	N																	
TP105-0.1 70	10/1/2006	1	250ml Soil		1	N			x														
TP105-0.5 71	10/1/2006	1	250ml Soil		1	N			x														
TP105-1.0 72	10/1/2006	1	250ml Soil		1	N																	
TP105-2.0 73	10/1/2006	1	250ml Soil		1	N																	
T106-0.1 74	10/1/2006	1	250ml Soil		1	N			x														
TP106-0.5 75	10/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
Sam	SGS	13.1.06	10:30	Sam.

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form.

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PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710

Project No. 2114407 Phone No. 9462 4810

Project Name Warriewood Fax No. 9462 4710

Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS

Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2030

Fax: 9666 1304

Attention: SGS

Phone: 8090 1426

Date Required: 5 days

Date Submitted: 13/1/2006

Page 27 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
~~TP106-0.5~~	10/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP106-1.0 76	10/1/2006	1	250ml Soil		1	N																	
TP106-2.0 77	10/1/2006	1	250ml Soil		1	N																	
TP107-0.1 78	10/1/2006	1	250ml Soil		1	N			x														
TP107-0.5 79	10/1/2006	1	250ml Soil		1	N			x														
TP107-1.0 80	10/1/2006	1	250ml Soil		1	N																	
TP107-2.0 81	10/1/2006	1	250ml Soil		1	N																	
TP108-0.1 82	10/1/2006	1	250ml Soil		1	N			x														
TP108-0.5 83	10/1/2006	1	250ml Soil		1	N			x														
TP108-1.0 84	10/1/2006	1	250ml Soil		1	N																	
TP108-2.0 85	10/1/2006	1	250ml Soil		1	N																	
TP108-3.6 86	10/1/2006	1	250ml Soil		1	N																	
TP109-0.1 87	10/1/2006	1	250ml Soil		1	N			x														
TP109-0.5 88	10/1/2006	1	250ml Soil		1	N			x														
TP109-1.0 89	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13.1.06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]27.100-108

GHD

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590   Telephone: (02) 9462 4700   Fax: (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

Project No. 2114407   Phone No. 9462 4810
Project Name Warriewood   Fax No. 9462 4710
Project Manager Andow Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 28 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP109-2.0 90	10/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP109-3.0 91	10/1/2006	1	250ml Soil		1	N																	
TP110-0.1 92	10/1/2006	1	250ml Soil		1	N			x														
TP110-0.5 93	10/1/2006	1	250ml Soil		1	N			x														
TP110-1.0 94	10/1/2006	1	250ml Soil		1	N			x														
TP110-2.0 95	10/1/2006	1	250ml Soil		1	N																	
TP110-3.0 96	10/1/2006	1	250ml Soil		1	N																	
TP111-0.1 97	10/1/2000	1	250ml Soil		1	N			x														
TP111-0.5 98	10/1/2006	1	250ml Soil		1	N			x														
TP111-1.0 99	10/1/2006	1	250ml Soil		1	N			x														
TP111-2.0 100	10/1/2006	1	250ml Soil		1	N																	
TP111-3.0 101	10/1/2006	1	250ml Soil		1	N																	
TP112-0.1 102	10/1/2006	1	250ml Soil		1	N			x														
TP112-0.5 103	10/1/2006	1	250ml Soil		1	N			x														
TP112-1.0 104	10/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		Sam	SGS	13.1.06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

SGS

20 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference: 2114407, Warriewood
Report Number: 42411

Attention: Andrew Hogan

Dear Andrew
The following samples were received from you on the date indicated.

Samples: Qty.	105 Soil Samples
Date of Receipt of Samples:	13/01/06
Date of Receipt of Instructions:	13/01/06
Date Preliminary Report Faxed:	Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.
Samples with id TP118-2.0, TP 122-1.0 and TP 122-2.0 were not received at SGS.
Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Approved Signatory

NATA Endorsed Test Report
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NATA WORLD RECOGNISED ACCREDITATION

SGS Australia Pty Ltd ABN 44 000 964 278 | Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-3	TP113-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-4	TP113-0.5	-	10/01/06	20g Clay	No asbestos detected
42411-5	TP113-1.0	-	10/01/06	20g Clay	No asbestos detected
42411-8	TP114-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-13	TP115-0.1	-	10/01/06	20g Soil, Clay & Rocks	No asbestos detected
42411-14	TP115-0.5	-	10/01/06	20g Soil, Clay & Rocks	No asbestos detected
42411-15	TP115-1.0	-	10/01/06	20g Soil & Rocks	No asbestos detected
42411-16	TP115-2.0	-	10/01/06	20g Soil & Rocks	No asbestos detected
42411-17	TP115-3.0	-	10/01/06	20g Soil	No asbestos detected
42411-18	TP116-0.1	-	10/01/06	20g Clay & Sand	No asbestos detected
42411-19	TP116-0.5	-	10/01/06	20g Clay & Sand	No asbestos detected
42411-20	TP116-1.0	-	10/01/06	20g Soil & Clay	No asbestos detected
42411-22	TP117-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-23	TP117-0.5	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-26	TP118-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-27	TP118-0.5	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-30	TP119-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-35	TP120-0.1	-	10/01/06	20g Sand & Clay	No asbestos detected
42411-36	TP120-0.5	-	10/01/06	20g Soil & Clay	No asbestos detected
42411-39	TP121-0.1	-	10/01/06	20g Soil & Plant Matter	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-40	TP121-0.5	-	10/01/06	20g Clay	No asbestos detected
42411-43	TP122-0.1	-	10/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-48	TP123-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-51	TP123-2.0	-	10/01/06	20g Soil, Rocks & Clay	No asbestos detected
42411-52	TP124-0.1	-	11/01/06	20g Soil & Clay	No asbestos detected
42411-56	TP125-0.1	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-57	TP125-0.5	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-59	TP125-2.0	-	11/01/06	20g Clay	No asbestos detected
42411-60	TP126-0.1	-	11/01/06	20g Sand, Clay & Plant Matter	No asbestos detected
42411-64	TP127-0.1	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-65	TP127-0.5	-	11/01/06	20g Clay	No asbestos detected
42411-66	TP127-1.0	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-68	TP128-0.1	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-72	TP129-0.1	-	11/01/06	20g Clay	No asbestos detected
42411-76	TP130-0.1	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-77	TP130-0.5	-	11/01/06	20g Sand & Soil	No asbestos detected
42411-78	TP130-1.0	-	11/01/06	20g Sand & Soil	No asbestos detected
42411-79	TP130-2.0	-	11/01/06	20g Soil	No asbestos detected
42411-80	TP131-0.1	-	11/01/06	20g Clay	No asbestos detected
42411-84	TP132-0.1	-	11/01/06	20g Soil & Clay	No asbestos detected
42411-85	TP132-0.5	-	11/01/06	20g Soil & Plant Matter	No asbestos detected

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-88	TP133-0.1	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-89	TP133-0.5	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-92	TP134-0.1	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-93	TP134-0.5	-	11/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-96	TP135-0.1	-	11/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-97	TP135-0.5	-	11/01/06	20g Clay	No asbestos detected
42411-99	TP135-2.0	-	11/01/06	20g Clay	No asbestos detected
42411-101	TP136-0.1	-	11/01/06	20g Soil & Rocks	No asbestos detected

U

Method ID	Methodology Summary
SASB-002	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques. Accreditation does not cover the identification of Synthetic Mineral Fibre.

PROJECT: 2114407, Warriewood REPORT NO: 42411

Result Codes

[INS] : Insufficient Sample for this test
[NR] : Not Requested
[NT] : Not tested
[HBG] : Results not Reported due to High Background Interference
* : Not part of NATA Accreditation
[N/A] : Not Applicable

Result Comments

ASBESTOS NB. Even after disintegration of certain bulk samples (vinyl tiles and bituminous type materials), the detection, of fibres may be difficult when using Polarised Light Microscopy and Dispersion Staining Techniques. This may be due to the matrix of the sample (uneven distribution), or fine fibres that are difficult to detect and positively identify.

NATA Accreditation No. 2562.

Quality Control Protocol

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch.
A duplicate is prepared at least every 20 samples.
Terms and conditions are available from www.au.sgs.com

NATA

WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
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✓

(5)

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 0402 4810
Project Name Wentewood Fax No. 9462 4710
Project Manager Andow Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036 Attention: SGS
Fax: 9666 1384 Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 29 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP112-2.0 1	10/1/2006	1	250ml Soil		1	N																	1: - Asbestos
TP112-3.0 2	10/1/2006	1	250ml Soil		1	N																	
TP113-0.1 3	10/1/2006	1	250ml Soil		1	N			x														
TP113-0.5 4	10/1/2006	1	250ml Soil		1	N			x														
TP113-1.0 5	10/1/2006	1	250ml Soil		1	N			x														
TP113-2.0 6	10/1/2006	1	250ml Soil		1	N																	SGS
TP113-3.0 7	10/1/2006	1	250ml Soil		1	N																	
TP114-0.1 8	10/1/2006	1	250ml Soil		1	N			x														Rec: 13/01/06
TP114-0.5 9	10/1/2006	1	250ml Soil		1	N																	By:
TP114-1.0 10	10/1/2006	1	250ml Soil		1	N																	Time: 10:30 am
TP114-2.0 11	10/1/2006	1	250ml Soil		1	N																	Samples intact Y
TP114-3.0 12	10/1/2006	1	250ml Soil		1	N																	Ice/Cooler Pack yes/no
TP115-0.1 13	10/1/2006	1	250ml Soil		1	N			x														Temp: 12.1
TP115-0.5 14	10/1/2006	1	250ml Soil		1	N			x														
TP115-1.0 15	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am			SGS	13/1/06	10:30 am	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462-4710
Project Manager Andow Hogan/ Katharine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 8668 1364
Attention: SGS
Phone: 8666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 30 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP115-2.0 16	10/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP115-3.0 17	10/1/2006	1	250ml Soil		1	N			x														
TP116-0.1 18	10/1/2006	1	250ml Soil		1	N			x														
TP116-0.5 19	10/1/2006	1	250ml Soil		1	N			x														
TP116-1.0 20	10/1/2006	1	250ml Soil		1	N			x														
TP116-2.0 21	10/1/2006	1	250ml Soil		1	N																	
TP117--0.1 22	10/1/2006	1	250ml Soil		1	N			x														
TP117-0.5 23	10/1/2006	1	250ml Soil		1	N			x														
TP117-1.0 24	10/1/2006	1	250ml Soil		1	N																	
TP117-2.0 25	10/1/2006	1	250ml Soil		1	N																	
TP118-0.1 26	10/1/2006	1	250ml Soil		1	N			x														
TP118-0.5 27	10/1/2006	1	250ml Soil		1	N			x														
TP118-1.0 28	10/1/2006	1	250ml Soil		1	N																	
TP118-2.0 29	10/1/2006	1	250ml Soil		1	N																	
TP119-0.1 30	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katharine Karlikoff	GHD	13/1/2006	am						

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

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FILE REF.: G:\Projects\2114407 - Warriewood Asbestos\COO.xls]30.115-119

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Wardwood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Korlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Attention: SGS
Fax: 9666 1364 Phone: 8999 1428

Date Required: 5 days
Date Submitted: 13/1/2008
Page 31 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP119-0.5 31	10/1/2008	1	250ml Soil		1	N																	1. - Asbestos
TP119-1.0 32	10/1/2008	1	250ml Soil		1	N																	
TP119-2.0 33	10/1/2008	1	250ml Soil		1	N																	
TP119-3.0 34	10/1/2008	1	250ml Soil		1	N																	
TP120-0.1 35	10/1/2008	1	250ml Soil		1	N			x														
TP120-0.5 36	10/1/2008	1	250ml Soil		1	N			x														
TP120-1.0 37	10/1/2008	1	250ml Soil		1	N																	
TP120-2.0 38	10/1/2008	1	250ml Soil		1	N																	
TP121-0.1 39	10/1/2008	1	250ml Soil		1	N			x														
TP121-0.5 40	10/1/2008	1	250ml Soil		1	N			x														
TP121-1.0 41	10/1/2008	1	250ml Soil		1	N																	
TP121-2.5 42	10/1/2008	1	250ml Soil		1	N																	
TP122-0.1 43	10/1/2008	1	250ml Soil		1	N			x														
TP122-0.5 44	10/1/2008	1	250ml Soil		1	N																	
TP122-1.0 45	10/1/2008	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Korlikoff	GHD	13/1/2006	pm	

RECEIVED BY

Name	Organisation	Date	Time	Signed

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wardwood Asbestos\(COC.xls)31.119-122

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 9666 1304
Attention: SGS
Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 32 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP122-2.0 46	10/1/2006	1	250ml Bot		1	N			[illegible]														1. - Asbestos
TP122-3.0 47	10/1/2006	1	250ml Bot		1	N																	
TP123-0.1 48	10/1/2006	1	250ml Bot		1	N			x														
TP123-0.5 49	10/1/2006	1	250ml Bot		1	N																	
TP123-1.0 50	10/1/2006	1	250ml Bot		1	N																	
TP123-2.0 51	10/1/2006	1	250ml Bot		1	N			X	As per conversation with Katherine 13/1/06 this to replace TP122-2-0 which was not received													
TP124-0.1 52	11/1/2006	1	250ml Bot		1	N			x														
TP124-0.5 53	11/1/2006	1	250ml Bot		1	N																	
TP124-1.0 54	11/1/2006	1	250ml Bot		1	N																	
TP124-2.0 55	11/1/2006	1	250ml Bot		1	N																	
TP125-0.1 56	11/1/2006	1	250ml Bot		1	N			x														
TP125-0.5 57	11/1/2006	1	250ml Bot		1	N			x														
TP125-1.0 58	11/1/2006	1	250ml Bot		1	N																	
TP125-2.0 59	11/1/2006	1	250ml Bot		1	N			x														
TP126-0.1 60	11/1/2006	1	250ml Bot		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13-1-06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

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FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]32.122-126

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1500 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Korlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Attention: SGS
Fax: 9666 1364 Phone: 9666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 33 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP126-0.5 61	11/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP126-1.0 62	11/1/2006	1	250ml Soil		1	N																	
TP126-2.0 63	11/1/2006	1	250ml Soil		1	N																	
TP127-0.1 64	11/1/2006	1	250ml Soil		1	N			x														
TP127-0.5 65	11/1/2006	1	250ml Soil		1	N			x														
TP127-1.0 66	11/1/2006	1	250ml Soil		1	N			x														
TP127-2.0 67	11/1/2006	1	250ml Soil		1	N																	
TP128-0.1 68	11/1/2006	1	250ml Soil		1	N			x														
TP128-0.5 69	11/1/2006	1	250ml Soil		1	N																	
TP128-1.0 70	11/1/2006	1	250ml Soil		1	N																	
TP128-2.0 71	11/1/2006	1	250ml Soil		1	N																	
TP129-0.1 72	11/1/2006	1	250ml Soil		1	N			x														
TP129-0.5 73	11/1/2006	1	250ml Soil		1	N																	
TP129-1.0 74	11/1/2006	1	250ml Soil		1	N																	
TP129-2.0 75	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Korlikoff	GHD	13/1/2005	am		SAM	SGS	13-1-05	10-30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]33.126-129

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2767 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810

Project Name Wentwood Fax No. 9462 4710

Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS

Address: Botany Industrial Park, Gate 3 Denison St

Matraville, NSW 2036

Fax: 8000 1364

Attention: SGS

Phone: 9660 1420

Date Required: 5 days

Date Submitted: 13/1/2006

Page 34 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP130-0.1 76	11/1/2006	1	250ml Soil		1	N			x														1.- Asbestos
TP130-0.5 77	11/1/2006	1	250ml Soil		1	N			x														
TP130-1.0 78	11/1/2006	1	250ml Soil		1	N			x														
TP130-2.0 79	11/1/2006	1	250ml Soil		1	N			x														
TP131-0.1 80	11/1/2006	1	250ml Soil		1	N			x														
TP131-0.5 81	11/1/2006	1	250ml Soil		1	N																	
TP131-1.0 82	11/1/2006	1	250ml Soil		1	N																	
TP131-2.0 83	11/1/2006	1	250ml Soil		1	N																	
TP132-0.1 84	11/1/2006	1	250ml Soil		1	N			x														
TP132-0.5 85	11/1/2006	1	250ml Soil		1	N			x														
TP132-1.0 86	11/1/2006	1	250ml Soil		1	N																	
TP132-2.0 87	11/1/2006	1	250ml Soil		1	N																	
TP133-0.1 88	11/1/2006	1	250ml Soil		1	N			x														
TP133-0.5 89	11/1/2006	1	250ml Soil		1	N			x														
TP133-1.0 90	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
Simon	SGS	13-1-06	10.30	Sam.

