



STATEMENT OF ENVIRONMENTAL EFFECTS

**St Philip's Christian
College, Port Stephens –
Senior School Building**

Establishment of a new three-storey
Senior School building on an existing
school campus.

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REVISION C

PROJECT NO. 3716

September 2017

SHAC

SUMMARY OF REVISIONS

| Revision | By | Review | Date | Comment |
|----------|-----|--------|----------|---------------------|
| A | JeH | EB | 19.07.17 | First Issue |
| B | JD | EB | 05.09.17 | Issue for DA |
| C | JD | EB | 26.09.17 | Revised for Council |
| | | | | |

Checked By: EB

Author: JeH

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Introduction

PROJECT OVERVIEW

This Statement of Environmental Effects forms part of a Development Application for a new construction of a 3-storey Senior School Building, and alterations and additions to an existing Trade Training Centre for St Philip's Christian College, Port Stephens, and should be read in conjunction with the following documents:

- a) Architectural drawings for the new Senior School Building noted as DA0000, DA1001, DA1002, DA1003, DA1004, DA1005, DA1101, DA2101, DA2102, DA2103, DA3101, DA3102, DA3201, DA3202, DA6001, DA6002, DA7001, DA9002, DA9003, DA9004 prepared by SHAC (20 pages total).
- b) Architectural drawings for the alterations and additions to the existing Trade Training Centre noted as SK2101 and SK2102 prepared by SHAC.
- c) Civil drawings C1 & C2 under project number 17-5206 prepared by Michael Fitzgerald Consulting Engineers.

Site Details

Address of Development Site

176 Salamander Way,
Salamander Bay NSW 2317

Real Property Address

Lot 1, DP847022

Site Area

26,400m² (2.614ha) entire site area (including existing campus)

Applicant Details

Applicant

SHAC
224 Maitland Road
Islington NSW 2296

Attention: Elizabeth Brown
Phone: 02 4961 5888
Email: elizabeth@shac.com.au

Owners

St Philip's Christian College Education Foundation Ltd
57 High Street,
Waratah, NSW, 2298

Attention: Graeme Irwin – Executive Principal
Phone: 02 4960 6600
Email: Graeme.irwin@spcc.nsw.edu.au



Planning Instruments & Statutory Controls

The design and planning of the school detailed within this submission has been undertaken with reference to the following documents (current at the date of submission). Copies of the purchased S149 Certificate on the lot is included in Appendix A of this report.

Port Stephens Local Environmental Plan 2013

The Port Stephens LEP identifies the land as being within the Special Purpose SP2– Infrastructure/School/Child Care Centre zone. The objectives of the zone is:

- To provide for infrastructure and related uses;
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

The SP2 zoning in Port Stephens only covers St Philip’s Christian College, an established school campus consisting of Pre-School, Junior, Middle and Senior Schools. The addition of a new building on the site will not adversely affect the zoned area.

Port Stephens Development Control Plan 2014

The Port Stephens Development Control 2014 was most recently amended in December 2015. This amendment covered Heatherbrae and Raymond Terrace Town Centre. Neither of these revisions affect the subject site.

Section 94 Contributions

St Philip’s Christian College wishes to seek exemption from the Section 94 Contribution. The School wishes to seek exemption based on the contribution they are providing to the local Port Stephens area in hope to retain more students from the area whilst providing infrastructure and jobs. Furthermore, the Section 94 contribution will detrimentally impact the funding of an already tight budget.

Site Suitability

The site at 176 Salamander Bay is located south of the main developed area of Salamander Bay and Corlette. Directly north of the site sits a large shopping complex, Tomaree High School and Tomaree TAFE.

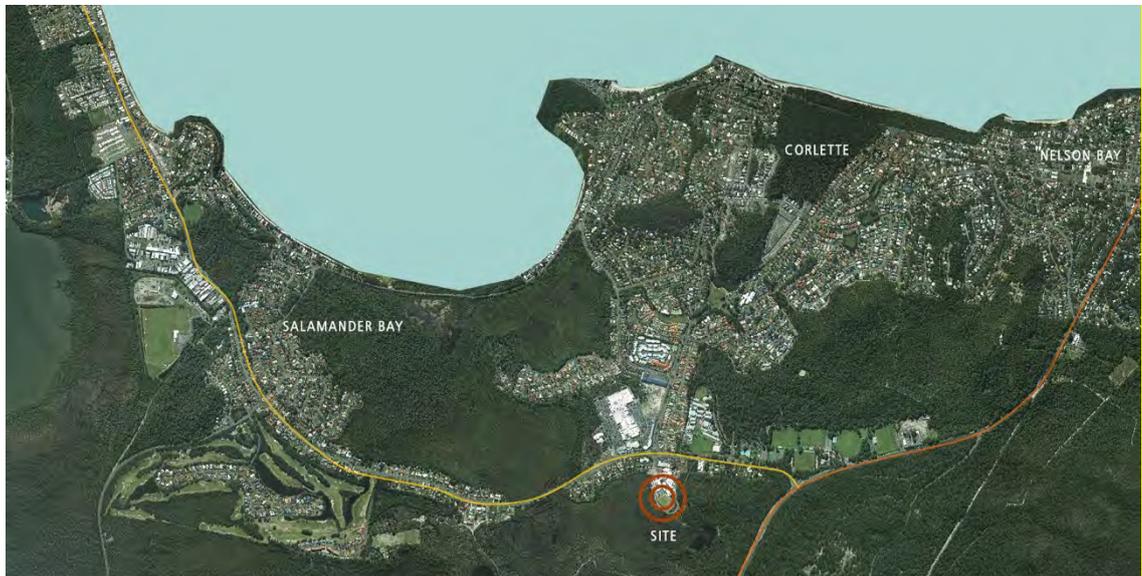


Image courtesy of SIXmaps – edited by SHAC

The site is currently a section of the school's field on the southern end of the school campus. The surrounding bushland to the south of the campus is protected wetland area and Crown land to the east. From this section onwards, unless noted otherwise, the SEE will report on the area of the site that is to be dedicated to the Senior School building only.



Images courtesy of SIXmaps – edited by SHAC



Images courtesy of SIXmaps – edited by SHAC

The area of site proposed for the development has an existing Senior School Technics building, which will be demolished as part of building works. The proposed development includes the new construction of a 3-storey building with COLA and associated landscape & gardens for use as a senior school facility. The existing Trade Training Centre (TTC) is centrally located on the school campus. The alterations and additions will not be visible beyond the perimeter of the sites boundary.

The site at St Philip's Christian College is a bootleg shape approximately 2.614ha. Entrance to the main campus is via a private road off a roundabout on Salamander Way with a kiss and drop area at the front of the school. Due to the site's location at the south of the main campus, general access to the site will be through the school. The view from the site of the new Senior School Building is across the sports field and 180° views to bushland and higher crown land.



View to the south from existing site

Existing sewer, water, electricity and telecommunications are provided to the site via the private entry road. These will be maintained and extended internally for connection to the senior school building. Existing services will be altered to suit the alterations and additions to the Trade Training Centre.