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wentwood Asbestos\COC.xls|34.100-133

GHD
GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

Project No. 2114407 Phone No. 9462 4610
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036 Attention: SGS
Fax: 9666 1364 Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 35 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP133-2.0 91	11/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP134-0.1 92	11/1/2006	1	250ml Soil		1	N			x														
TP134-0.5 93	11/1/2006	1	250ml Soil		1	N			x														
TP134-1.0 94	11/1/2006	1	250ml Soil		1	N																	
TP134-2.0 95	11/1/2006	1	250ml Soil		1	N																	
TP135-0.1 96	11/1/2006	1	250ml Soil		1	N			x														
TP135-0.5 97	11/1/2006	1	250ml Soil		1	N			x														
TP135-1.0 98	11/1/2006	1	250ml Soil		1	N																	
TP135-2.0 99	11/1/2006	1	250ml Soil		1	N			x														
TP135-3.0 100	11/1/2006	1	250ml Soil		1	N																	
TP136-0.1 101	11/1/2006	1	250ml Soil		1	N			x														
TP136-0.5 102	11/1/2006	1	250ml Soil		1	N																	
TP136-1.0 103	11/1/2006	1	250ml Soil		1	N																	
TP136-2.0 104	11/1/2006	1	250ml Soil		1	N																	
TP136-3.0 105	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	pm		SAM	SGS	13-1-06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]35.103-136

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590
Telephone: (02) 9462 4700 Fax: (02) 9462 4710
ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036 Attention: SGS
Fax: 0666 1364 Phone: 9666 1426

Date Required: 5 days
Date Submitted: 16/1/2006
Page 23 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP93-2.0 16	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP93-3.0 17	9/1/2006	1	250ml Soil		1	N																	
TP94-0.1 18	9/1/2006	1	250ml Soil		1	N			x														
TP94-0.5 19	9/1/2006	1	250ml Soil		1	N			x														
TP94-1.0 20	9/1/2006	1	250ml Soil		1	N																	
TP94-2.0 21	9/1/2006	1	250ml Soil		1	N																	
TP95-0.1 22	9/1/2006	1	250ml Soil		1	N			x														
TP95-0.5 23	9/1/2006	1	250ml Soil		1	N			x														
TP95-1.0 24	9/1/2006	1	250ml Soil		1	N																	
TP95-2.0 25	9/1/2006	1	250ml Soil		1	N																	
TP95-3.0 26	9/1/2006	1	250ml Soil		1	N																	
TP96-0.1 27	9/1/2006	1	250ml Soil		1	N			x														
TP96-0.5 28	9/1/2006	1	250ml Soil		1	N			x														
TP96-1.0 29	9/1/2006	1	250ml Soil		1	N																	
TP96-2.0 30	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13/1/06	10.30am	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|23.03-99

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4010
Project Name Warriewood Fax No. 9462 4710
Project Manager Andaw Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 8860 1304
Attention: SGS
Phone: 8806 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 24 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP96-3.0 31	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP97-0.1 32	9/1/2006	1	250ml Soil		1	N			x														
TP97-0.5 33	9/1/2006	1	250ml Soil		1	N																	
TP97-1.0 34	9/1/2006	1	250ml Soil		1	N																	
TP97-2.0 35	9/1/2006	1	250ml Soil		1	N																	
TP97-3.0 36	9/1/2006	1	250ml Soil		1	N																	
TP98-0.1 37	9/1/2006	1	250ml Soil		1	N			x														
TP98-0.5 38	9/1/2006	1	250ml Soil		1	N			x														
TP98-1.0 39	9/1/2006	1	250ml Soil		1	N																	
TP98-2.0 40	9/1/2006	1	250ml Soil		1	N																	
TP98-3.0 41	9/1/2006	1	250ml Soil		1	N																	
TP99-0.1 42	9/1/2006	1	250ml Soil		1	N			x														
TP99-0.5 43	9/1/2006	1	250ml Soil		1	N																	
TP99-1.0 44	9/1/2006	1	250ml Soil		1	N			x														
TP99-2.0 45	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		Sam	SGS	13/1/06	10:30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|24.06-01

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710

Project No. 2114407
Project Name Warriewood
Project Manager Andew Hogan/ Katherine Karlikoff
Phone No. 9462 4910
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Mairaville, NSW 2036
Fax: 8888 1364
Attention: SGS
Phone: 8880 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 28 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP99-3.0 46	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP100-0.1 47	9/1/2006	1	250ml Soil		1	N			x														
TP100-0.5 48	9/1/2006	1	250ml Soil		1	N			x														
TP100-1.0 49	9/1/2006	1	250ml Soil		1	N																	
TP100-2.0 50	9/1/2006	1	250ml Soil		1	N																	
TP100-3.0 51	9/1/2006	1	250ml Soil		1	N																	
TP101-0.1 52	9/1/2006	1	250ml Soil		1	N			x														
TP101-0.5 53	9/1/2006	1	250ml Soil		1	N			x														
TP101-1.0 54	9/1/2006	1	250ml Soil		1	N																	
TP101-2.0 55	9/1/2006	1	250ml Soil		1	N																	
TP101-3.0 56	9/1/2006	1	250ml Soil		1	N																	
TP102-0.1 57	9/1/2006	1	250ml Soil		1	N			x														
TP102-0.5 58	9/1/2006	1	250ml Soil		1	N																	
TP102-1.0 59	9/1/2006	1	250ml Soil		1	N																	
TP102-2.0 60	9/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	pm	

RECEIVED BY

Name	Organisation	Date	Time	Signed
SAm	SGS	13/1/06	10.30	Sam

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\2114407 - Warriewood Asbestos\COC.xls]26.99-102

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Wanlewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlkoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036 Attention: SGS
Fax: 9666 1364 Phone: 9666 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 26 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP102-3.0 61	9/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP103-0.1 62	10/1/2006	1	250ml Soil	1	1	N			x														
TP103-0.5 63	10/1/2006	1	250ml Soil		1	N			x														
TP103-1.0 64	10/1/2006	1	250ml Soil		1	N			x														
TP103-2.0 65	10/1/2006	1	250ml Soil		1	N																	
TP104-0.1 66	10/1/2006	1	250ml Soil		1	N			x														
TP104-0.5 67	10/1/2006	1	250ml Soil		1	N																	
TP104-1.0 68	10/1/2006	1	250ml Soil		1	N																	
TP104-2.0 69	10/1/2006	1	250ml Soil		1	N																	
TP105-0.1 70	10/1/2006	1	250ml Soil		1	N			x														
TP105-0.5 71	10/1/2006	1	250ml Soil		1	N			x														
TP105-1.0 72	10/1/2006	1	250ml Soil		1	N																	
TP105-2.0 73	10/1/2006	1	250ml Soil		1	N																	
T106-0.1 74	10/1/2006	1	250ml Soil		1	N			x														
TP106-0.5 75	10/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	10/1/2006	am		Sam	SGS	13.1.06	10:30	Sam.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Wanlewood Asbestos\COO.xls]26.102-106

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407
Project Name Warriewood
Project Manager Andew Hogan/ Katherine Karlikoff
Phone No. 9462 4810
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St Matraville, NSW 2036
Fax: 9666 1364
Attention: SGS
Phone: 9666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 27 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
~~TP106-0.5~~	10/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP106-1.0 76	10/1/2006	1	250ml Soil		1	N																	
TP106-2.0 77	10/1/2006	1	250ml Soil		1	N																	
TP107-0.1 78	10/1/2006	1	250ml Soil		1	N			x														
TP107-0.5 79	10/1/2006	1	250ml Soil		1	N			x														
TP107-1.0 80	10/1/2006	1	250ml Soil		1	N																	
TP107-2.0 81	10/1/2006	1	250ml Soil		1	N																	
TP108-0.1 82	10/1/2006	1	250ml Soil		1	N			x														
TP108-0.5 83	10/1/2006	1	250ml Soil		1	N			x														
TP108-1.0 84	10/1/2006	1	250ml Soil		1	N																	
TP108-2.0 85	10/1/2006	1	250ml Soil		1	N																	
TP108-3.6 86	10/1/2006	1	250ml Soil		1	N																	
TP109-0.1 87	10/1/2006	1	250ml Soil		1	N			x														
TP109-0.5 88	10/1/2006	1	250ml Soil		1	N			x														
TP109-1.0 89	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2006	am		SAM	SGS	13.1.06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls|27.100-109

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590
Telephone: (02) 9462 4700 Fax: (02) 9462 4710
ABN 39 008 488 373

Project No. 2114407
Project Name Warriewood
Project Manager Andew Hogan/ Katherina Karlkoff
Phone No. 9462 4810
Fax No. 9462 4710

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Donison St Malraville, NSW 2030
Fax: 9888 1364
Attention: SGS
Phone: 8666 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 28 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP109-2.0 90	10/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP109-3.0 91	10/1/2006	1	250ml Soil		1	N																	
TP110-0.1 92	10/1/2006	1	250ml Soil		1	N			x														
TP110-0.5 93	10/1/2006	1	250ml Soil		1	N			x														
TP110-1.0 94	10/1/2006	1	250ml Soil		1	N			x														
TP110-2.0 95	10/1/2006	1	250ml Soil		1	N																	
TP110-3.0 96	10/1/2006	1	250ml Soil		1	N																	
TP111-0.1 97	10/1/2006	1	250ml Soil		1	N			x														
TP111-0.5 98	10/1/2006	1	250ml Soil		1	N			x														
TP111-1.0 99	10/1/2006	1	250ml Soil		1	N			x														
TP111-2.0 100	10/1/2006	1	250ml Soil		1	N																	
TP111-3.0 101	10/1/2006	1	250ml Soil		1	N																	
TP112-0.1 102	10/1/2006	1	250ml Soil		1	N			x														
TP112-0.5 103	10/1/2006	1	250ml Soil		1	N			x														
TP112-1.0 104	10/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	10/1/2006	801	

RECEIVED BY Name	Organisation	Date	Time	Signed
Sam	SGS	13.1.06	10.30	Sam.

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\2114407 - Warriewood Asbestos\COC.xls]28.109-112

SGS

20 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference: 2114407, Warriewood
Report Number: 42411

Attention: Andrew Hogan

Dear Andrew

The following samples were received from you on the date indicated.

Samples:	Qty.	105 Soil Samples
Date of Receipt of Samples:		13/01/06
Date of Receipt of Instructions:		13/01/06
Date Preliminary Report Faxed:		Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.
Samples with id TP118-2.0, TP 122-1.0 and TP 122-2.0 were not received at SGS.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Approved Signatory

NATA
WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
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NATA Accredited laboratory No. 2562 (4354)

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

Member of the SGS Group

PROJECT: 2114407, Warriewood REPORT NO: 42411

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-3	TP113-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-4	TP113-0.5	-	10/01/06	20g Clay	No asbestos detected
42411-5	TP113-1.0	-	10/01/06	20g Clay	No asbestos detected
42411-8	TP114-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-13	TP115-0.1	-	10/01/06	20g Soil, Clay & Rocks	No asbestos detected
42411-14	TP115-0.5	-	10/01/06	20g Soil, Clay & Rocks	No asbestos detected
42411-15	TP115-1.0	-	10/01/06	20g Soil & Rocks	No asbestos detected
42411-16	TP115-2.0	-	10/01/06	20g Soil & Rocks	No asbestos detected
42411-17	TP115-3.0	-	10/01/06	20g Soil	No asbestos detected
42411-18	TP116-0.1	-	10/01/06	20g Clay & Sand	No asbestos detected
42411-19	TP116-0.5	-	10/01/06	20g Clay & Sand	No asbestos detected
42411-20	TP116-1.0	-	10/01/06	20g Soil & Clay	No asbestos detected
42411-22	TP117-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-23	TP117-0.5	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-26	TP118-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-27	TP118-0.5	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-30	TP119-0.1	-	10/01/06	20g Clay & Soil	No asbestos detected
42411-35	TP120-0.1	-	10/01/06	20g Sand & Clay	No asbestos detected
42411-36	TP120-0.5	-	10/01/06	20g Soil & Clay	No asbestos detected
42411-39	TP121-0.1	-	10/01/06	20g Soil & Plant Matter	No asbestos detected

✓

SGS Ref	Sample ID	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-40	TP121-0.5	-	10/01/06	20g Clay	No asbestos detected
42411-43	TP122-0.1	-	10/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-48	TP123-0.1	-	10/01/06	20g Clay	No asbestos detected
42411-51	TP123-2.0	-	10/01/06	20g Soil, Rocks & Clay	No asbestos detected
42411-52	TP124-0.1	-	11/01/06	20g Soil & Clay	No asbestos detected
42411-56	TP125-0.1	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-57	TP125-0.5	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-59	TP125-2.0	-	11/01/06	20g Clay	No asbestos detected
42411-60	TP126-0.1	-	11/01/06	20g Sand, Clay & Plant Matter	No asbestos detected
42411-64	TP127-0.1	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-65	TP127-0.5	-	11/01/06	20g Clay	No asbestos detected
42411-66	TP127-1.0	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-68	TP128-0.1	-	11/01/06	20g Clay & Sand	No asbestos detected
42411-72	TP129-0.1	-	11/01/06	20g Clay	No asbestos detected
42411-76	TP130-0.1	-	11/01/06	20g Sand, Clay & Rocks	No asbestos detected
42411-77	TP130-0.5	-	11/01/06	20g Sand & Soil	No asbestos detected
42411-78	TP130-1.0	-	11/01/06	20g Sand & Soil	No asbestos detected
42411-79	TP130-2.0	-	11/01/06	20g Soil	No asbestos detected
42411-80	TP131-0.1	-	11/01/06	20g Clay	No asbestos detected
42411-84	TP132-0.1	-	11/01/06	20g Soil & Clay	No asbestos detected
42411-85	TP132-0.5	-	11/01/06	20g Soil & Plant Matter	No asbestos detected

SGS Ref —	Sample ID —	Depth	Date Sampled	Sample Description	Asbestos ID in soil
42411-88	TP133-0.1	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-89	TP133-0.5	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-92	TP134-0.1	-	11/01/06	20g Soil & Plant Matter	No asbestos detected
42411-93	TP134-0.5	-	11/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-96	TP135-0.1	-	11/01/06	20g Soil, Rocks & Plant Matter	No asbestos detected
42411-97	TP135-0.5	-	11/01/06	20g Clay	No asbestos detected
42411-99	TP135-2.0	-	11/01/06	20g Clay	No asbestos detected
42411-101	TP136-0.1	-	11/01/06	20g Soil & Rocks	No asbestos detected

Method ID	Methodology Summary
SASB-002	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques. Accreditation does not cover the identification of Synthetic Mineral Fibre.

Result Codes

[INS] : Insufficient Sample for this test
[NR] : Not Requested
[NT] : Not tested
[HBG] : Results not Reported due to High Background Interference
* : Not part of NATA Accreditation
[N/A] : Not Applicable

Result Comments

ASBESTOS NB. Even after disintegration of certain bulk samples (vinyl tiles and bituminous type materials), the detection, of fibres may be difficult when using Polarised Light Microscopy and Dispersion Staining Techniques. This may be due to the matrix of the sample (uneven distribution), or fine fibres that are difficult to detect and positively identify.

NATA Accreditation No. 2562

Quality Control Protocol

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch.
A duplicate is prepared at least every 20 samples.
Terms and conditions are available from www.au.sgs.com

✓

(5)

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Fax: 9666 1384
Attention: SGS
Phone: 9666 1428

Date Required: 5 days
Date Submitted: 13/1/2006
Page 29 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP112-2.0 1	10/1/2006	1	250ml Soil		1	N																	1:- Asbestos
TP112-3.0 2	10/1/2006	1	250ml Soil		1	N																	
TP113-0.1 3	10/1/2006	1	250ml Soil		1	N			x														
TP113-0.5 4	10/1/2006	1	250ml Soil		1	N			x														
TP113-1.0 5	10/1/2006	1	250ml Soil		1	N			x														
TP113-2.0 6	10/1/2006	1	250ml Soil		1	N																	
TP113-3.0 7	10/1/2006	1	250ml Soil		1	N																	SGS
TP114-0.1 8	10/1/2006	1	250ml Soil		1	N			x														Re... 13/01/06
TP114-0.5 9	10/1/2006	1	250ml Soil		1	N																	B...
TP114-1.0 10	10/1/2006	1	250ml Soil		1	N																	Time 10:30 am
TP114-2.0 11	10/1/2006	1	250ml Soil		1	N																	Samples intact yes
TP114-3.0 12	10/1/2006	1	250ml Soil		1	N																	Ice/Cooler Pack yes/no
TP115-0.1 13	10/1/2006	1	250ml Soil		1	N			x														...ment 1,2,11
TP115-0.5 14	10/1/2006	1	250ml Soil		1	N			x														
TP115-1.0 15	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	10/1/2006	am		[signature]	SGS	13/1/06	10:30 am	[signature]

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 94624710
Project Manager Andew Hogan/ Katherine Karlkoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Fax: 9600 1354
Attention: SGS
Phone: 9606 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 30 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP115-2.0 16	10/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP115-3.0 17	10/1/2006	1	250ml Soil		1	N			x														
TP116-0.1 18	10/1/2006	1	250ml Soil		1	N			x														
TP116-0.5 19	10/1/2006	1	250ml Soil		1	N			x														
TP116-1.0 20	10/1/2006	1	250ml Soil		1	N			x														
TP116-2.0 21	10/1/2006	1	250ml Soil		1	N																	
TP117-0.1 22	10/1/2006	1	250ml Soil		1	N			x														
TP117-0.5 23	10/1/2006	1	250ml Soil		1	N			x														
TP117-1.0 24	10/1/2006	1	250ml Soil		1	N																	
TP117-2.0 25	10/1/2006	1	250ml Soil		1	N																	
TP118-0.1 26	10/1/2006	1	250ml Soil		1	N			x														
TP118-0.5 27	10/1/2006	1	250ml Soil		1	N			x														
TP118-1.0 28	10/1/2006	1	250ml Soil		1	N																	
TP118-2.0 29	10/1/2006	1	250ml Soil		1	N																	
TP119-0.1 30	10/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY					RECEIVED BY				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	am						

RELINQUISHED BY					RECEIVED BY				
Name	Organisation	Date	Time	Signed	Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]30.115-119

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2/27 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlkoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Fax: 9666 1084
Attention: SGS
Phone: 9666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 31 of 41

SAMPLE No.		Date Sampled	No. of Containers	Container Type /Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP119-0.5	31	10/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP119-1.0	32	10/1/2006	1	250ml Soil		1	N																	
TP119-2.0	33	10/1/2006	1	250ml Soil		1	N																	
TP119-3.0	34	10/1/2006	1	250ml Soil		1	N																	
TP120-0.1	35	10/1/2006	1	250ml Soil		1	N			x														
TP120-0.5	36	10/1/2006	1	250ml Soil		1	N			x														
TP120-1.0	37	10/1/2006	1	250ml Soil		1	N																	
TP120-2.0	38	10/1/2006	1	250ml Soil		1	N																	
TP121-0.1	39	10/1/2006	1	250ml Soil		1	N			x														
TP121-0.5	40	10/1/2006	1	250ml Soil		1	N			x														
TP121-1.0	41	10/1/2006	1	250ml Soil		1	N																	
TP121-2.5	42	10/1/2006	1	250ml Soil		1	N																	
TP122-0.1	43	10/1/2006	1	250ml Soil		1	N			x														
TP122-0.5	44	10/1/2006	1	250ml Soil		1	N																	
TP122-1.0	45	10/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	pm						

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]31.119-122

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlkoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 8666 1364
Attention: SGS
Phone: 8666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 32 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP122-2.0 46	10/1/2006	1	250ml Soil		1	N			~~x~~														1. - Asbestos
TP122-3.0 47	10/1/2006	1	250ml Soil		1	N																	
TP123-0.1 48	10/1/2006	1	250ml Soil		1	N			x														
TP123-0.5 49	10/1/2006	1	250ml Soil		1	N																	
TP123-1.0 50	10/1/2006	1	250ml Soil		1	N																	
TP123-2.0 51	10/1/2006	1	250ml Soil		1	N			X	As per conversation with Katherine 13/1/06 this to replace TP122-2.0 which was not received													
TP124-0.1 52	11/1/2006	1	250ml Soil		1	N			x														
TP124-0.5 53	11/1/2006	1	250ml Soil		1	N																	
TP124-1.0 54	11/1/2006	1	250ml Soil		1	N																	
TP124-2.0 55	11/1/2006	1	250ml Soil		1	N																	
TP125-0.1 56	11/1/2006	1	250ml Soil		1	N			x														
TP125-0.5 57	11/1/2006	1	250ml Soil		1	N			x														
TP125-1.0 58	11/1/2006	1	250ml Soil		1	N																	
TP125-2.0 59	11/1/2006	1	250ml Soil		1	N			x														
TP126-0.1 60	11/1/2006	1	250ml Soil		1	N			x														

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlkoff	GHD	13/1/2006	am		SAM	SGS	13-1-06	10.30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\[COC.xls]32.122-126

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 29 008 488 373

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036 Attention: SGS
Fax: 9666 1364 Phone: 9666 1426

Date Required: 5 days
Date Submitted: 13/1/2006
Page 33 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP126-0.5 61	11/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP126-1.0 62	11/1/2006	1	250ml Soil		1	N																	
TP126-2.0 63	11/1/2006	1	250ml Soil		1	N																	
TP127-0.1 64	11/1/2006	1	250ml Soil		1	N			x														
TP127-0.5 65	11/1/2006	1	250ml Soil		1	N			x														
TP127-1.0 66	11/1/2006	1	250ml Soil		1	N			x														
TP127-2.0 67	11/1/2006	1	250ml Soil		1	N																	
TP128-0.1 68	11/1/2006	1	250ml Soil		1	N			x														
TP128-0.5 69	11/1/2006	1	250ml Soil		1	N																	
TP128-1.0 70	11/1/2006	1	250ml Soil		1	N																	
TP128-2.0 71	11/1/2006	1	250ml Soil		1	N																	
TP129-0.1 72	11/1/2006	1	250ml Soil		1	N			x														
TP129-0.5 73	11/1/2006	1	250ml Soil		1	N																	
TP129-1.0 74	11/1/2006	1	250ml Soil		1	N																	
TP129-2.0 75	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	13/1/2005	am		SAM	SGS	13-1-05	10-30	Sam

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]33.126-129

GHD

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

ABN 39 008 488 373

GHD Pty Ltd 57 Harbour Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710

Project No. 2114407 Phone No. 9462 4810
Project Name Warriewood Fax No. 9462 4710
Project Manager Andew Hogan/ Katherine Karlikoff

Sent to Lab: SGS
Address: Botany Industrial Park, Gate 3 Denison St
Matraville, NSW 2036
Fax: 8666 1364
Attention: SGS
Phone: 8666 1420

Date Required: 5 days
Date Submitted: 13/1/2006
Page 34 of 44

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	ANALYSIS REQUIRED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP130-0.1 76	11/1/2006	1	250ml Soil		1	N			x														1. - Asbestos
TP130-0.5 77	11/1/2006	1	250ml Soil		1	N			x														
TP130-1.0 78	11/1/2006	1	250ml Soil		1	N			x														
TP130-2.0 79	11/1/2006	1	250ml Soil		1	N			x														
TP131-0.1 80	11/1/2006	1	250ml Soil		1	N			x														
TP131-0.5 81	11/1/2006	1	250ml Soil		1	N																	
TP131-1.0 82	11/1/2006	1	250ml Soil		1	N																	
TP131-2.0 83	11/1/2006	1	250ml Soil		1	N																	
TP132-0.1 84	11/1/2006	1	250ml Soil		1	N			x														
TP132-0.5 85	11/1/2006	1	250ml Soil		1	N			x														
TP132-1.0 86	11/1/2006	1	250ml Soil		1	N																	
TP132-2.0 87	11/1/2006	1	250ml Soil		1	N																	
TP133-0.1 88	11/1/2006	1	250ml Soil		1	N			x														
TP133-0.5 89	11/1/2006	1	250ml Soil		1	N			x														
TP133-1.0 90	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed
Katherine Karlikoff	GHD	10/1/2006	am		Sum	SGS	13-1-06	10.30	Sam.

RELINQUISHED BY Name	Organisation	Date	Time	Signed	RECEIVED BY Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying samples numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]34,160-133

CHAIN OF CUSTODY AND ANALYSIS REQUEST FORM

GHD Pty Ltd 57 Herbert Street Artarmon NSW 2727 Australia, Locked Bag 2727 St Leonards NSW 1590 Telephone: (02) 9462 4700 Fax: (02) 9462 4710 ABN 39 008 488 373

Project No.	2114407	Phone No.	9462 4810
Project Name	Warriewood	Fax No.	9462 4710
Project Manager	Andew Hogan/ Katharine Karlikoff		

Sent to Lab:	SGS
Address:	Botany Industrial Park, Gate 3 Denison St, Matraville, NSW 2036
Fax:	8666 1304
Attention:	SGS
Phone:	9566 1426
Date Required:	5 days
Date Submitted:	13/1/2006
Page	35 of 41

SAMPLE No.	Date Sampled	No. of Containers	Container Type/Size	MATRIX Water	MATRIX Soil	PRESERVATION Chill	PRESERVATION Acid	PRESERVATION Other	1	2	3	4	5	6	7	8	9	10	11	12	13	14	COMMENTS
TP133-2.0 91	11/1/2006	1	250ml Soil		1	N																	1. - Asbestos
TP134-0.1 92	11/1/2006	1	250ml Soil		1	N			x														
TP134-0.5 93	11/1/2006	1	250ml Soil		1	N			x														
TP134-1.0 94	11/1/2006	1	250ml Soil		1	N																	
TP134-2.0 95	11/1/2006	1	250ml Soil		1	N																	
TP135-0.1 96	11/1/2006	1	250ml Soil		1	N			x														
TP135-0.5 97	11/1/2006	1	250ml Soil		1	N			x														
TP135-1.0 98	11/1/2006	1	250ml Soil		1	N																	
TP135-2.0 99	11/1/2006	1	250ml Soil		1	N			x														
TP135-3.0 100	11/1/2006	1	250ml Soil		1	N																	
TP136-0.1 101	11/1/2006	1	250ml Soil		1	N			x														
TP136-0.5 102	11/1/2006	1	250ml Soil		1	N																	
TP136-1.0 103	11/1/2006	1	250ml Soil		1	N																	
TP136-2.0 104	11/1/2006	1	250ml Soil		1	N																	
TP136-3.0 105	11/1/2006	1	250ml Soil		1	N																	

RELINQUISHED BY

Name	Organisation	Date	Time	Signed
Katharine Karlikoff	GHD	13/1/2006	am	

RECEIVED BY

Name	Organisation	Date	Time	Signed
SAM	SGS	13-1-06	10.30	Sam

RELINQUISHED BY

Name	Organisation	Date	Time	Signed

RECEIVED BY

Name	Organisation	Date	Time	Signed

It is the responsibility of the receiver to verify that the number of samples and their identifying sample numbers correspond to those listed on this form

PLEASE FAXED COMPLETED FORM TO GHD PROJECT MANAGER ON RECEIPT (02) 9462 4710

FILE REF.: G:\Projects\21\14407 - Warriewood Asbestos\COC.xls]35.133-136

SGS

19 January 2006

TEST REPORT

GHD (Sydney) Pty Ltd
57-63 Herbert Street
ARTARMON
NSW 2064

Your Reference: 2114407, Warriewood
Report Number: 42412

Attention: Andrew Hogan

Dear Andrew

The following samples were received from you on the date indicated.

Samples:	Qty.	93 Soil Samples
Date of Receipt of Samples:		13/01/06
Date of Receipt of Instructions:		13/01/06
Date Preliminary Report Faxed:		Not Issued

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.
Samples with id TP118-2.0, TP 122-1.0 and TP 122-2.0 were not received at SGS.
Yours faithfully
SGS ENVIRONMENTAL SERVICES

Edward Ibrahim
Approved Signatory

NATA
WORLD RECOGNISED ACCREDITATION

NATA Endorsed Test Report
This document may not be reproduced except in full
NATA Accredited laboratory No. 2562 (4354)

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Botany Industrial Park Gate 3, Denison Street, Matraville 2036 NSW Australia
t +61 (0)2 9666 1426 f +61 (0)2 9666 1364 url www.sgs.com

Pittwater Council

ABN 61 340 837 871 **Telephone** (02) 9970 1111 **Facsimile** (02) 9970 7150
Postal Address: P.O. Box 882, Mona Vale NSW 1660, DX 9018 Mona Vale

pittwaterlga.com.au **e-mail:** pittwater_council@pittwater.nsw.gov.au

Andrew Pigott, Acting Project Manager (Land Release Projects)
8am to 5pm Mon - Fri
Phone 9970 1163 Mobile 0418 443 167

15 June 2007

Anglican Retirement Villages
PO Box 284
CASTLE HILL NSW 1765

Attention: Peter Paltoo

Re: DA N0102/05 - 6-14 MacPherson Street, Warriewood

I refer to the Development Application at the above mentioned site. The documentation referenced below is now considered to satisfy the requirements of Condition C32.

- Construction Process Plan of Management, Dated: 8 June 2007, Ref: 1236-002-01, Prepared by: Connell Wagner Pty Ltd
- Construction Noise Impact Statement, Dated: 14/6/07, Ref: 2k7422/0605A/R1/MC, Prepared by: Acoustic Logic Consultancy

Should you have any questions in relation to the above, please do not hesitate to contact me.

Yours faithfully

Lindsay Dyce
Manager Planning & Assessment

cc. Richard Abbott – Morgan Moore & Associates

STEVE WATSON & PARTNERS

BUILDING REGULATIONS CONSULTANTS AND CERTIFIERS
FIRE SAFETY ENGINEERS

LEVEL 5, 432 KENT STREET, SYDNEY NSW 2000
TEL +61 2 9283 6555 | FAX +61 2 9283 8500
sydney@swpartners.com.au
www.swpartners.com.au
ABN 48 102 366 576

APPLICATION FOR CONSTRUCTION CERTIFICATE

PART 1 Application and Site Details

Applicant

It is important that we are able to contact you if we need more information.

Please give us as much detail as possible.

Mr ☑ Mrs ☐ Miss ☐ Ms ☐ Other ☐

Surname (or Company): MORGAN MOORE & ASSOCIATES

Given names (or ABN): RICHARD ABBOTT

Address: LEVEL 5, 140 ARTHUR STREET NORTH SYDNEY

State: NSW Post Code: 2060

Phone: (02) 9957-6188 Fax: (02) 9957-3043

Mobile: 0411-252-777 E-mail: richard@morganmoore.com.au

Please ensure you sign the declaration in Part 3 of this application

Owner's Consent

Every owner of the land must sign this form.

If the owner is a company, an authorised director must sign the form.

Where the works are being carried out in a strata titled building the consent of the Body Corporate must be provided.

Surname (or Company): ANGLICAN RETIREMENT VILLAGES

Given names (or ABN):

Address: 62 NORWEST BOULEVARD, BAULKHAM HILLS

State: NSW Post Code: 2153

Phone: (02) 9421-5429 Fax: (02) 9421-2223

Mobile: E-mail:

As owner of the land to which this application relates, I consent to this application. I also consent for SWP staff to enter the land to carry out inspections relating to this application.

Signature(s): [signature] Date: 4/5/07

Without the owner's consent, we will not accept the application. This is a very strict requirement for all applications. If you are signing on the owner's behalf as the owner's legal representative, you must state the nature of your legal authority and attach documentary evidence (eg. Power of attorney, executor, trustee, company director, etc.

Location of the Property

We need this to correctly identify the land.

Address: 6-14 MACPHERSON ST, WARRIEWOOD NSW

Post Code: 2102

Real Property Description: (eg. Lot/DP/Section, etc)

Lot B DP 400488 Lot B DP 358765
Lot A DP 400488 Lot A DP 358765
Lot 22 DP 5464

The real property description is mandatory, these details are shown on your rate notices, property deeds etc

RECEIVED
18 MAY 2007
STEVE WATSON & PARTNERS

PART 2 Work Description

Description of Work *Please describe briefly everything that you want approved.*	Building Work BULK EXCAVATION + CONTAMINATION REMEDIATION + PRELIMINARY SITE STORMWATER WORKS (NOT INCLUDING WORKS WITHIN 40m OF THE BANK OF NARRABEEN CREEK)
Estimated Cost of Work *(inclusive of GST)*	$ 1'000'000.00
Development Consent	Development Consent No: NO 102/05 Date of Determination: 6 / 4 / 06
Building Code of Australia Classification	BCA Classification: 2 + 7A
Principal Contractors Details *Required for all projects*	Name: TBA Address: Contact Number:

PART 3 Declaration

ALL THE DETAILS SOUGHT IN THE CHECKLIST IN PART 5 MUST BE PROVIDED.

THE COMPLETED CHECKLIST MUST BE SUBMITTED WITH THIS APPLICATION. FAILURE TO PROVIDE THE REQUIRED DOCUMENTATION OF AN ACCEPTABLE STANDARD WILL RESULT IN YOUR APPLICATION BEING RETURNED.

Declaration *If the applicant is a company or strata title body corporate, a director or authorised delegate must sign this declaration.*	I apply for approval to carry out the development or works described in this application. I declare that all the information in the application and checklist is, to the best of my knowledge, true and correct. I also understand that if the information is incomplete the application may be delayed or rejected or more information may be requested. I acknowledge that if the information provided is misleading any approval granted 'may be void'. Signature ______ Date: 25 / 4 / 07

RECEIVED
18 MAY 2007
STEVE WATSON & PARTNERS

PART 4 Schedule to Application for a Construction Certificate

Please complete this schedule. The information will be sent to the Australian Bureau of Statistics.

All new buildings

Please complete the following:

- Number of storeys (including underground floors) — N/A
- Gross floor area of new building (m^2) — N/A
- Gross site area (m^2) — N/A

Residential buildings only

Please complete the following details on residential structures:

- Number of dwellings to be constructed — N/A
- Number of pre-existing dwellings on site — N/A
- Number of dwellings to be demolished — N/A
- Will the new dwelling(s) be attached to other new buildings? Yes ☐ No ☐
- Will the new building(s) be attached to existing buildings? Yes ☐ No ☐
- Does the site contain a dual occupancy? (NB dual occupancy = two dwellings on the same site) Yes ☐ No ☐

Materials – residential buildings

Please indicate the materials to be used in the construction of the new building(s):

Walls	Code	Roof	Code	Floor	Code	Frame	Code
Brick (double)	☐ 11	Tiles	☐ 10	Concrete or slate	☐ 20	Timber	☐ 40
Brick (veneer)	☐ 12	Concrete or slate	☐ 20	Timber	☐ 40	Steel	☐ 60
Concrete or stone	☐ 20	Fibre cement	☐ 30	Other	☐ 80	Aluminium	☐ 70
Fibre cement	☐ 30	Steel	☐ 60	Not specified	☐ 90	Other	☐ 80
Timber	☐ 40	Aluminium	☐ 70			Not specified	☐ 90
Curtain glass	☐ 50	Other	☐ 80				
Steel	☐ 60	Not specified	☐ 90				
Aluminium	☐ 70						
Other	☐ 80						
Not specified	☐ 90						

PART 5 Checklist

Where relevant, have you provided/completed the following:	Yes	Not Relevant
• 4 copies of plans, elevations and sections	☐	☐
• 4 copies of specifications	☐	☐
• List of any existing and proposed fire safety measures (Refer to the Fire Safety Schedule)	☐	☐
• Evidence of Home Building Act requirements satisfied	☐	☐
• Evidence that Long Service Levy has been paid	☐	☐
• Schedule to application for a construction certificate is completed	☐	-
• Owners consent	☐	-
• Applicants signature	☐	-

PART 6 Notes for Completing Application for a Construction Certificate

The following information must accompany applications for a Construction Certificate for Building Work

1. The ABS schedule is required to be completed for the purposes of providing information to the Australian Bureau of Statistics.
2. Copies of compliance certificates relied upon.
3. Four (4) copies of all plans and specifications must be submitted with your application. Plans for the building must be drawn to a suitable scale and consist of a general plan and a block plan. The general plan of the building is to:
   a) Show a plan of each floor section.
   b) Show a plan of each elevation.
   c) Show the levels of the lowest floor and of any yard or unbuilt on area belonging to that floor and the levels of the adjacent ground.
   d) Indicate the height, design, construction and provisions for fire safety and fire resistance.
4. Where proposed building work involves any alteration or addition to, or rebuilding of, an existing building the plan is to be coloured or otherwise marked to distinguish the prosed work to be approved.
5. Where the proposed building work involves a modification to previously approved plans and specifications the general plans must be coloured or marked up to adequately distinguish the modifications.
6. The specification is:
   a) To describe the construction and materials of which the building is to be built and the method of drainage, sewerage and water supply.
   b) State whether the materials proposed to be used are new or second hand and give particulars of any second hand materials used.
7. Where the application involves an alternative solution to meet the Performance Requirements of the BCA, the application must also be accompanied by:
   a) Details of the Performance Requirements that the alternative solution is intended to meet, and

   Details of the assessment methods used to establish compliance with those Performance Requirements.
8. Evidence of any accredited component, process or design sought to be relied upon.
9. Except in the case of any application for, or in the respect of, a class 1a or class 10 building:
   a) A list of any fire safety measures that are proposed to be implemented in the building or on the land on which the building is situated.
   b) If the application relates to a proposal to carry out any alteration or rebuilding of, or addition to, an existing building, a separate list of such of those measures as are currently implemented in the building or on the land on which the building is situated.