Council zoning has the site located within the buffer zone of a bushfire prone area. Refer to Bushfire Threat Assessment section of this report for further details.

The site is not located within a Mine Subsidence District.

Present & Previous Uses

St Philip's Christian College Port Stephens was established in 1995 to accommodate the Tomaree Peninsula as the second school campus after the growth of the first and founding school at Waratah, Newcastle. The site of the school campus has always been an educational site and previous to the establishment of St Philip's Christian College, the site was a greenfield bushland/wetland area.

Currently, the site contains a full Pre-School and K-12 school campus with over 800 enrolled students.

The existing Trade Training Centre currently houses an Electro Lab and TAS units.

Operational Details

As mentioned in the previous sections, this SEE and the accompanying Development Application relates to the approval of a Senior School building on a currently undeveloped portion of the site, and alterations and additions to an existing Trade Training Centre at the Port Stephens campus of St Philip's Christian College. The new Senior School building will assist in the growing enrolment numbers of the school and is the first building to undergo construction as part of the revised Port Stephens campus masterplan. Alterations and additions to the existing Trade Training Centre will better suit the needs of the school.

At completion, the new Senior School building will accommodate the college's Senior School population for general learning tasks, consisting of Years 9-12 – approximately 300 students – and the relevant staff body of 16. This building allows the College to expand its overall school population to the masterplanned total of 1,200 students through all three schools (junior, middle & senior). A copy of the masterplan site plan is included in this report as Appendix B.

The buildings will maintain the current hours of school use and provide general learning, lecture, staff and gym facilities for the Senior School.

The site itself will be internally serviced for waste disposal, as per the existing arrangement onsite, with an area dedicated to the north of Block A for both bin storage and loading bay for deliveries. There will be no requirement for dilution pits with the proposed building, given the functional use and requirements.

Architectural Design Principles

Our teams' interpretation and vision is for an exciting innovative new learning environment – a physical manifestation which allows for teaching and learning to become 'stations' not 'subjects' along the journey of education. Our key ordering principles help us to translate this language into the built environment. By incorporating these principles into our design methodology and approach, they become markers by which we can test and measure our outcomes.

CONNECTIVITY

- Establish links between learning areas, staff facilities and communal spaces.

FLEXIBILITY

- Future proof flexible open plan spaces.
- Providing a variety of interchangeable, custom learning spaces catering to large groups, class sized groups and the individual.

ADAPTABILITY

- Spaces can be modified by the individual or the group to adapt to teaching and learning needs, now and into the future. As stations or subjects change, spaces can be adaptively reused over and over.

EFFICIENCY

- Economies of scale – materiality and technique.
- Spaces which are easy to change and adapt for reuse, whilst maintaining longevity.

SUSTAINABILITY

- Harness the natural energy, light, shade, breezes and landscape of the site.
- Utilising natural site features, orientation, solar access, views and topography.



- Incorporating modern ESD strategies, building materials and technologies.

Design Approach & Social Impact

The project has design criteria requirements which must be satisfied to ensure that the educational philosophy is encapsulated into a building which can be granted BGA funding as well as satisfy Council requirements and industry standard practice.

The form of the new Senior School building is based on an even grid system that offers solutions to internal and external planning and proportion, and structural integrity and simplicity. The addition of a COLA provides shade and shelter as well as outdoor learning opportunities.

The new building will consist of general purpose teaching spaces, staff areas, support rooms, specialist teaching rooms, café, and a general-purpose lecture theatre with seating for 160. The 3 levels are connected by a main stair adjacent to a full height, glazed atrium void space to the south-east. Communal areas are spread across the building surrounding the stairs to create an activated core in the centre of the building. Two external fire stairs provide separate access across all floors while addressing the fire safety issues associated with a building of this size. The building includes all main services such as staff and student amenities and a lift to facilitate disabled access to all floors.

The robust nature of this building is reflected in the materiality and detailing with the use of precast concrete, post tension floor slabs, non-load bearing internal walls, lightweight external fire stairs and an extensive glazed wall to facilitate a connection between the internal spaces and the external sports field. The inclusion of the extruded brick wall to the south-south-west end of the building adds gravity to the building and also ties in to the palette of the existing campus.

The learning areas of the building are designed to be flexible areas with the implementation of glazed operable walls between classroom spaces, as well as a scattering of breakout communal spaces for combined open learning. The approach to education that is being developed within this project reflects the 'future-focused learning' movement. These breakout spaces will consist with flexible furniture and adaptable areas available for use, especially in the Ground Floor communal area. Furniture ranging from large group lounging, large shared desks and intimate single desks around a central café reflects a university-level style of communal learning.

The form of the existing Trade Training Centre will be maintained and extended to match existing. The edges of the building will be filled in to accommodate a more flexible teaching space and an additional accessible W.C. All materials and finishes are to match existing to ensure coherence.

Building Parameters

Building Envelope & Height

The maximum building height from Port Stephens Council does not include the subject site of the school campus. The adjacent site of The Rock Church is included, however, and is capped at 9m in height as well as the majority of Salamander Bay. The shopping centre to the north of the site also has a maximum building height of 15m.

The building heights of the existing school is generally 1 to 2 storeys, with the existing covered sports courts being the highest structure at approximately 9.5m. The proposed Senior School building is 10.5m, making it the tallest building in the campus, but due to its position at the south of the site there will be no overshadowing issues as seen in the accompanying Shadow Diagram drawings DA6001 and DA6002 provided in this package. Given the buildings location onsite, its visibility from the public road will also be limited.

The height of the existing Trade Training Centre will not be altered as a part of these works.

Building Setbacks

The proposed development is located within an existing school site and is placed in direct relation to existing building site lines. At its closest points the building is the following perpendicular distances from the nearest boundaries, as can be seen on DA1101 Proposed Site Plan:

- South-east boundary: 18.9m from southern corner of Lecture Theatre (14.4m from edge of external stair)
- East boundary: 23.8m from eastern corner

Given that the Council does not appear to list specific requirements in regards to building heights or setbacks for an educational facility, the proposed Senior School building has been designed to limit any impact to its immediate surrounds and is sympathetic to existing building heights and setbacks.

As mentioned earlier in the report, the Trade Training Centre is centrally located within the school campus and will not be affected by setbacks.

Access & Traffic

As part of the existing school campus, a generous 'kiss & go' drop off zone and a number of parking spaces are available for staff and students – as well as a delivery area servicing the Performing Arts Centre and Maintenance Yard.

Not part of this application, a new carpark and busbay DA application has been approved (DA 16-2016-770-1) to the west of the campus site which proposes 163 extra car parking spaces and 10 new bus bays in addition to the current parking available. The works to this new carpark will intend to be done concurrently to the proposed Senior School building to allow access to the building site through the western boundary without directly impacting the main school grounds. As stated earlier, the current access to St Philip's Christian College Port Stephens is via a private road dedicated to the school. This already minimises traffic congestion to the main road, Salamander Way, and allows uninterrupted access in and out of the campus.

Access to the proposed building will be through the main campus between the existing Senior School building and Trade Training Centre, leading to the proposed COLA space and further out to the field / open outdoor play space or in to the Communal Area inside the proposed building.