   The list must describe the extent, capability and basis of design of each of the measures concerned.
10. The Development Consent conditions together with stamped approved DA drawings are to be provided for our assessment of the development and record purposes.
11. Under section 109F(1)(b) of the *Environmental Planning and Assessment Act 1979* a Construction Certificate cannot be issued until any long service levy payable under section 34 of the *Building and Construction Industry Long Service Payments Act 1986* (or where such a levy is payable by instalments, the first instalment of the levy) has been paid. The local council may be authorised to accept payment.
12. In the case of an application for a Construction Certificate for residential building work (within the meaning of the Home Building Act 1989) attach the following:
   a) In the case of work performed by a licensee under that Act:
      i) A statement detailing the licensee's name and contract licence number, and
      ii) documentary evidence that the licensee has complied with the applicable requirements of that Act*, or
   b) in the case of work done by an y other person:
      i) a statement detailing the persons name and owner-builder permit number, or
      ii) a declaration signed by the owner of the land, to the effect that the reasonable market cost of the labour and materials involved in the work is less than the amount prescribed for the purposes of the definition of owner-builder work in section 29 of that Act. *(If the building work is less than $12,000 provide a statement that states the proposed work is less than $12,000)*

   * A certificate purporting to be issued by an approved insurer under Part 6 of the Home Building Act 1989 to the effect that a person is the holder of an insurance contract issued for the purposes of that Part, is sufficient evidence that the person has complied with the requirements of that Part.

Pittwater Council

OFFICIAL RECEIPT

15/05/2007 Receipt No 215330

To anglican retirement villages

6-14 mcpherson street
warriewood nsw 2102

Applic	Reference	Amount
GL Re	SWBF-S94 1 x n0102/05	$33,277.91
GL Re	SWCF-S94 1 x n0102/05	$705,499.58
GL Re	SWCL-S94 1 x n0102/05	$105,169.97
GL Re	SWCW-S94 1 x n0102/05	$744,182.29
GL Re	SWLS-S94 1 x n0102/05	$145,802.63
GL Re	SWPC-S94 1 x n0102/05	$664,371.90
GL Re	SWPM-S94 1 x n0102/05	$233,409.15
GL Re	SWPR-S94 1 x n0102/05	$1,509,579.60
GL Re	SWTT-S94 1 x n0102/05	$475,703.22

Total: $4,616,996.25

Amounts Tendered

Cash	$0.00
Cheque	$4,616,996.25
Db/Cr Card	$0.00
Money Order	$0.00
Agency Rec	$0.00
Total	$4,616,996.25
Rounding	$0.00
Change	$0.00
Nett	$4,616,996.25

Printed 15/05/2007 1:37:42

Cashier NCulli

Section 94 Contribution Breakdown (Warriewood Valley)

NOTE: - PLEASE ENSURE THAT PAYMENT IS SUBMITTED TO CASHIER WITH THIS FORM

DA Consent No.: N0102/05 (For Receipt Description)

Consent Date:

DA Consent Description: SEPP SENIORS LIVING DEVELOPMENT

Property Address: 6-14 MACPHERSON STREET, WARRIEWOOD (For Receipt Description)

S94 Subset	Contribution Amount	Cashier Code	Account No.	Responsible Business Unit
Traffic and Transport	$ 475,703.22	SWTT	91310C1210000	Urban Infrastructure
Creekline corridor (works)	$ 744,182.29	SWCW	91317C1210000	Urban Infrastructure
Creekline corridor (land)	$ 105,169.97	SWCL	91303C1210000	Urban Infrastructure
Community Facilities	$ 705,499.58	SWCF	91316C1210000	Community & Library Services
Public Recreation	$ 1,509,579.60	SWPR	91312C1210000	Reserves & Recreation
Pedestrian Cycleway	$ 664,371.90	SWPC	91311C1210000	Reserves & Recreation
Bushfire	$ 33,277.91	SWBF	91314C1210000	Natural Resources
Library Services	$ 145,802.63	SWLS	91315C1210000	Community & Library Services
Ponderosa Parade	$	SWVP	91250C1210000	Urban Infrastructure
Plan Management	$ 233,409.15	SWPM	91318C2210000	
Total Payment	$4,616,996.25			

To be completed by Cashier	
Date Paid:	15.5.07
Receipt Number:	215330.

NOTE TO CASHIER: - *PLEASE SEND COMPLETED FORM AND A COPY OF THE RECEIPT TO PROJECT LEADER WARRIEWOOD INFRASTRUCTURE*

LONG SERVICE
BUILDING & CONSTRUCTION

See reverse of form for instructions

LEVY PAYMENT FORM

FORM NO.
OFFICE USE ONLY

PART A – DETAILS OF PERSON/COMPANY/ORGANISATION LIABLE TO PAY LEVY

PLEASE PRINT ALL DETAILS USING CAPITALS

Surname (if person) or Company/Organisation name: ANGLICAN RETIREMENT

Given names (if person): VILLAGES

ABN (if applicable):

POSTAL ADDRESS No. and street or PO Box: 62 NORWEST BOULEVARD

Town/suburb: BAUKKHAM HILLS

State: NSW Postcode: 2153 Bus. hours phone: 94215429

PART B – ADDRESS OF BUILDING/CONSTRUCTION WORK

Number and street: 6-19 MACPHERSON ST

Town/suburb: WARRIEWOOD

State: NSW Postcode: 2102

Estimated start date D 19 M 06 Y 2007 Estimated finish date D M Y

PART C – DETAILS OF WORK – To be completed by consenting/certifying authority with whom plans lodged for approval

Local Council Area: PITTWATER

[1] DA/~~CC/CDC~~ No.: N0102/05

Estimated value of work (see note on back) $ 1,000,000,——. Levy payable $ 3,500.

[1] If you have provided a CC above, please provide ~~DA~~ CC number here 05/307/01

Signature of Officer/Pri~~vate Certifier~~ [signature] Date D 18 M 06 Y 2007

Name of Officer/P~~rivate Certi~~fier Andrew R/S Business hours phone 0292836555

PART D – DETAILS – To be completed by Dept/Authority where applicable – see reverse

Department/Authority

Contract/DA No (circle which) Contract amount $, , , .

Levy payable $, , .

Contact person (Print) Phone number

Contact person (Signature) Date D M Y

PART E – DECLARATION – To be signed by person liable to pay levy or authorised officer if company/organisation

Any false or misleading information provided on this form may result in prosecution under Section 58A.
I hereby declare that the information provided on this form is true and correct to the best of my knowledge

Name [signature] Signature [signature] Date D 18 M 06 Y 2007

PART F – TO BE COMPLETED WHERE APPLICABLE – SEE REVERSE

Exemption Approval Certificate No.

Building and Construction Industry Long Service Payments Corporation, Locked Bag 3000, Central Coast MC NSW 2252
Tel: 13 14 41 Fax: (02) 9287 5685 Email: levy@lspc.nsw.gov.au www.lspc.nsw.gov.au ABN 93 646 090 808

ANGLICAN RETIREMENT VILLAGES DIOCESE OF SYDNEY
LEVEL 2,CENTURY CORP. CENTRE, 62 NORWEST BOULEVARD BAULKHAM HILLS, N.S.W. 2153

Westpac Westpac Banking Corporation
CASTLE HILL, 283 OLD NORTHERN ROAD, NSW

130260

DATE 10/05/07

PAY THE SUM OF DOLLARS

Millions	Hundreds of Thousands	Tens of Thousands	Thousands	Hundreds	Tens	Units	Cents
ZERO	ZERO	ZERO	THREE	FIVE	ZERO	ZERO	00

$ ******3,500.00

PAY TO THE ORDER OF

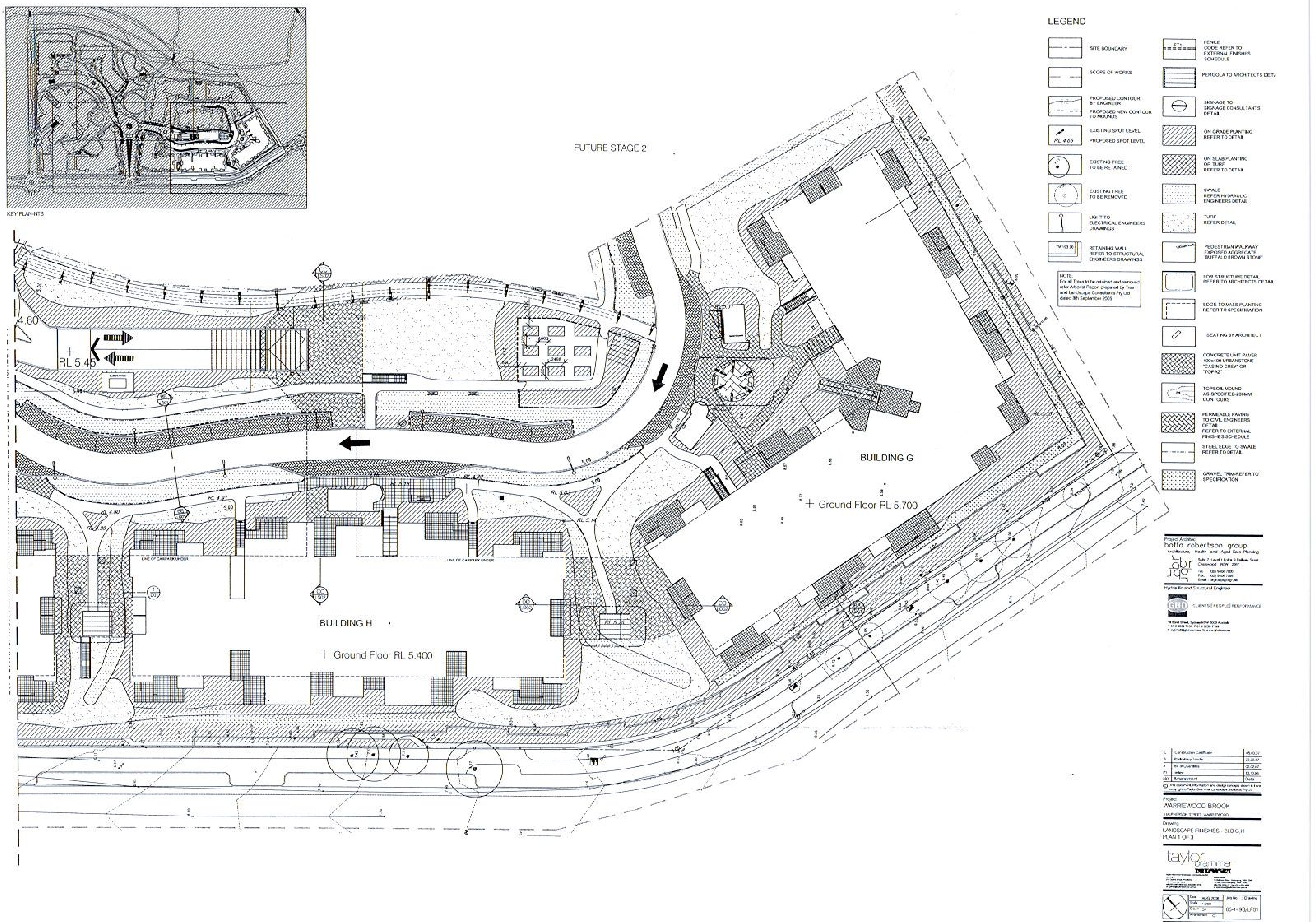
BUILDING & CONSTRUCTION INDUSTY
LONG SERVICE PAYMENTS CORPORATION

NOT NEGOTIABLE

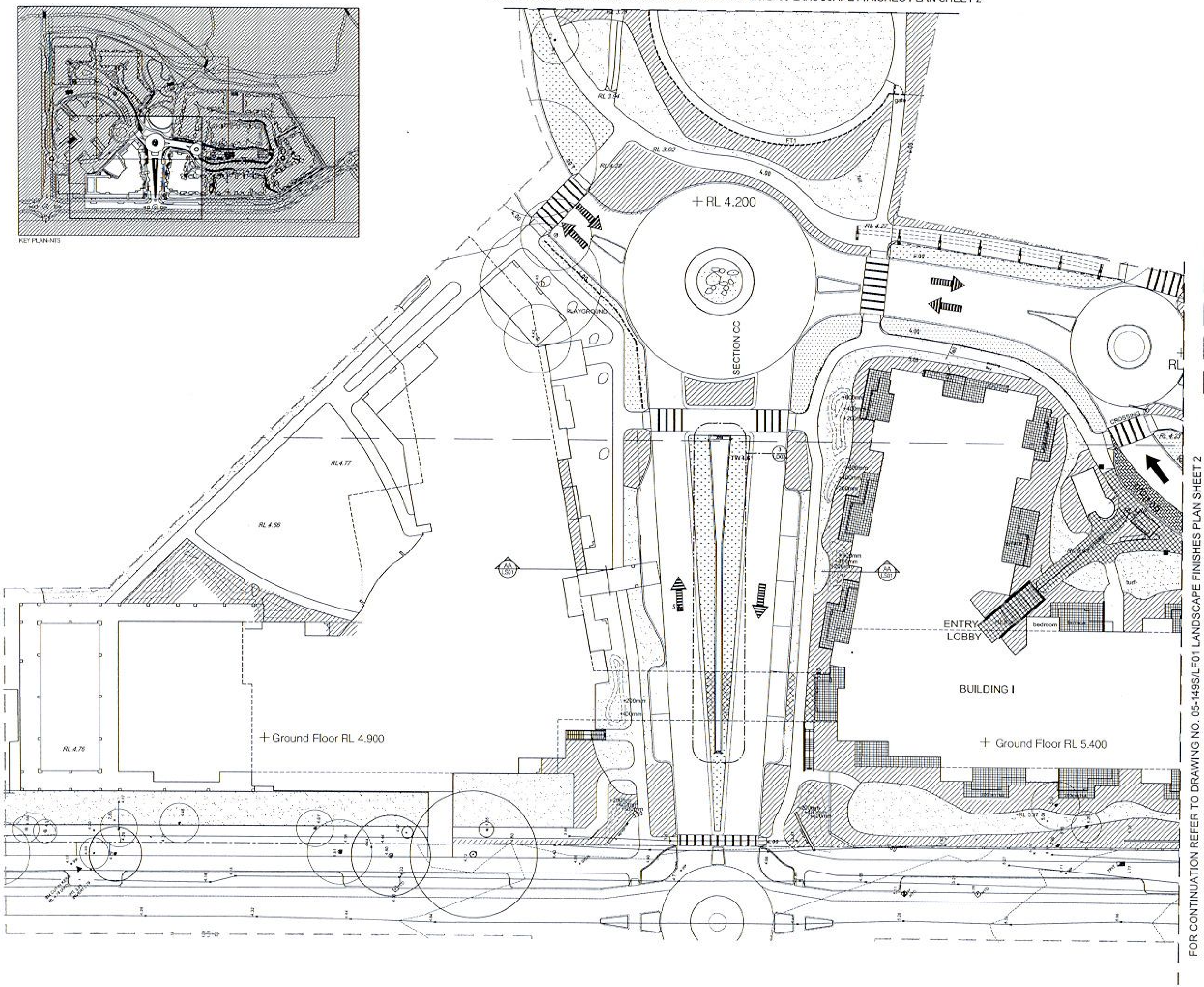
For and on behalf of ANGLICAN RETIREMENT VILLAGES / WORKING ACCOUNT

Security feature included in this cheque is a microprinted signature line, the absence of which could indicate a fraudulent cheque.

⑈130260⑈ 032⑉173⑆ 00⑉0005⑈


KEY PLAN-NTS
FUTURE STAGE 2
BUILDING G
+ Ground Floor RL 5.700
BUILDING H
+ Ground Floor RL 5.400
RL 5.45
4.60
LINE OF CARPARK UNDER
LEGEND
SITE BOUNDARY
SCOPE OF WORKS
PROPOSED CONTOUR BY ENGINEER
PROPOSED NEW CONTOUR TO MOUNDS
EXISTING SPOT LEVEL
PROPOSED SPOT LEVEL
EXISTING TREE TO BE RETAINED
EXISTING TREE TO BE REMOVED
LIGHT TO ELECTRICAL ENGINEERS DRAWINGS
RETAINING WALL REFER TO STRUCTURAL ENGINEERS DRAWINGS
NOTE: For all Trees to be retained and removed refer Arborist Report prepared by Tree and Landscape Consultants Pty Ltd dated 8th September 2005
FENCE CODE REFER TO EXTERNAL FINISHES SCHEDULE
PERGOLA TO ARCHITECTS DET.
SIGNAGE TO SIGNAGE CONSULTANTS DETAIL
ON GRADE PLANTING REFER TO DETAIL
ON SLAB PLANTING OR TURF REFER TO DETAIL
SWALE REFER HYDRAULIC ENGINEERS DETAIL
TURF REFER DETAIL
PEDESTRIAN WALKWAY EXPOSED AGGREGATE 'BUFFALO BROWN STONE'
FOR STRUCTURE DETAIL REFER TO ARCHITECTS DETAIL
EDGE TO MASS PLANTING REFER TO SPECIFICATION
SEATING BY ARCHITECT
CONCRETE UNIT PAVER 400x400 URBANSTONE "CASINO GREY" OR "TOPAZ"
TOPSOIL MOUND AS SPECIFIED-200MM CONTOURS
PERMEABLE PAVING TO CIVIL ENGINEERS DETAIL REFER TO EXTERNAL FINISHES SCHEDULE
STEEL EDGE TO SWALE REFER TO DETAIL
GRAVEL TRIM-REFER TO SPECIFICATION
Project Architect
boffa robertson group
Architecture, Health and Aged Care Planning
Hydraulic and Structural Engineer
GHD
CLIENTS | PEOPLE | PERFORMANCE
C Construction Certificate
B Preliminary Tender
A Bill of Quantities
P1 review
No. Amendment Date
Project
WARRIEWOOD BROOK
MACPHERSON STREET, WARRIEWOOD
Drawing
LANDSCAPE FINISHES - BLD G,H
PLAN 1 OF 3
taylor brammer
Date AUG 2006
Job No. : Drawing
05-149S/LF01
Amendment C

FOR CONTINUATION REFER TO DRAWING NO. 05-149S/LF03 LANDSCAPE FINISHES PLAN SHEET 2



FOR CONTINUATION REFER TO DRAWING NO. 05-149S/LF01 LANDSCAPE FINISHES PLAN SHEET 2

LEGEND

- SITE BOUNDARY
- SCOPE OF WORKS
- PROPOSED CONTOUR BY ENGINEER / PROPOSED NEW CONTOUR TO MOUNDS
- EXISTING SPOT LEVEL / PROPOSED SPOT LEVEL (RL 4.66)
- EXISTING TREE TO BE RETAINED
- EXISTING TREE TO BE REMOVED
- LIGHT TO ELECTRICAL ENGINEERS DRAWINGS
- RETAINING WALL REFER TO STRUCTURAL ENGINEERS DRAWINGS
- CONCRETE UNIT PAVER 400x400 URBANSTONE "CASINO GREY" OR "TOPAZ"
- TOPSOIL MOUND AS SPECIFIED-200MM CONTOURS
- PERMEABLE PAVING TO CIVIL ENGINEERS DETAIL REFER TO EXTERNAL FINISHES SCHEDULE
- STEEL EDGE TO SWALE REFER TO DETAIL
- GRAVEL TRIM-REFER TO SPECIFICATION
- FT1 FENCE CODE REFER TO EXTERNAL FINISHES SCHEDULE
- PERGOLA TO ARCHITECTS DETAIL
- SIGNAGE TO SIGNAGE CONSULTANTS DETAIL
- ON GRADE PLANTING REFER TO DETAIL
- ON SLAB PLANTING OR TURF REFER TO DETAIL
- SWALE REFER HYDRAULIC ENGINEERS DETAIL
- TURF REFER DETAIL
- PEDESTRIAN WALKWAY EXPOSED AGGREGATE 'BUFFALO BROWN STONE'
- FOR STRUCTURE DETAIL REFER TO ARCHITECTS DETAIL
- EDGE TO MASS PLANTING REFER TO SPECIFICATION
- SEATING BY ARCHITECT

NOTE:
For all Trees to be retained and removed refer Arborist Report prepared by Tree and Landscape Consultants Pty Ltd dated 6th September 2005

Project Architect
boffa robertson group
Architecture, Health and Aged Care Planning
Suite 7, Level 1 Cplx, 9 Railway Street Chatswood NSW 2067
Tel. (02) 9408 1000
Fax. (02) 9408 1000

Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

Electrical Engineer

No.	Amendment	Date
C	Construction Certificate	25.03.07
B	Preliminary Tender	23.02.07
A	Bill of Quantities	02.02.07
P1	Infotex	10.10.06

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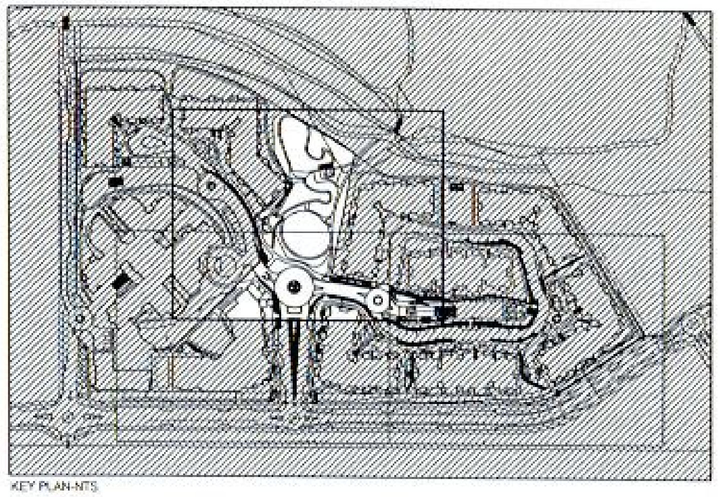
Project
WARRIEWOOD BROOK
8 MCPHERSON STREET, WARRIEWOOD

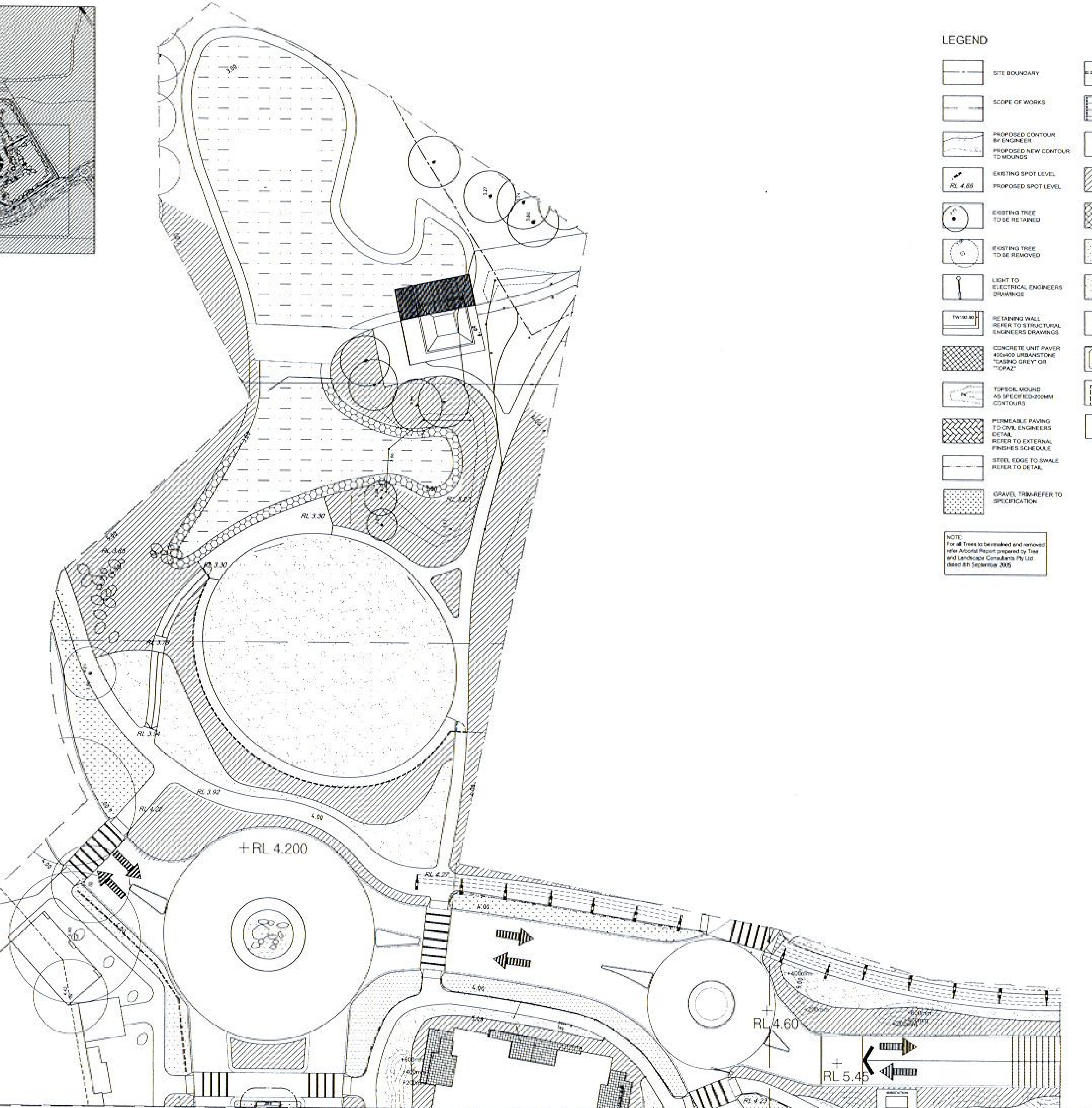
Drawing
LANDSCAPE FINISHES - BLD I

taylor brammer

Date AUG 2006
Scale 1:200
Drawn DP
Job No. : Drawing 05-149S/LF02



KEY PLAN-NTS



FOR CONTINUATION REFER TO DRAWING NO. 05-149S/LF01/LF02 LANDSCAPE FINISHES PLAN SHEET 2

LEGEND

- SITE BOUNDARY
- SCOPE OF WORKS
- PROPOSED CONTOUR BY ENGINEER
- PROPOSED NEW CONTOUR TO MOUNDS
- EXISTING SPOT LEVEL (RL 4.65)
- PROPOSED SPOT LEVEL
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- ON GRADE PLANTING REFER TO DETAIL
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Project Architect
baffa robertson group
Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

Electrical Engineer

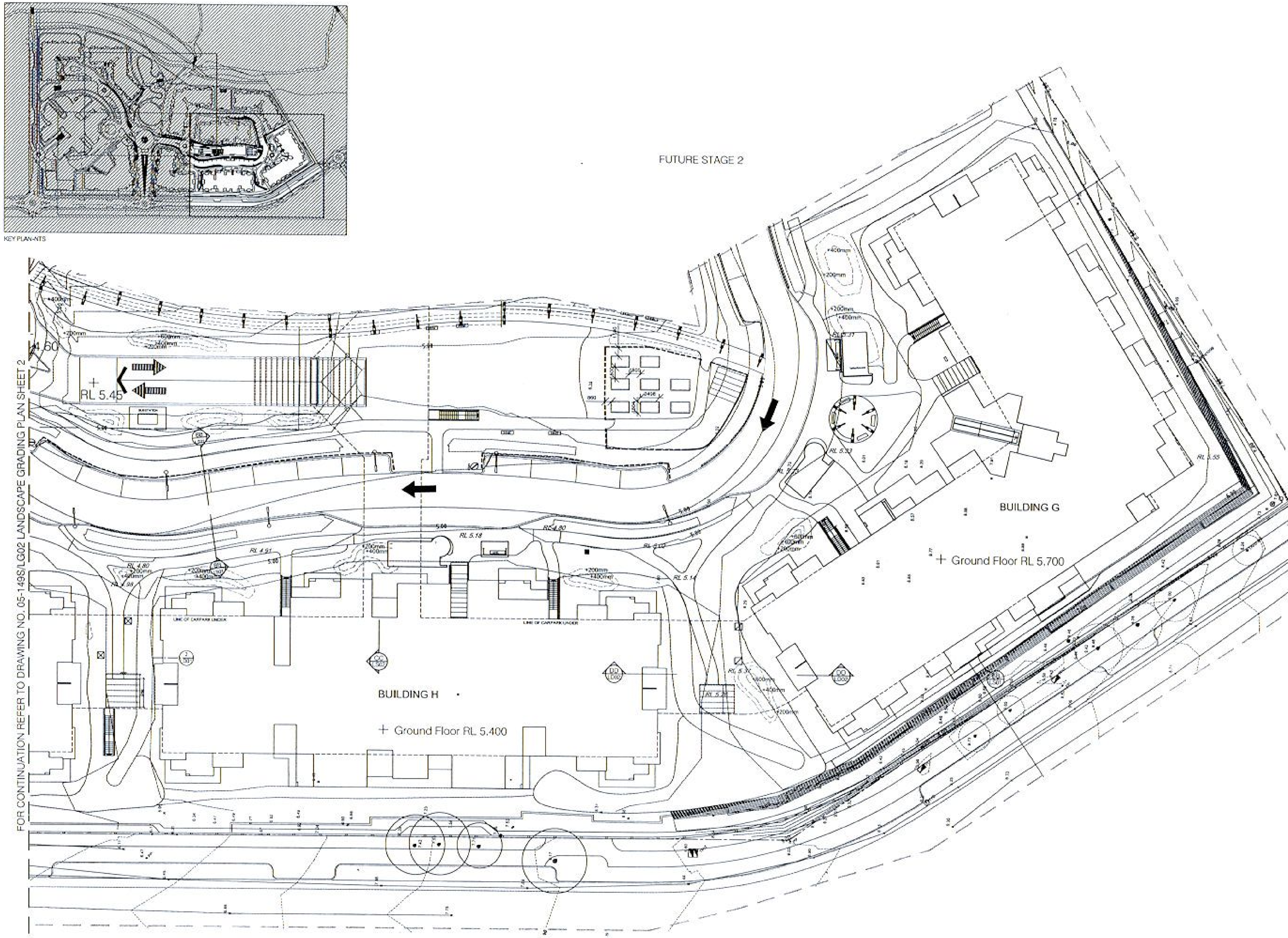
No.	Amendment	Date
C	Construction Certificate	[illegible]
B	Preliminary Tender	[illegible]
A	Bill of Quantities	[illegible]
P1	review	[illegible]

Project
WARRIEWOOD BROOK
6 McPHERSON STREET, WARRIEWOOD

Drawing
LANDSCAPE FINISHES - LAKE
PLAN 3 OF 12

taylor brammer

Date	AUG 2006	Job No.	Drawing
Scale	1:200		05-149S/LF03
Drawn	DP		
Amendment	C		



LEGEND

SITE BOUNDARY

SCOPE OF WORKS

PROPOSED CONTOUR BY ENGINEER

PROPOSED NEW CONTOUR TO MOUNDS

EXISTING SPOT LEVEL

RL 4.66 PROPOSED SPOT LEVEL

EXISTING TREE TO BE RETAINED

EXISTING TREE TO BE REMOVED

NOTE:
For all Trees to be retained and removed refer Arborist Report prepared by Tree and Landscape Consultants Pty Ltd dated 8th September 2005

Project Architect
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Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

No.	Amendment	Date
C	Construction Certificate	05.03.07
B	Preliminary Tender	21.02.07
A	Bill of Quantities	02.02.07
P1	review	18.12.06

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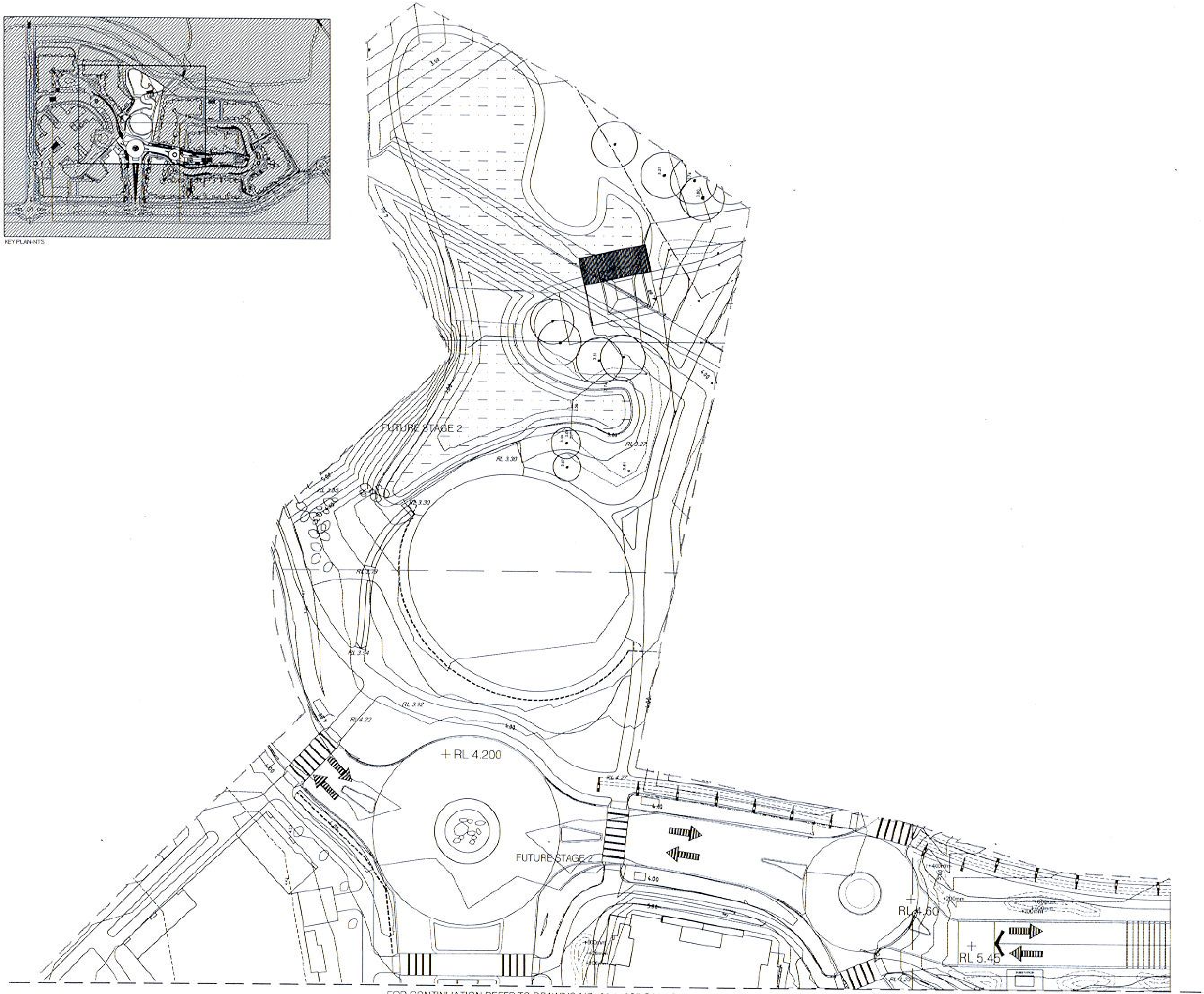
Project
WARRIEWOOD BROOK
MACPHERSON STREET, WARRIEWOOD