A Traffic Impact Statement was undertaken by Better Transport Futures in July 2016, and was based upon the proposed masterplan population allowance of 1,200 students. As such this report reflects any impacts that would relate to the approval and subsequent construction of the Senior Building onsite. A summary of the report conclusions is as follows:

The conclusions drawn from these investigations are that the proposed site entry and car parking arrangements proposed for the expanded school operations will result in an improved ratio of parking supply to levels of school enrolments. By providing additional parking on site and adjacent to the School it is expected that conditions on the surrounding network will be improved also as some existing parking activity would be expected to transfer to the new parking facilities. Thus the School's proposal for additional parking and expanded pick up and set down areas is supported as a positive contribution traffic and road operations.

The full report is included in Appendix C of this SEE document.

Privacy Views & Overshadowing

Visual Privacy

As previously stated, the proposed Senior School building is located at the southern-most end of the site and due to the demolition of the Senior School Technics building, are substantially setback from existing structures except the current covered sports courts.

Currently there are no neighbouring lots in direct distance to the proposed Senior School as it is surrounded by bushland and the distance between the proposed building and site boundaries provides significant buffer to the surrounding areas.

The proposed alterations and additions to the existing Trade Training Centre will not alter the current site conditions.

Acoustic Privacy

The major noise producing functions for the Senior School building have been located on the southern side of the building, with operable walls facing out to the COLA and field. The main noise producing factors are the Lecture Theatre and the Ground Floor Communal Area. The Lecture Theatre is situated within the brick section of the building, providing acoustic protection from neighbouring areas and the Communal Area faces out to the existing field.

The northern side of the building mainly consists of the learning areas and amenities behind a more solid façade compared to the southern side. This will protect the main school campus from extra acoustic noise, although the existing courts likely already produce a significant amount of noise.

The proposed alterations and additions to the existing Trade Training Centre will not alter the current site conditions.

Views

The proposed works will have a negligible impact on views from adjoining or nearby properties given the location of the proposed site and the general location of the school.

Overshadowing

The proposed development will affect the existing overshadowing conditions of the site, due to the size of the new building over the field area. Please refer to the accompanying Shadow Diagram drawings DA6001 and DA6002. Overshadowing on the school is only very minimal and is directed on the existing covered sports court.

Air & Noise

The proposed works will not produce any undue air or noise pollution, outside of normal operational use.

Noise during construction will be minimised wherever possible and hours of construction will comply with Council's requirements.

Geotechnical Information

Soil

A geotechnical investigation has commenced on the direct subject site of the Senior Building, although previous investigations have been completed by Barker Harle (March 2017) and have been used for preliminary information purposes. A copy of this report is included as Appendix D. The main consideration associated with the development is the location of the water table the existing sandy soil subsurface condition.

The structural design and Construction Certificate documentation for the proposed educational buildings will be executed by a qualified structural engineer in conjunction in accordance with the included reports findings.

Erosion & Sediment Control

A qualified civil engineer has been engaged to undertake design and documentation works associated with the proposed new Senior School building project.

Heritage Conservation

The site is not listed on any Heritage conservation registers, however given the close location of the crown land which we understand has aboriginal and indigenous significance, in the event of the exposure of unanticipated relics, work must be ceased in the affected area and the Heritage Office notified.

Flora, Fauna Impact

The subject site is not listed within an area of flora & fauna management as it sits on a portion of an established existing school site. The removal of trees will not be necessary as part of this application and therefore there is no impact on the surrounding ecological environment.

Bushfire Threat Assessment

As an educational facility, the project will be listed as a special fire protection purposes under the NSW Rural Fires Act 1997. The site is also nominated as within the buffer zone of the bushfire threat zone on Councils mapping site.

A Bushfire Assessment Report has been undertaken by Firebird ecoSultants Pty Ltd and is included as Appendix E of this SEE. The conclusion and recommendations of the report are as follows:

As the development is not a stand-alone development, but rather an extension of the St Philip's Christian College facilities being senior school buildings it is considered infill development in accordance with Planning

for Bushfire Protection (RFS, 2006) (PBP 2006). As the site is to be used for education purposes the proposal has been considered a Special Fire Protection Purpose (SFPP) development in accordance with Planning for Bushfire Protection (RFS, 2006) (PBP 2006).

This BTA has been undertaken to recommend Bush Fire Protection Measures (BPMs) in order for the proposal to comply with the intent and performance criteria of section 4.3.5 of PBP (RFS, 2006) 'Specifications and Requirements for Bush Fire Protection Measures for Infill Development' and Section 4.2.5 'SFPPs as Infill'.

In summary, the following is recommended for the proposal:

1. The existing site does not allow for the required APZs and therefore additional measures with regard to higher construction standards, siting and design of buildings, access, water supply, landscaping and emergency planning will be required.
2. In combination with the additional measures detailed in the Performance Based Assessment, the APZs outlined in Table 4.1 and Figure 4-1 are to be provided.
3. The Emergency Response and Evacuation Plan for the site is to be updated and be consistent with the RFS document "A guide to Developing Bushfire Evacuation Plan" (2004).

Conclusion

The development is not a stand-alone development, but rather an extension as part of the school facilities of St Philip's Christian College Port Stephens and established under a single ownership that controls St Philip's Christian College Port Stephens. The proposal is considered infill development and provides a better outcome than if the development did not proceed.

Pursuant to Section 4.2.5 SFPPs as Infill, PBP (RFS, 2006), the circumstances of this development make it difficult to achieve the preferred standards for SFPP development. The proposal seeks the creation of larger APZs being established along the western side of the school by the proposed carparking and the widening of the fire-trail with additional PFFM that achieve a better bushfire risk outcome for the school facilities than if the development did not proceed. The proposed building works will comply with AS 3959 – 2009 to ensure improved safety.

The proposal provides a combination of BPM, including opportunity for safe emergency evacuation procedures, provision for the needs of SPCC students and staff, multiple points of access for fire fighting through the school grounds and adjacent fire trail with readily defendable space, location of the emergency exit away from the hazard with protection from the existing buildings.

The proposal demonstrates the requirement for exceptional circumstance and justifies a reduction in APZ. In summary, the following key recommendations have been generated to enable the proposal to meet the requirements of Section 4.2.5 and 4.3.5 of PBP 2006:

- The existing site does not allow for the required APZ's and therefore additional measures with regard to higher construction standards, siting and design of buildings, access, water supply and emergency planning will be required.
- In combination with the additional measures detailed in the Performance Based Assessment, the APZ's outlined in Table 4.1 are to be provided.
- Additional fire hydrants should be installed within the site. Installed fire hydrants will be required to comply with AS2419.1 –2005. Hydrants must be located outside parking bays and should be clearly marked to ensure accessibility for fire-fighting personnel.
- The Emergency Response and Evacuation Plan is to be upgraded to include the proposed buildings and is to be consistent with the RFS document "A guide to Developing Bushfire Evacuation Plan" (2004).
- The proposed extensions are to be built to BAL-12.

National Construction Code

NewCert Pty Ltd have been engaged to undertake both the BCA certification and the following CC and Private Certifying Authority role for Senior School building works and the alterations and additions to the existing Trade Training Centre, based upon the approval of this DA.

All areas of concern associated with NCC compliance have now been highlighted and addressed.

Infrastructure/Services Supply

Electrical

The site is already meeting its maximum demand supply to the site, prior to the construction of the new proposed Senior Building. Marline Newcastle have been engaged to coordinate the design and documentation of a new substation to the school as part of this development. The substation will be located on SPCC land, close to the existing switchboard. All relevant Australian Standard and Ausgrid design requirements will be met.

Hydraulic

Existing supply of water is being reviewed in regards to the pressure at the street. The existing water supply may require upgrade, once onsite to allow for compliance with standard requirements for pressure. Again, Marline Newcastle have been engaged to undertake these works.

All other services onsite will connect into the existing supply. Hunter Water will be consulted in regards to the sewer and water supply with Section 50 applications undertaken.

Waste

A grease arrestor is required for the proposed Hospitality commercial kitchen. The proposed location is shown on the architectural drawings which is externally accessed for ease of pump out. This system will be developed by Marline Newcastle as a part of construction documentation.

The proposed construction will not change the existing waste production process on site.

Council Consultation

One meeting has been undertaken with Port Stephens Council in regards to the enclosed DA application for the proposed Senior School building – 26th May 2017. The main issues of concern for Council related to the traffic, which had already been addressed with the completed report for the carpark DA (included in this SEE) which was based on a 1,200 student population, as well as the civil & structural design requirements. This issue has been addressed through engaging the same engineer who completed the design of the previous school buildings, as well as the recent carpark DA, to ensure Council design requirements are satisfied. The reuse of the same geotechnical engineering firm will also ensure that all requirements are met.

Conclusion

The proposed construction is intended to satisfy an existing need for specific senior student needs on the SPCC Port Stephens site. Whilst this will not increase student numbers initially, this is the first building proposed since the completion of the revised 2016 masterplan, and as such is the first step towards the school growing to the future capacity of 1,200. All relevant reports and Council mandated requirements have been based on this increased population. The proposed works have been designed in accordance with listed Council requirements with a conscious effort made to reduce the impact on the surrounding neighbours in regards to overshadowing, acoustic privacy, visual privacy and traffic management. The proposed works are designed within the acceptable DCP, LEP, and Australian Standard parameters and will therefore not have any detrimental impact on adjoining residences.

Appendix A – S149 Certificate

Issued by Port Stephens Council – 10th March 2017



**PLANNING CERTIFICATE PURSUANT TO
SECTION 149 ENVIRONMENTAL PLANNING
AND ASSESSMENT ACT, 1979**

APPLICANT DETAILS:

**SHAC ARCHITECTURE
224 MAITLAND ROAD
ISLINGTON NSW 2296**

Reference.: #3716 SPCC PS

Application number: 98885

Receipt number: 2509275

Issue Date: 10/03/2017

PROPERTY DESCRIPTION:

**176 Salamander Way SALAMANDER BAY 2317 Parcel No: 21388
LOT: 1 DP: 847022**

Disclaimer

Information contained in this certificate relates only to the land for which this certificate is issued on the day it is issued. This information is provided in good faith and Council shall not incur any liability in respect of any such advice. Council relies on state agencies for advice and accordingly can only provide that information in accordance with the advice. Verification of the currency of agency advice should occur. For further information, please contact Council's Strategy & Environment Section by telephoning 49800326 or email S149@portstephens.nsw.gov.au.

Title Information

Title information shown on this Planning Certificate is provided from Council's records and may not conform to information shown on the current Certificate of Title. Easements, restrictions as to user, rights of way and other similar information shown on the title of the land are not provided on this planning certificate.

Inspection of the land

The Council has made no inspection of the land for the purposes of this Planning Certificate.

PART A: INFORMATION PROVIDED UNDER SECTION 149 (2)

Matters contained in this certificate apply only to the land on the date of issue.

1. Name of Relevant Planning Instruments and DCPs

1.1 Which environmental planning instruments apply to the carrying out of development on the land?

Local Environmental Plan

Port Stephens Local Environmental Plan 2013 - Published on the NSW Legislation website and in force from 22 February 2014.

State Environmental Planning Policies

State Environmental Planning Policy No 21 - Caravan Parks

State Environmental Planning Policy No 30 - Intensive Agriculture

State Environmental Planning Policy No 33 - Hazardous and Offensive Development

State Environmental Planning Policy No 36 - Manufactured Home Estate

State Environmental Planning Policy No 44 - Koala Habitat Protection

State Environmental Planning Policy No 50 - Canal Estate Development

State Environmental Planning Policy No 55 - Remediation of Land

State Environmental Planning Policy No 62 - Sustainable Aquaculture

State Environmental Planning Policy No 64 - Advertising and Signage

State Environmental Planning Policy No 65 - Design Quality of Residential Flat Development

State Environmental Planning Policy No 70 - Affordable Housing (Revised Schemes)

State Environmental Planning Policy No 71 - Coastal Protection

State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

State Environmental Planning Policy (Exempt & Complying Development Codes) 2008

State Environmental Planning Policy (Housing for Seniors or People with Disability) 2004

State Environmental Planning Policy (Affordable Rental Housing) 2009

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Rural Lands) 2008

State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (Temporary Structures) 2007

Regional Environmental Plans

No Regional Environmental Plans currently exist which affect the site, the subject of this certificate.

- 1.2 Which proposed environmental planning instruments apply to the carrying out of development on the land that is or has been the subject of community consultation or public exhibition?**

Draft Local Environmental Plan

No Draft Local Environmental Plans currently exist which affect the site the subject of this certificate.

Draft State Environmental Planning Policies:

DRAFT Coastal Management SEPP 2016 applies to the whole or part of the lot.

- 1.3 Which development control plans apply to the carrying out of development on the land?**

Port Stephens Development Control Plan 2014. 10 December 2015 – Amendment No.2

- 1.4 In this clause, proposed environmental planning instrument includes a planning proposal for the LEP or a draft environmental planning instrument.**

No Draft Local Environmental Plans currently exist which affect the site the subject of this certificate.

2. Zoning And Land Use Under Relevant Local Environmental Plan(s):

For each environmental planning instrument or proposed instrument referred to in clause 1 above (other than a SEPP or proposed SEPP) that applies to the land:

- 2.1 What is the identity of the zoning for the land?**

SP2 Infrastructure

Port Stephens Local Environmental Plan 2013

- (a) The land is zoned SP2 Infrastructure under the provisions of Part 2 in the Port Stephens Local Environmental Plan 2013.
- (b) **Item 2 – Permitted without consent**
Environmental protection works; Roads
- (c) **Item 3 – Permitted with consent**
The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose
- (d) **Item 4 - Prohibited**
Any development not specified in item 2 or 3
- (e) **Development Standard for the erection of a dwelling-house**

No development standard that fixes a minimum land dimension for the erection of a dwelling-house applies to the land.

NOTE: The land subject of this certificate DOES NOT have a site specific clause applying to it.