Drawing
LANDSCAPE GRADING & SETOUT

taylor brammer

Date	AUG 2006	Job No. Drawing
Scale	1:200	05-149S/LG01
Drawn	CP	
Amendment	C	



FOR CONTINUATION REFER TO DRAWING NO. 05-149S/LG02/LG02 LANDSCAPE GRADING PLAN SHEET 2

LEGEND

- SITE BOUNDARY
- SCOPE OF WORKS
- PROPOSED CONTOUR BY ENGINEER
- PROPOSED NEW CONTOUR TO MOUNDS
- EXISTING SPOT LEVEL
- RL 4.66 PROPOSED SPOT LEVEL
- EXISTING TREE TO BE RETAINED
- EXISTING TREE TO BE REMOVED

NOTE
For all Trees to be retained and removed refer Arborist Report prepared by Tree and Landscape Consultants Pty Ltd dated 6th September 2005

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No.	Amendment	Date
C	Construction Certificate	26.03.07
B	Preliminary Tender	21.03.07
A	Bill of Quantities	02.02.07
P1	Review	10.10.06

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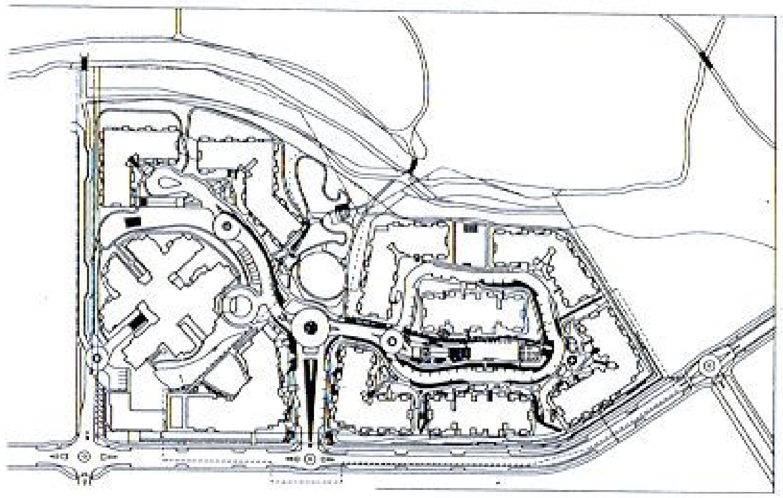
Project
WARRIEWOOD BROOK
8 McPHERSON STREET, WARRIEWOOD

Drawing
LANDSCAPE GRADING & SETOUT

taylor brammer

Date	AUG 2006	Job No. : Drawing
Scale	1:200	05-149S/LG03
Drawn	pr	
Amendment	C	

WARRIEWOOD BROOK

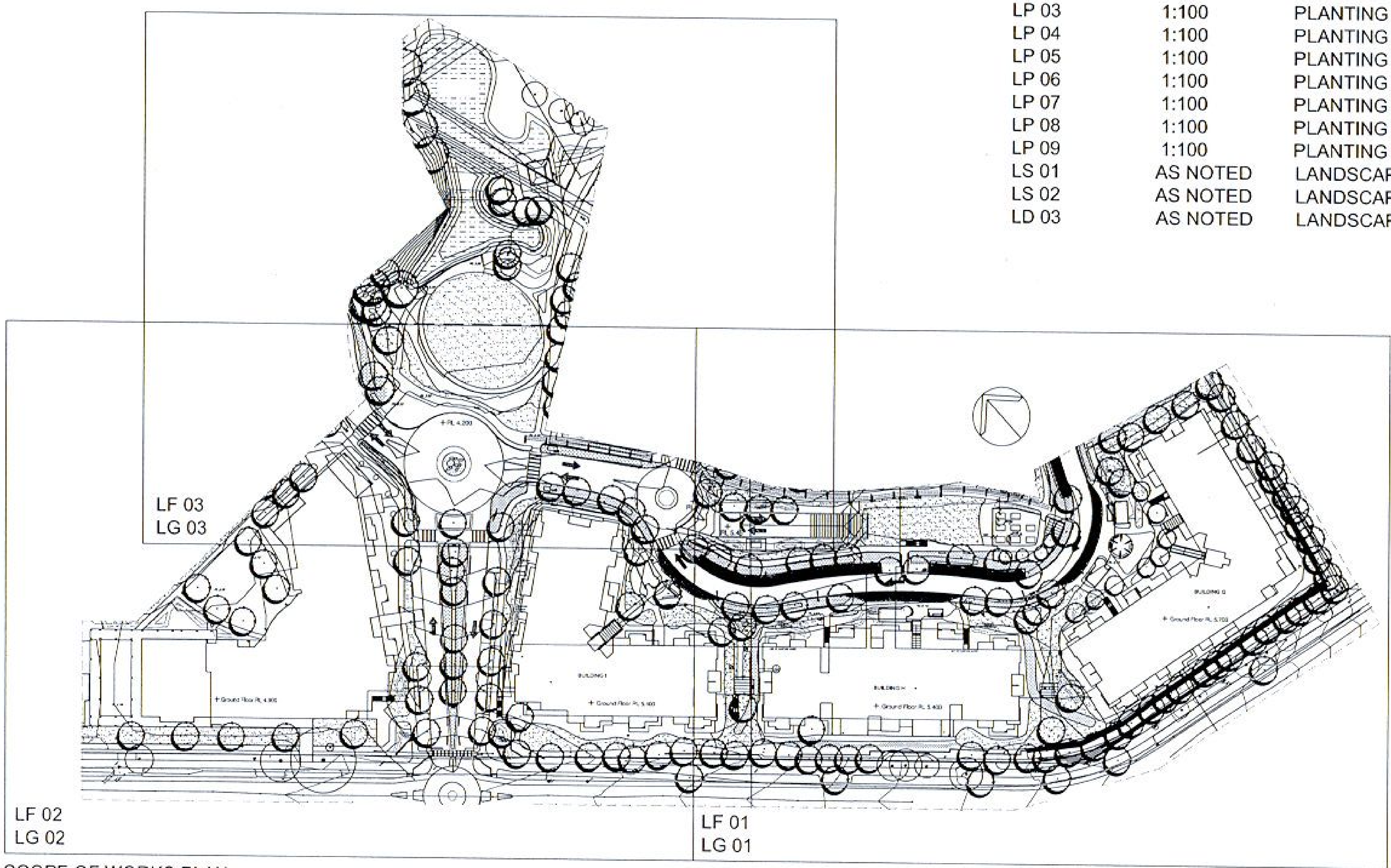


LOCALITY PLAN

STAGE 1

DRAWING REGISTER

DRAWING NO.	SCALE	DRAWING TITLES
LG 01	1:200	LANDSCAPE GRADING & SETOUT
LG 02	1:200	LANDSCAPE GRADING & SETOUT
LG 03	1:200	LANDSCAPE GRADING & SETOUT
LF 01	1:200	LANDSCAPE FINISHES - BLD H, G
LF02	1:200	LANDSCAPE FINISHES - BLD I
LF03	1:200	LANDSCAPE FINISHES - LAKE
LP 01	1:100	PLANTING PLAN 1 OF 9
LP 02	1:100	PLANTING PLAN 2 OF 9
LP 03	1:100	PLANTING PLAN 3 OF 9
LP 04	1:100	PLANTING PLAN 4 OF 9
LP 05	1:100	PLANTING PLAN 5 OF 9
LP 06	1:100	PLANTING PLAN 6 OF 9
LP 07	1:100	PLANTING PLAN 7 OF 9
LP 08	1:100	PLANTING PLAN 8 OF 9
LP 09	1:100	PLANTING PLAN 9 OF 9
LS 01	AS NOTED	LANDSCAPE DESIGN SECTION
LS 02	AS NOTED	LANDSCAPE DESIGN SECTION
LD 03	AS NOTED	LANDSCAPE DETAIL



SCOPE OF WORKS PLAN

Project Architect
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Hydraulic and Structural Engineer

GHD

Project
WARRIEWOOD BROOK

Drawing
LANDSCAPE COVER SHEET
PLAN 1 OF 19

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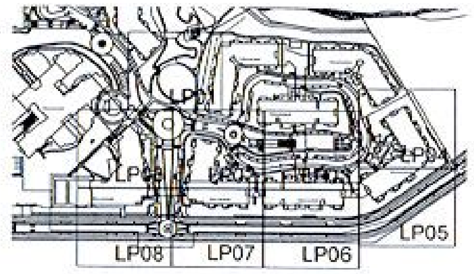

KEY PLAN

LEGEND

SHEET JOIN LINE

EXISTING TREE TO BE RETAINED

TURF

PAVING

GRAVEL PATH

SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

DRAFT

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Hydraulic and Structural Engineer

GHD CLIENTS | PEOPLE | PERFORMANCE

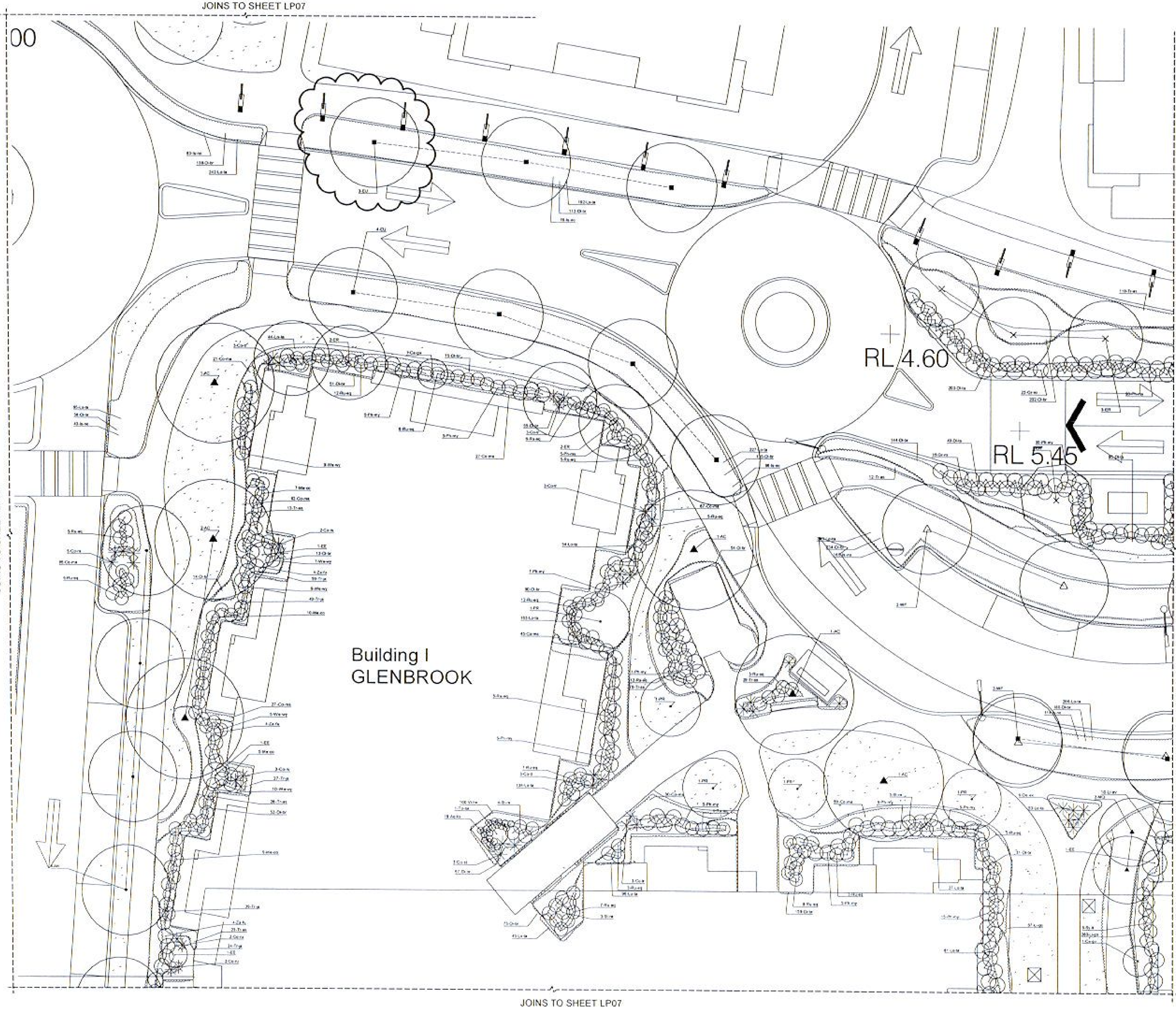
C	Construction Certificate	02.03.07
B	Preliminary Tender	20.02.07
A	Bd/Q	02.02.07
No	Amendment	Date

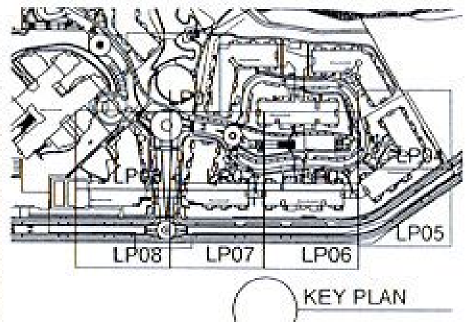
Project
WARRIEWOOD BROOK
8 MCPHERSON STREET, WARRIEWOOD

Drawing
PLANTING PLAN

taylor brammer

Date AUG 2006	Job No	Drawing
Scale 1:100@A1	05-149	LP01
Drawn MC		
Amendment C		





LEGEND

- SHEET JOIN LINE
- EXISTING TREE TO BE RETAINED
- TURF
- PAVING
- GRAVEL PATH
- SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect
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Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

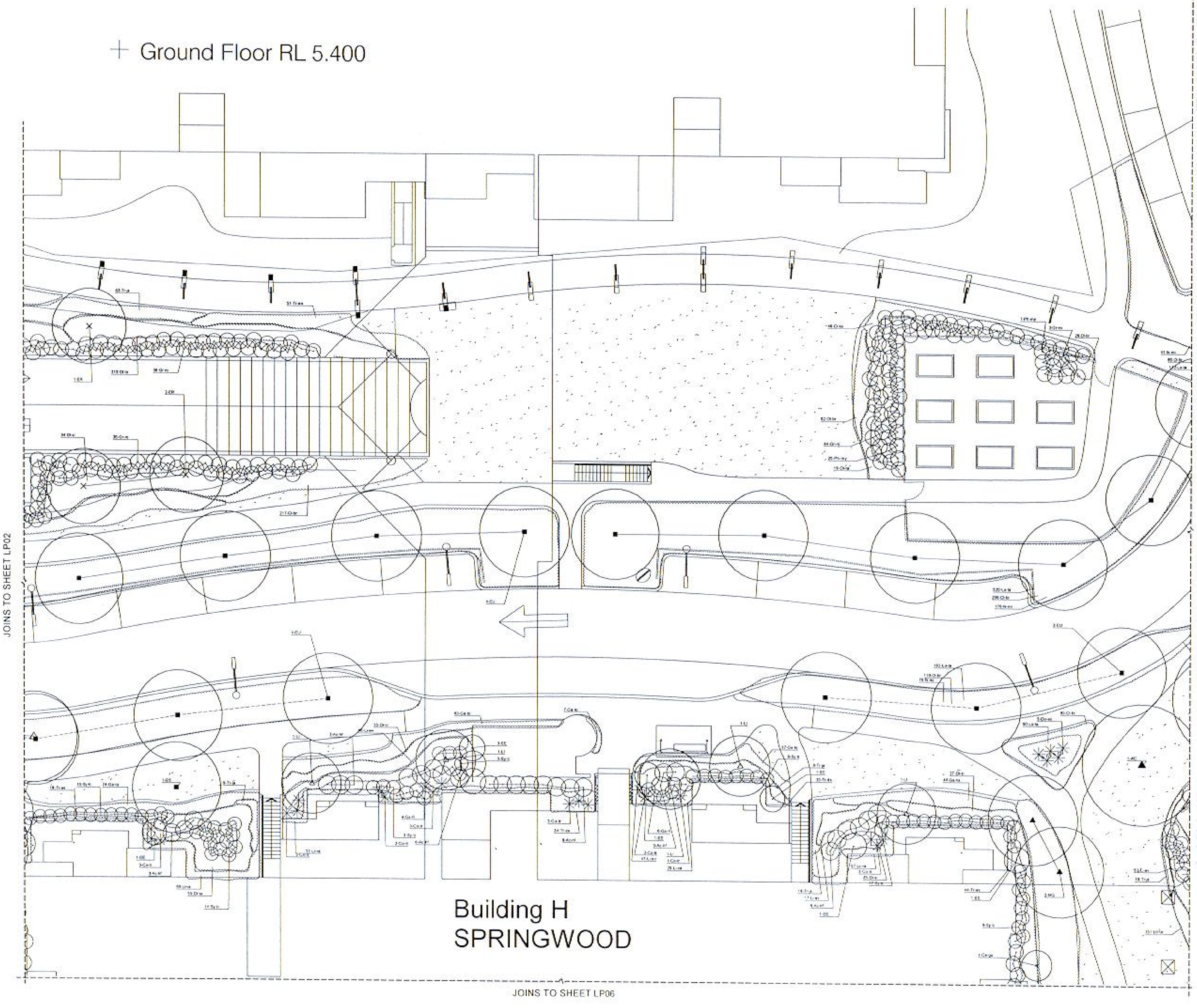
C	Construction Certificate	
B	Preliminary Tender	
A		
No.	Amendment	Date