2.2 Does the land include or comprise a critical habitat?

Port Stephens Local Environmental Plan 2013 DOES NOT identify the land as including or comprising critical habitat.

2.3 Is the land in a conservation area?

The land IS NOT located within a heritage conservation area under the provisions in Port Stephens Local Environmental Plan 2013.

2.4 Is an item of environmental heritage situated on the land?

The land IS NOT identified as containing an item of environmental heritage under the provisions in Port Stephens Local Environmental Plan 2013.

3. Complying Development (State Environmental Planning Policy – Exempt and Complying Development Codes) 2008

General Housing Code:

Complying development under the General Housing Code MAY NOT be carried out on the land.

Rural Housing Code:

Complying development under the Rural Housing Code MAY NOT be carried out on the land.

Commercial and Industrial Alterations Code:

Complying development under the Commercial and Industrial Alterations code MAY NOT be carried out on the land.

Commercial and Industrial (New Buildings and Additions) Code:

Complying development under the Commercial and Industrial (new buildings and additions) code MAY NOT be carried out on the land.

Housing Alterations Code:

Complying development under the Housing Alterations Code MAY NOT be carried out on the land.

General Development Code:

Complying development under the General Development Code MAY NOT be carried out on the land.

Demolition Code:

Complying development under the Demolition Code MAY NOT be carried out on the land.

Subdivision Code:

Complying development under the Subdivision Code MAY NOT be carried out on the land.

Fire Safety Code:

Complying development under the Fire Safety code MAY NOT be carried out on the land.

Note: The abovementioned advice for all complying development codes is limited to identifying whether or not the land, the subject of this certificate, is on land where complying development may be carried out because of Clauses 1.17A (1), (1)(c) to (e), (2), (3) and (4), 1.18(1)(c3) and 1.19 of State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 (the Codes SEPP). There may be other requirements under the Codes SEPP or another Environmental Planning Instrument that needs to be satisfied.

4. Coastal Protection

4.1 Is the land affected by the operation of section 38 or 39 of the Coastal Protection Act 1979, but only to the extent that the Council has been notified by the Department of Services, Technology and Administration?

The land IS NOT affected by the operation of section 38 or 39 of the Coastal Protection Act 1979 (which Council is aware).

4a Certain Information Relating To Beaches And Coasts

4a.1 Whether an order has been made under Part 4D of the Coastal Protection Act 1979 in relation to temporary coastal protection works (within the meaning of that Act) on the land (or on public land adjacent to that land), except where the council is satisfied that such an order has been fully complied with.

The land IS NOT affected by an order under 4D of the *Coastal Protection Act*.

4a.2(a) Whether the council has been notified under section 55X of the Coastal Protection Act 1979 that temporary coastal protection works (within the meaning of the Act) have been placed on the land (or on public land adjacent to that land).

The land IS NOT affected by temporary coastal protection works.

4a.2(b) Whether the council is satisfied that the works referred to in 4A.2(a) have been removed and the land restored in accordance with the *Coastal Protection Act 1979*.

Not applicable.

4b. Annual Charges Under Local Government Act 1993 For Coastal Protection Services That Relate To Existing Coastal Protection Works

The land IS NOT subject to annual charges under section 496B of the Local Government Act 1993 for coastal protection services relating to existing coastal protection works to which the owner (or any previous owner) of the land has consented.

Note: "existing coastal protection works" are works to reduce the impact of coastal hazards on land (such as seawalls, reetments, groynes and beach nourishment) that existed before the commencement of section 553B of the Local Government Act 1993.

5. Mine Subsidence

5.1 Is the land proclaimed to be a mine subsidence district within the meaning of section 15 of the Mine Subsidence Compensation Act 1961?

The land IS NOT within a proclaimed Mine Subsidence District under the Mine Subsidence Compensation Act 1961.

6. Road Widening And Road Realignment

Council's records indicate that the land the subject of this Certificate is not affected by any road widening or road realignment under:- (1) Section 25 of the Roads Act 1993; or (2) any environmental planning instrument; or (3) any resolution of the Council.

7. Council and Other Public Authority Policies on Hazard Risk Restrictions

Council's records indicate that the land subject of this certificate IS NOT affected by RAAF Base Williamtown & Salt Ash Weapons Range 2025 ANEF (10th August 2011); or the Aircraft Noise Planning Area within Port Stephens Development Control Plan 2014 - Chapter B7 Aircraft Noise for Buildings.

7A. Flood Related Development Controls Information

Development on the land or part of the land for the purposes of dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings or any other purpose IS NOT subject to flood related development controls.

8 Land Reserved For Acquisition

8.1 Does any environmental planning instrument or proposed environmental planning instrument referred to in item 1 above make provision in relation to the acquisition of the land by a public authority, as referred to in section 27 of the Environmental Planning & Assessment Act?

Port Stephens Local Environmental Plan 2013 DOES NOT provide for the acquisition of this land, or part thereof, by a public authority as referred to in Section 27 of the Environmental Planning and Assessment Act 1979.

9. Contributions Plan

9.1 Which contributions plan/s apply to the land?

* Port Stephens Section 94 Development Contributions Plan 2007.

* Port Stephens Section 94A Development Contributions Plan 2006.

Note: These documents specify development contributions required towards the cost of providing additional community services or facilities if a property is developed. They are available on request from Council or can be viewed www.portstephens.nsw.gov.au.

9a Biodiversity Certified Land

9a.1 Is the land biodiversity certified land (within the meaning of Part 7AA of the Threatened Species Conservation Act 1995)?

No

10. Biobanking Agreements

10.1 Is there a biobanking agreement for the land under Part 7A of the Threatened Species Conservation Act 1995, that council is aware?

No

11. Bush Fire Prone Land

11.1 Is any of the land bushfire prone land as defined in the Environmental Planning & Assessment Act 1979?

The land IS shown as bush fire prone land in Council's records. Further details of any applicable restrictions on development of the land may be obtained on application to Council. For further information, please contact Council's Duty Officer by telephoning 49800115.

12. Property Vegetation Plans

12.1 Does a property vegetation plan under the Native Vegetation Act 2003 apply to the land, being a plan to which the council has been notified of its existence by the person or body that approved the plan under the Act?

Council has not been notified of any Property Vegetation Plans under the Native Vegetation Act 2003 that affect the land to which this certificate applies.

13. Orders Under Trees (Disputes Between Neighbours) Act 2006

13.1 Has an order been made under the Trees (Disputes Between Neighbours) Act 2006 to carry out work in relation to a tree on the land, being an order to which the council has been notified of?

The land IS NOT affected by an order under the Trees (Disputes Between Neighbours) Act 2006 (of which Council is aware).

14. Directions Under Part 3a

14.1 Is there a direction by the Minister in force under section 75P(2)(c1) of the Environmental Planning & Assessment Act 1979 that a provision of an environmental planning instrument prohibiting or restricting the carrying out of a project or a stage of a project on the land under Part 4 of the Act does not have effect?

The land IS NOT affected by a direction by the Minister, in force under section 75P(2) (c1) of the Environmental Planning and Assessment Act 1979.

15. Site Compatibility Certificates And Conditions For Seniors Housing

- 15.1** If the land is land to which State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004 applies, is there a current site compatibility certificate (seniors housing), of which the council is aware, in respect of proposed development on the land?

Site Compatibility Certificate:

Council is not aware of a site compatibility certificate (seniors housing) issued in respect of the subject land.

Condition of Consent:

No terms referred to in clause 18(2) of the policy have been imposed as a condition of development consent in respect of the land to which this certificate relates.

16. Site Compatibility Certificates For Infrastructure

- 16.1** Is there a valid site compatibility certificate (infrastructure), of which the council is aware, in respect of proposed development on the land?

The land IS NOT affected (of which Council is aware) by a valid site compatibility certificate (infrastructure) issued under the State Environmental Planning Policy (Infrastructure 2007).

17. Site Compatibility Certificates And Conditions For Affordable Rental Housing

- 17.1** Is there a current site compatibility statement (affordable rental housing), of which the council is aware, in respect of proposed development on the land?

The land IS NOT affected by a current site compatibility certificate (of which Council is aware) issued under State Environmental Planning Policy (Affordable Rental Housing) 2009.

- 17.2** Have any terms of a kind referred to in clause 17(1) or 38(1) of the State Environmental Planning Policy (Affordable Rental Housing) 2009 been imposed as a condition of consent to a development application in respect of the land?

The land IS NOT affected by any terms of a kind (of which Council is aware) referred to in clause 17(1) or 38(1) of State Environmental Planning Policy (Affordable Rental Housing) 2009 that have been imposed as conditions of consent to a development application granted after 11th October, 2007 in respect of the land.

18. Section 59(2) of the Contaminated Land Management Act 1997

There are no prescribed matters under section 59(2) of the Contaminated Land Management Act 1997 to be disclosed.

19. Section 26 of the National Building and Jobs Plan (State Infrastructure Delivery) Act 2009

The land IS NOT subject to any exemption under Section 23 or authorisation under Section 24 of the Act (which Council is aware).

20. Loose Filled Asbestos Insulation

The land DOES NOT include any residential dwelling identified on the Loose-Fill Asbestos Insulation Register as containing loose-fill asbestos ceiling insulation. For further information, please contact Department of Fair Trading by telephoning 13 77 88 or go to their website at www.fairtrading.nsw.gov.au.

For further information please contact the Strategy & Environment Section on 02 4980 0326.

Wayne Wallis
General Manager

Per: _____



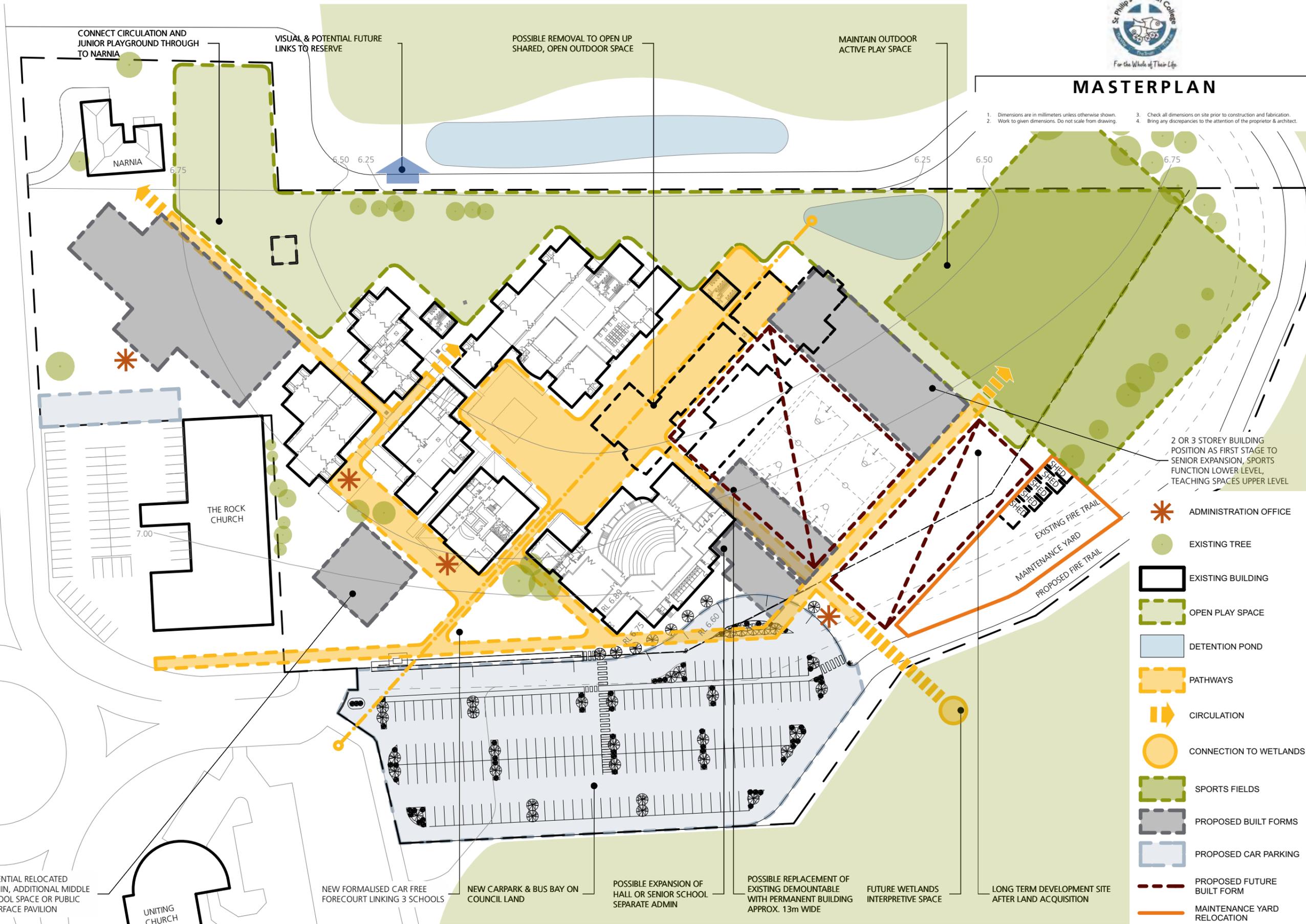
Appendix B – SPCC site masterplan

Undertaken by SHAC – 1st June 2016



MASTERPLAN

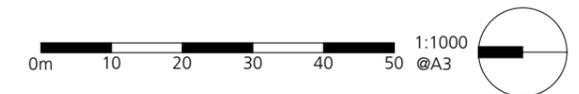
1. Dimensions are in millimeters unless otherwise shown.
2. Work to given dimensions. Do not scale from drawing.
3. Check all dimensions on site prior to construction and fabrication.
4. Bring any discrepancies to the attention of the proprietor & architect.