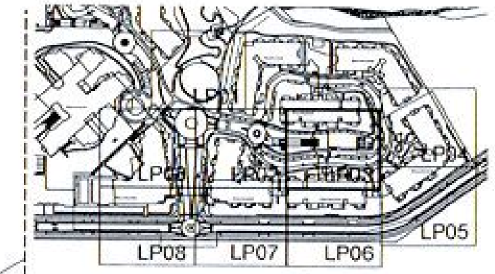
Project
WARRIEWOOD BROOK

Drawing
PLANTING PLAN

taylor brammer

Date	AUG 2006	
Scale		
Drawn		05-149S/LP02
Amendment	C	





KEY PLAN

LEGEND

- SHEET JOIN LINE
- EXISTING TREE TO BE RETAINED
- TURF
- PAVING
- GRAVEL PATH
- SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect
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Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer
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No.	Amendment	Date
C	Construction Certificate	05.03.07
B	Preliminary Tender	23.02.07
A	S.o.I.D	02.02.07

Project
WARRIEWOOD BROOK

Drawing
PLANTING PLAN

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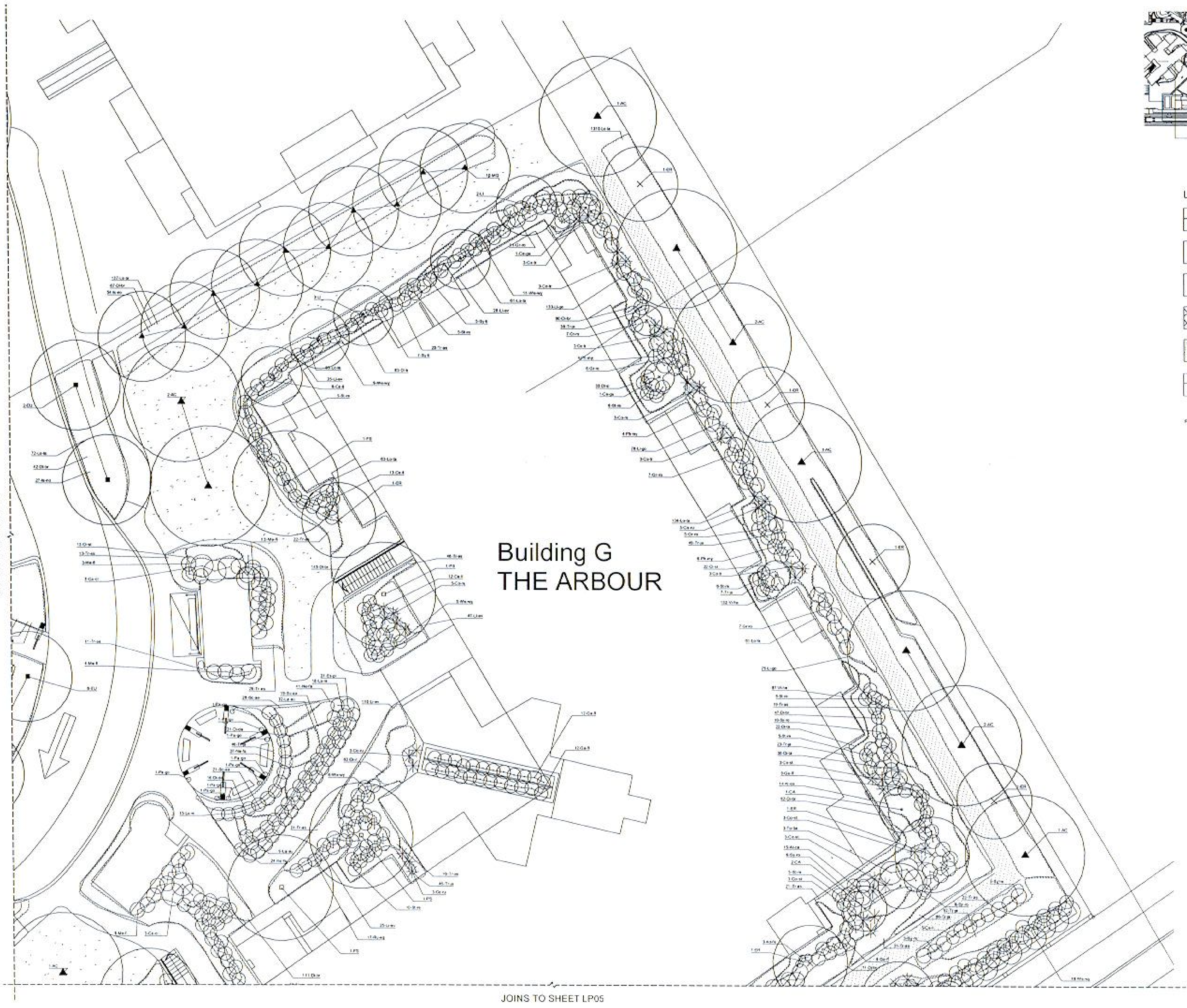
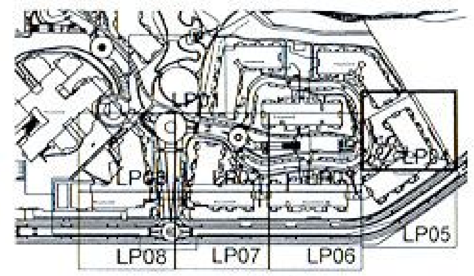
Date	AUG 2006
Job No.	
Drawing	05-1495/LP00
Amendment	C





KEY PLAN

LEGEND

- SHEET JOIN LINE
- EXISTING TREE TO BE RETAINED
- TURF
- PAVING
- GRAVEL PATH
- SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

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No.	Amendment	Date
C	Construction Certificate	05.03.07
B	Preliminary Tender	23.02.07
A	B+I O	02.02.07

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Project
WARRIEWOOD BROOK
8 MCPHERSON STREET, WARRIEWOOD

Drawing
PLANTING PLAN

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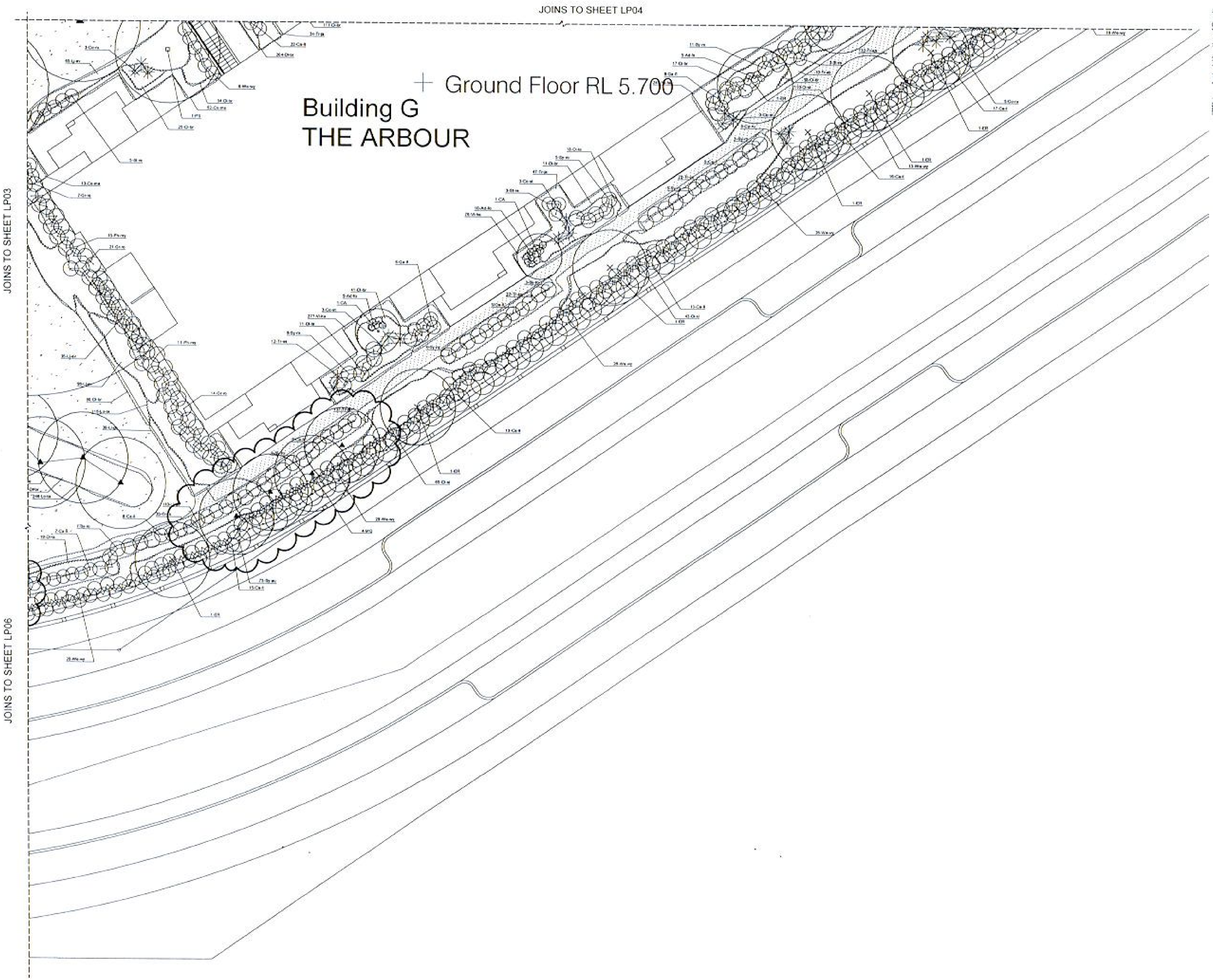
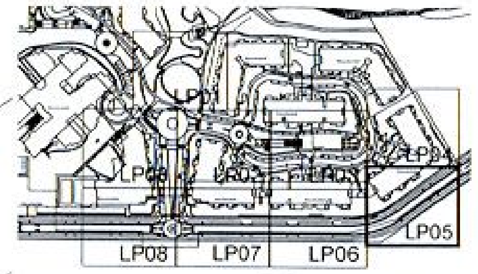
Date AUG 2006	Job No	Drawing
Scale 1:100@A1	05-1495/LP04	
Drawn MC		
Amendment C		

JOINS TO SHEET LP04





KEY PLAN

LEGEND

- SHEET JOIN LINE
- EXISTING TREE TO BE RETAINED
- TURF
- PAVING
- GRAVEL PATH
- SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect

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Hydraulic and Structural Engineer

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No.	Amendment	Date
C	Construction Certificate	[illegible]
B	Preliminary Tender	[illegible]
A	[illegible]	[illegible]

Project

WARRIEWOOD BROOK

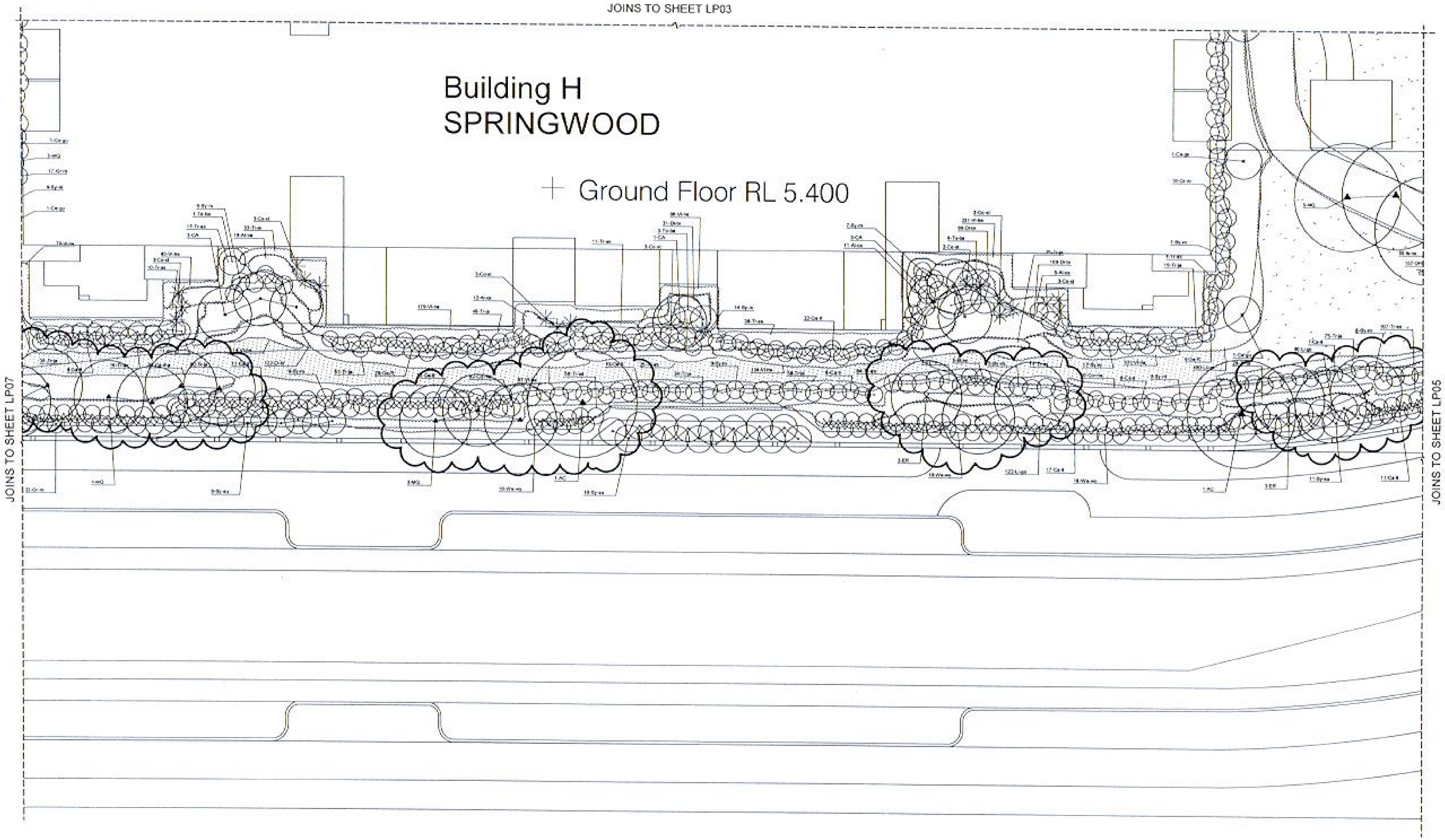
3 McPHERSON STREET, WARRIEWOOD

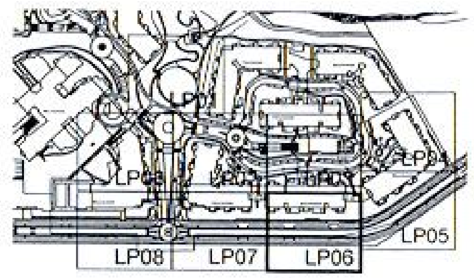
Drawing

PLANTING PLAN

taylor brammer

Date	AUG 2006	Job No. / Drawing
Scale	1:100@B1	05-149S/LP05
Drawn	MC	
Amendment	C	





KEY PLAN

LEGEND

SHEET JOIN LINE

EXISTING TREE TO BE RETAINED

TURF

PAVING

GRAVEL PATH

SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect
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Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer

CLIENTS | PEOPLE | PERFORMANCE

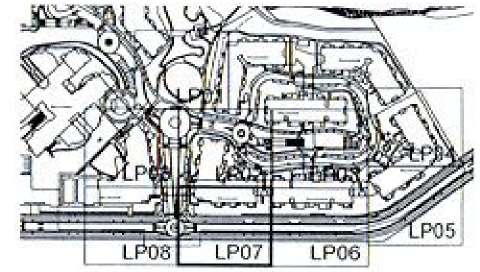
No	Amendment	Date
C	Construction Certificate	05.03.07
B	Preliminary Tender	23.02.07
A	B of Q	22.02.07