Drawing and design © SHAC Pty Ltd 2016. The signed control copy of this drawing is held by SHAC Pty Ltd. | Ref: Volume/Projects/26003676-SPCC Port Stephens/515 Sketch Design/0676.515.005.100%Masterplan.pln date: 15/06/2017 time: 3:26 PM

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Masterplan - Proposed Ground Floor
St Philip's Christian College, Port Stephens Campus
182 Salamander Way, Salamander Bay



Appendix C – Traffic Assessment Report

Report undertaken by Better Transport Futures – July 2016





BETTER TRANSPORT FUTURES
MARK WAUGH



St Philip's Christian Colleges

Port Stephens

Traffic Impact Statement
July 2016



Mark Waugh Pty Ltd

ABN 67 106 169 180

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1.3 Report Format

The remainder of this report is structured as follows:

- Section 3 describes the existing traffic and transport conditions in the vicinity of the School
- Section 4 details the proposed development of the campus as described in the School masterplan
- Section 5 outlines the road network considerations requiring assessment
- Section 6 presents results of the road network performance evaluation
- Section 7 summarises our findings and conclusions on this matter.

2.2 Local Roads

Access to the School campus is provided from Salamander Way, at the intersection of Bagnall Beach Road. The site has a single vehicle access point as a fourth leg from the roundabout intersection of these roads, with access provided on either side of the link to two existing churches.

Salamander Way

Salamander Way is the main collector road serving the Salamander Bay area to the main road system. The School site is about 1 km west of the junction of Salamander Way with the main road serving the Port Stephens area, the B63 Nelson Bay Road.



Photo 1 – Salamander Way heading west toward Bagnall Beach Road

In the immediate vicinity of the School it is constructed as a 2 lane undivided carriageway.



Photo 2 – Salamander Way looking east from the School crossing

2.3 School Access

The School vehicular access is via one road connected to the Salamander Bay / Bagnall Beach Road roundabout.

It provides access to the School, its pick up / set down area, car parking and also two neighbouring churches.

The churches and the School have informal arrangements in place whereby they allow short term use of their parking facilities at different times of the week. This works well, with church activities focussed on weekends and around the middle of the day, and school peak movements on term weekdays at the beginning and end of the School day activities.

The School also makes use of an existing temporary car park adjacent to the set down / pick up area.



Photo 5 – School access road PM pick up activity – Looking toward Salamander Way roundabout



Photo 6 – School Pick-Up Area during PM pick-up activity



Photo 9 – Bus and Car Traffic currently uses same set down pickup area



Photo 10 – School set down pick-up 'roundabout'



Photo 13 – Admin Car park Access



Photo 14 – Merging of traffic – Admin Car Park and Pick UP zone T

General Site Observations

Observations of traffic movements have been undertaken by the School over several days across varied weeks and also independently. The results proved to be fairly consistent over the period of observations. It confirms on average there is around 220 car movements through the College set down / pick up area (the roundabout) in the space of about 25 minutes. This level of activity causes short pressure on the council roundabout on Salamander Way with buses and cars utilising the same space, and with only 3 drop off spaces.

The most significant findings from a traffic movement efficiency and road safety perspective that were observed from the data monitoring and site work were:

1. Morning drop off activity around the School campus was generally orderly, and was not observed as impacting significantly on the external road network. This is because of the extended time frame over which arrival at the School drop off zone occurs when compared to afternoon pick up activity.
2. Pick up activity commences at least 30 to 45 minutes before bell time, with parents and carers utilising the range of parking, both in the church car parks and in some instances on road verges.
3. Some uncontrolled parking did occur during the PM pick up period where practical capacity (100%) is reached for a very short period (15 to 30 minutes)
4. Some parking occurs on Salamander Way, where parents take advantage of the controlled pedestrian crossing allowing older students to avoid the congestion within the School access.
5. There is no formal queuing all call up system currently utilised at the School and so it becomes a first in first out proposition.
6. Bus movements in the PM were sometimes hindered by queuing cars in the pick-up forecourt area. There is limited separation of cars and buses with the queuing space for the limited car pick up bays immediately behind the designated bus bays.
7. Pedestrians moving from more remote parking locations (e.g. the church car parks) sometimes were placed in conflict with the vehicle movements.

The overall impression gained from the site observations was that the PM pick up activity would benefit from some rationalisation of parking and traffic management arrangements.

2.6 Cycling / Pathway Facilities

Port Stephens Council adopted the Port Stephens Pathways Plan in May 2016.

This is a series of maps that show existing footpaths and shared paths throughout the Local Government Area, as well as identifying locations for future pathways construction when funding becomes available. The future pathway program allows Council to prioritise construction and to apply for grant funding to assist Council in the provision of pathway connections and missing links.

In the vicinity of the School the extent of the existing pathway network is limited. A copy of the plan covering the immediate area is include as Appendix B – (Source: Port Stephens Pathways Plan – Sheet 20)

2.7 Public Transport Services

Public transport for the School is provided by Port Stephens Coaches under a Community Service Obligation (CSO) to the NSW Government.

The School owns and operates 2 minibuses for specific school activities, as well as the scheduled school commuting services, and regular bus routes on Salamander Way, there is a reasonably high degree of patronage of the bus services. The bus network maps, are illustrated in **Appendix C**.

The combined existing parking supply available for school use at critical set town and pick up times is 149 spaces. This includes the temporary (unsealed) parking on adjacent land, and the current agreement in place to utilise the facilities of the neighbouring Church of Christ car park. It does not include any allowance for use of the United Church car park which is only available intermittently.

Allowing for development of new parking, the net surplus in available parking will be 118 spaces. Even excluding the parking available through the agreement with the neighbouring Church of Christ, the surplus parking would still be 62 spaces over the DCP requirement.

Thus the School plans can be seen to more than satisfy the Council's Development Control Plan requirements for car parking taking into account the planned growth nominated in Table 4.1.

In terms of overall supply, this increase in parking is very beneficial, and represents more than double the existing parking supply. This coupled with a planned increase in enrolments of only around 50% over existing levels will ease the burden on alternate car parking and make the School effectively self-sufficient in this regard.

Also of significance is the increase in the bus set down / pick up area from 3 to 10 spaces. And the car pick up / set down area increases from 3 to 14 spaces.

Based on the planned expansion of school enrolments, and subsequent increase in staffing levels as well this level of proposed set down / pick up and parking facilities, represents a major improvement in the School's ability to accommodate its set down, pick up and parking demands within its own facilities.

3.3 Bicycle Parking

The potential for school enrolments to increase up to 1200 students would see a requirement for up to 66 bike storage spaces being required under Councils current DCP requirements. The School currently has a dedicated area behind the kindergarten class rooms for bike storage. This has the potential to accommodate extra bikes if demand were to increase. If needed, the School has plenty of flexibility in terms of creating another bike storage location if required.

3.4 Traffic Generation Potential

The School development potential has been considered when assessing patronage levels, traffic and parking generations etc. For the purposes of this exercise a series of assumptions have been made about these key factors, essentially that the existing mode split is retained, and that the amount of travel by car increases proportionally in line with assumed student growth.

Table 3 – Applied Traffic Generation Rates presents the calculated traffic generation characteristics of the key activities under consideration in the revision of the School's masterplan.