Project
WARRIEWOOD BROOK
8 MCPHERSON STREET, WARRIEWOOD

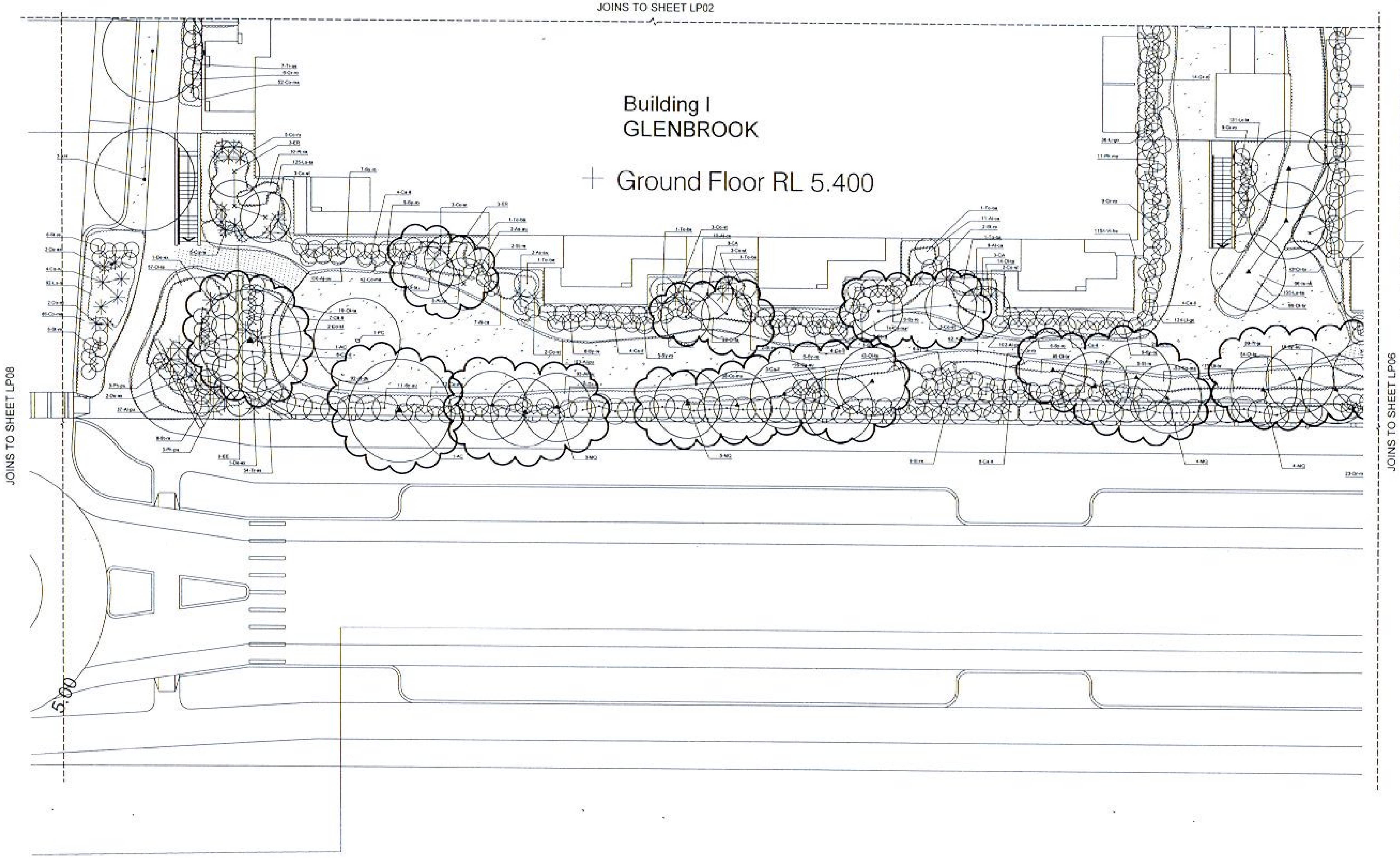
Drawing
PLANTING PLAN

taylor brammer

Date	AUG 2006	Job No	Drawing
Scale	1:100@A1	05-149SLP06	
Drawn	MC		
Amendment	C		



KEY PLAN



LEGEND

	SHEET JOIN LINE
	EXISTING TREE TO BE RETAINED
	TURF
	PAVING
	GRAVEL PATH
	SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect
boffa robertson group
Architecture Health and Aged Care Planning

Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

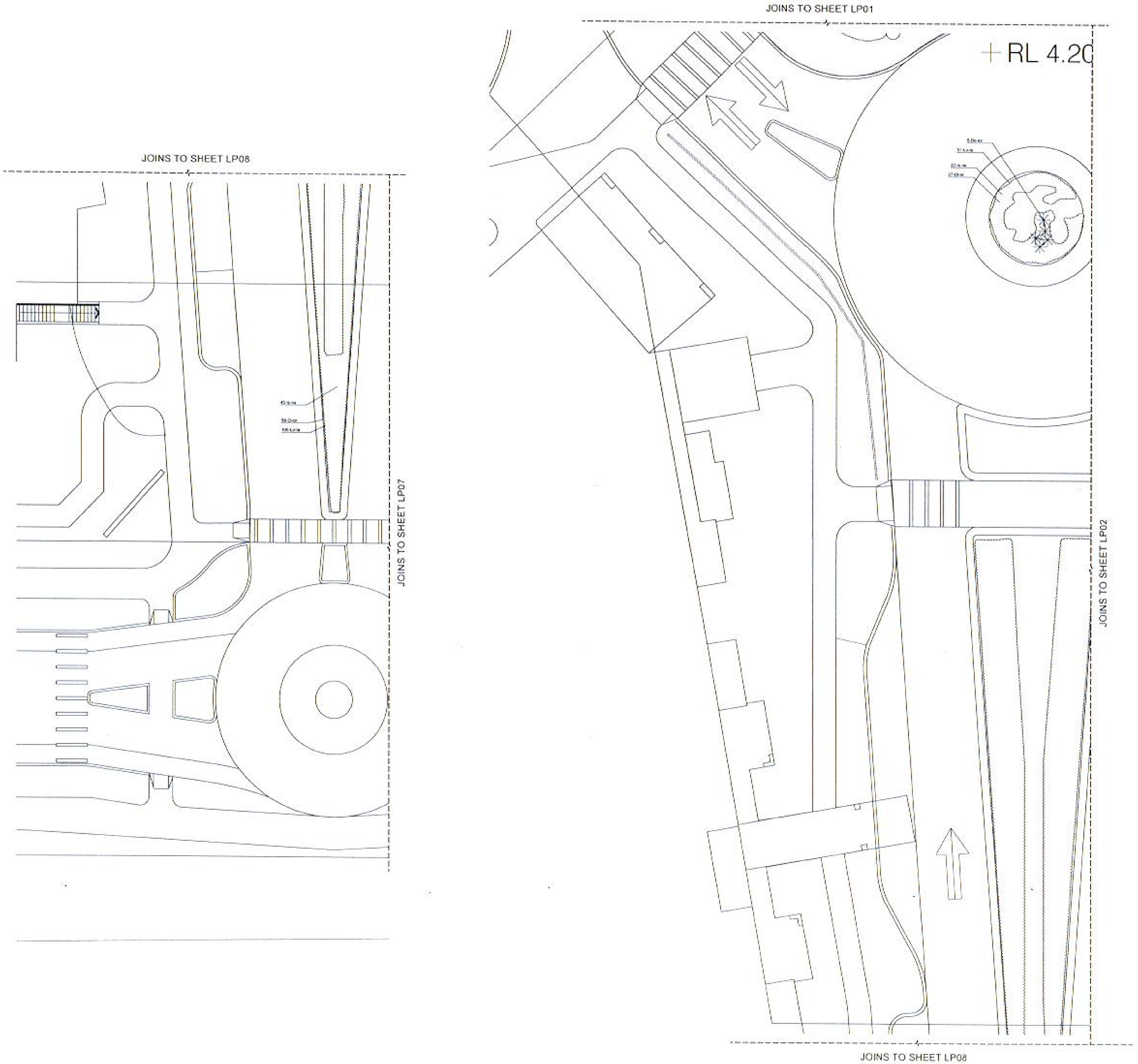
No	Amendment	Date
C	Construction Certificate	
B	Preliminary Tender	
A		

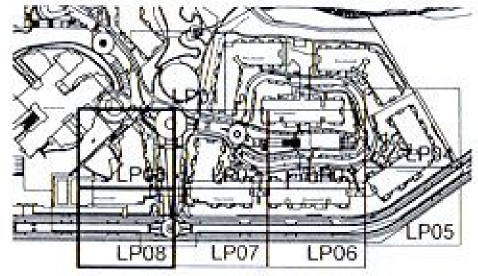
Project
WARRIEWOOD BROOK

Drawing
PLANTING PLAN

taylor brammer

Date AUG 2006	Job No. Drawing
Drawn MC	05-1495/LP07
Amendment C	





KEY PLAN

LEGEND

SHEET JOIN LINE

EXISTING TREE TO BE RETAINED

TURF

PAVING

GRAVEL PATH

SITE BOUNDARY

FOR PLANT SCHEDULE REFER TO LP09

Project Architect
boffa robertson group
Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer

CLIENTS | PEOPLE | PERFORMANCE

No	Amendment	Date
C	Construction Certificate	
B	Preliminary Tender	
A		

Project
WARRIEWOOD BROOK

Drawing
PLANTING PLAN

taylor brammer

Date	AUG 2006	Job No / Drawing
Scale		05-149S/LP08
Amendment	C	

STAGE 1

PLANT SCHEDULE

ID	Botanical Name	Common Name	Mature Height	Scheduled Size	Quantity
TREES					
					0
AC	Angophora costata	Sydney Red Gum, Smooth-barked Apple	>15 - 25m	45L	23
AC2	Angophora costata (2)	Sydney Red Gum	>15 - 25m	100L	1
AH	Araucaria heterophylla	Norfolk Island Pine	>15 - 25m	400L	9
CA	Callicoma serratifolia	Black Wattle, Silver-leaf Butterwood	>15 - 25m	45L	21
CS	Cercis siliquastrum	Judas-tree	>5 - 10m	75L	1
EE	Elaeocarpus eumundi	Eumundi quandong	>5 - 10m	75L	21
ER	Elaeocarpus reticulatus	Blueberry Ash	>5 - 10m	75L	37
EB	Eucalyptus botryoides	Bangalay	>15 - 25m	45L	2
EU	Eucalyptus robusta	Swamp Mahogany, Bangaly	>15 - 25m	45L	37
LI	Lagerstroemia indica sp.	Crepe Myrtle	>5 - 10m	75L	10
ML	Melaleuca linariifolia	Snow-in-Summer, Narrow-leaved Paperbark	>5 - 10m	25L	3
MQ	Melaleuca quinquenervia	Broad-leafed Paperbark	>15 - 25m	45L	40
PC	Pistacia chinensis	Chinese Pistachio	>15 - 25m	100L	1
PR	Prunus cerasifera 'Nigra'	Plum Purple Blaze	>5 - 10m	25L	5
PS	Prunus serrulata 'Mount Fuji'	Japanese Flowering Cherry	>3 - 5m	25L	5
WF	Waterhousia floribunda 'Sweeper'	Weeping Lilly Pilly	>5 - 10m	45L	4
SHRUBS					
					0
Ac-hf	Acmena smithii var. minor 'Hot Flush'	Lilli Pilli	>150cm - 3m	45L	29
Ad-fo	Adiantum formosum	Giant Maidenhair, Black Stem	>75 - 90cm	5L	42
Al-ca	Alpinia caerulea	Native ginger	>90 - 150cm	5L	164
As-au	Asplenium australasicum	Bird's Nest Fern	>45 - 60cm	5L	4
Ba-ru	Bauera rubioides	River Rose, Dog Rose	>90 - 150cm	5L	302
Ca-li	Callistemon 'Little John'	Dwarf Callistemon	>75 - 90cm	5L	290
Ca-ci	Callistemon citrinus	Crimson/Red Bottlebrush	>150cm - 3m	5L	51
Ce-gu	Ceratopetalum gummiferum	NSW Christmas Bush	>3 - 5m	5L	29
Co-ru	Cordyline rubra	Red Fruited Palm Lily	>150cm - 3m	5L	56
Co-st	Cordyline stricta	Narrow-leaved Palm Lily	>150cm - 3m	5L	67
Co-tr	Cordyline terminalis 'Tricolor'	Ti Plant	>90 - 150cm	5L	53
Co-al	Correa alba	White Correa	>90 - 150cm	5L	74
Do-ex	Doryanthes excelsa	Gymea Lily	>150cm - 3m	5L	36
Es-pi	Escallonia 'Pink Pixie'	Escallonia	>75 - 90cm	5L	21
Ga-fl	Gardenia augusta 'Florida'	Gardenia	>90 - 150cm	5L	129
Gr-ro	Grevillea 'Robyn Gordon'	Grevillea	>90 - 150cm	5L	375
Ku-am	Kunzea ambigua	Tick Bush	>150cm - 3m	5L	40
Lo-ni	Lonicera nitida	Dwarf Honeysuckle	>90 - 150cm	5L	33
Me-er	Melaleuca ericifolia	Swamp Paperbark	>150cm - 3m	5L	49
Me-co	Metrosideros collina 'Tahitian Sunset'	NZ Christmas Flower	>75 - 90cm	5L	31
Me-fi	Metrosideros vitiensis 'Fiji'	Metrosideros 'Fiji'	>150cm - 3m	5L	29
Ph-my	Philotheca myoporoides	The Longleaf Waxflower	>90 - 150cm	5L	228
Ph-pu	Phormium tenax 'Purpureum'	New Zealand flax	>90 - 150cm	5L	6
Ru-eq	Russelia equisetiformis	Firecracker Plant	>60 - 75cm	5L	128
St-re	Strelitzia reginae	Bird of Paradise	>90 - 150cm	5L	123
Sy-au	Syzygium 'Aussie Southern'	Lilly Pilly	>3 - 5m	5L	154
Sy-ro	Syzygium 'Royal Flame'	Magenta Lillypilly	>90 - 150cm	5L	271
Sy-ti	Syzygium 'Tiny Trev'	Tiny Trev Lilly Pilly	>90 - 150cm	5L	92
To-ba	Todea barbara	King Fern	>90 - 150cm	5L	20
We-wy	Westringia 'Wynyabbie Gem'	Coast Rosemary	>90 - 150cm	5L	253
Za-fu	Zamia furfuracea	Cardboard palm	>75 - 90cm	5L	12
GROUNDCOVERS					
					0
Al-pu	Alternanthera dentata 'Purple Knight'	Purple Knight	<=30cm	5L	569
Ba-ar	Baumea articulata	Jointed Twig-rush	>90 - 150cm	200mm	559
Ba-ju	Baumea juncea	Sedge	>75 - 90cm	200mm	603
Ca-ap	Carex appressa	Tall Sedge	>75 - 90cm	200mm	590
Co-ma	Convolvulus mauritanicus	Convolvulus	<=30cm	150mm	1124
Co-tr	Cordyline terminalis 'Tricolor'	Ti Plant	>90 - 150cm	5L	5
Di-br	Dianella 'Breeze'	Paroo Lily, Blue Flax-lily	<=30cm	200mm	7045
Di-si	Dianella 'Silver Streak'	Flax Lily	>60 - 75cm	5L	509
Di-ta	Dianella tasmanica 'Tas Red'	Red Dianella	>30 - 45cm	5L	906
Di-de	Dianthus deltoides	Maiden Pink	<=30cm	150mm	37
Di-ir	Dietes iridioides	Fortnight Lily	>45 - 60cm	200mm	705
Ga-si	Gahnia sieberiana	Red Fruited Saw Sedge	>150cm - 3m	200mm	148
Ga-to	Gazania tomentosa	Gazania	<=30cm	5L	229
Ha-vi	Hardenbergia violacea	Purple Twining-pea, False Sarsaparilla	<=30cm	200mm	626
Is-no	Isolepis nodosa	Knobby Club-rush	>90 - 150cm	200mm	1156
Ju-us	Juncus usitatus	Common Rush	>45 - 60cm	200mm	527
La-au	Lampranthus aureus	Ice Plant	>30 - 45cm	150mm	41
Li-go	Libertia ixioides 'Goldfinger'	Libertia 'Goldfinger'	>45 - 60cm	5L	1649
Li-ev	Liriope muscari 'Evergreen Giant'	Turf Lily	>60 - 75cm	5L	656
Li-va	Liriope muscari 'Variegata'	Variegated Lilyturf	<=30cm	5L	212
Lo-ta	Lomandra 'Tanika'	Mat-Rush	>45 - 60cm	200mm	7084
My-pa	Myoporum parvifolium	Creeping Boobialla	<=30cm	200mm	122
Ne-fa	Nepeta x faassenii	Catmint	<=30cm	150mm	92
Pa-go	Pandorea pandorana 'Golden Showers'	Wonga-wonga vine	—	150mm	4
Ru-eq	Russelia equisetiformis	Firecracker Plant	>60 - 75cm	5L	3
Sc-ae	Scaevola aemula 'Purple Fanfare'	Fan Flower	>30 - 45cm	150mm	68
Tr-as	Trachelospermum asiaticum	Yellow Star Jasmine	<=30cm	5L	1436
Tr-ja	Trachelospermum jasminoides 'Tricolor'	Star Jasmine	<=30cm	5L	1484
Vi-he	Viola hederacea	Native Violet	<=30cm	5L	3155
We-wy	Westringia 'Wynyabbie Gem'	Coast Rosemary	>90 - 150cm	5L	45

Project Architect
boffa robertson group
Architecture, Health and Aged Care Planning

Hydraulic and Structural Engineer
GHD CLIENTS | PEOPLE | PERFORMANCE

No	Amendment	Date
C	Construction Certificate	05.03.07
B	Preliminary Tender	23.02.07
A	BofG	02.02.07

Project
WARRIEWOOD BROOK
5 McPHERSON STREET, WARRIEWOOD

Drawing
PLANTING PLAN

taylor brammer

Date	AUG 2006	Job No	Drawing
Scale	1:100@A1	05-149S/LP09	
Drawn	MC		
Amendment	C		

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