Table 3 – Applied Traffic Generation Rates

| Masterplan Component | AM Peak Trip Rate (vph) | PM Peak Trip Rate (vph) | Factor |
|--------------------------|-------------------------|-------------------------|--|
| Existing School Activity | 266 IN 284 OUT | 166 IN 122 OUT | Total Movements (Staff/ Student / Parents/ Carers) |
| Sports Centre | - | - | Ancillary Use |
| With Student Growth | 418 IN 446 OUT | 261 IN 192 OUT | Total Movements (Staff/ Student / Parents/ Carers) |
| TOTALS | | | |

Notes:

1. All peak trip rates are expressed in vehicles per hour (vph)
2. GFA – Gross Floor Area
3. GLFA – Gross Leasable Floor Area

The PM data set indicates that during the surveyed afternoon period associated with normal school pick up activities, the two-way traffic flow along Salamander Way east of Bagnall Beach Road was in the order of 1450 vph (773 EB +686 WB), somewhat more than the morning peak observed. These directional flows though are again well within the technical capacity of urban traffic lanes.

PM Peak flows on Bagnall Beach Road were observed at similar levels, around 1180 vph two way. (592 NB +588 SB) Well within the capacity of a 4 lane dual carriageway urban road.

For the School access as would be expected, the two way traffic flows are lower again, around 390 vph two way. (203 NB + 187 SB). Again the flows observed are within the technical mid-block capacity of urban traffic lanes, and within the Level of Service 'B' range. (See Table 5.2 below) What is evident form the survey results is that the School peak is only around 30 minutes long.

A summary of the Thursday traffic data is presented in **Table 5.1 – Existing Traffic Volumes** below.

Table 5.1 – Existing Traffic Volumes

| Road | Peak Period | Peak flow (1) | Mid-Block Road Capacity | Level of Service |
|--|-------------|----------------------------------|--|------------------|
| Salamander Way (East of Bagnall Beach Road) | AM peak | 589 eastbound 690 westbound | 600 (one-way) ⁽²⁾ 900 (one-way) ⁽²⁾ | C D |
| | PM peak | 773 eastbound 686 westbound | 900 (one-way) ⁽²⁾ 900 (one-way) ⁽²⁾ | D D |
| Bagnall Beach Rd (North of Salamander Way) | AM peak | 447 northbound 552 southbound | 900 (one-way) ⁽³⁾ | A A |
| | PM peak | 592 northbound 588southbound | 900 (one-way) ⁽³⁾ 900 (one-way) ⁽³⁾ | A A |
| School Access (South of Salamander Way) | AM peak | 266 northbound 284 southbound | 380 (one-way) ⁽²⁾ 380 (one-way) ⁽²⁾ | B B |
| | PM peak | 203 northbound 187 southbound | 200 (one-way) ⁽²⁾ 200 (one-way) ⁽²⁾ | A A |

Notes: 1. Peak flow from 2nd June 2016 traffic survey results by Mark Waugh Pty Ltd
 2. RTA 2002, Urban Road Conditions, One Lane, Level of Service (Refer Table 5.2 below)
 3. RTA 2002, Urban Road Conditions, Two Lanes, Level of Service (Refer Table 5.2 below)

Table 5.1 demonstrates that both approach roads to the School campus are currently operating well within their technical and functional lane capacity levels as described by Austroads and NSW RMS guidelines.

The results above are drawn from the urban flow conditions Levels of Service definitions as presented in the Guide to Traffic Generating Developments ((NSW ART October 2002) Theses are reproduced here as **Table 5.2 – Urban Road peak hour flows per direction**, overleaf. It can be seen that the ultimate capacity for College Crescent for example in this location is around 1,400 vehicles per hour in one direction. For the current observed traffic flows along Marconi Road and Ironbark Road it can be seen that the level of service for road users is A.

Table 5.2 – Urban Road peak hour flows per direction

| Level of service | One Lane (vph) | Two Lanes (vph) |
|------------------|----------------|-----------------|
| A | 200 | 900 |
| B | 380 | 1400 |
| C | 600 | 1800 |
| D | 900 | 2200 |
| E | 1400 | 2800 |

Source: RTA Guide to Traffic Generating Developments, version 2.2 dated October 2002.

4.5 Trip Distribution and Assignment

Additional trip generation, then distribution and assignment has been assumed to be consistent with the observed existing flow patterns. The additional flows have been assigned on a pro rata basis from the assumed increase in student enrolments, resulting in around 30% increase in approach and departure flows for the expanded school operations. This is based on student enrolments increasing from the existing 930 students to around 1200 students in the future.

4.6 Revised Site Entry and Parking Arrangements

With the incorporation of expanded formal parking arrangements on the available land adjacent to the School campus, the following access and parking arrangements have been developed:

1. All vehicular access is via the existing connection to the Salamander Way / Bagnall Beach Road roundabout.
2. A separate car set down area catering for up to 14 car spaces is proposed in the location of the existing car and bus set down and pick up "roundabout" outside the main school entrance.
3. The existing car park adjacent to the School administration building is retained as visitor parking, with room for up to 12 short term and 17 visitor spaces
4. A separate bus set down and pick up lane is proposed with room for up to 10 buses. The entry lane for this area is one way, with buses leaving via a dedicated bus exit lane around the adjacent car park.
5. An expanded parking area of 164 spaces for general parking (Staff, Students, parents and carers.)
6. Total parking supply of 222 car spaces and 10 buses. Note this does not place any reliance on the existing arrangements of 56 spaces via agreement with the adjacent Church of Christ, which are understood to also still be available for school set down and pick up activity.
7. This level of parking provision represents a doubling of available parking for school operations.
8. Growth in student enrolments has been assumed at 1200, up from the current 765 students. This represents about a 55% increase in enrolments.
9. On this basis the ratio of parking supply to school parking demands will be improved considerably.
10. Intersection operation at the Salamander Way / Bagnall Beach Road roundabout has been assessed as being well within technical capacity limits for this type of junction control.
11. Even allowing for the around 55% increase in school activity the intersection is forecast to continue to operate within its technical capacity limits.
12. Site observations have indicated that there is a very short term queuing issue in the PM pick up period that leads to queuing back through the Salamander Way / Bagnall Beach Road roundabout. This activity is generally completed within a period of no more than 30 minutes, with most queuing occurring on the side roads such as the School access.

The conclusions drawn from these investigations are that the proposed site entry and car parking arrangements proposed for the expanded school operations will result in an improved ratio of parking supply to levels of school enrolments. By providing additional parking on site and adjacent to the School it is expected that conditions on the surrounding network will be improved also as some existing parking activity would be expected to transfer to the new parking facilities. Thus the School's proposal for additional parking and expanded pick up and set down areas is supported as a positive contribution traffic and road operations.

Table 6.1 – Forecast Traffic Volumes

| Road | Peak Period | Peak flow (1) | Mid-Block Road Capacity | Level of Service |
|--|-------------|----------------------------------|--|------------------|
| Salamander Way (East of Bagnall Beach Road) | AM peak | 671 eastbound 872 westbound | 900 (one-way) ⁽²⁾ 900 (one-way) ⁽²⁾ | D D |
| | PM peak | 801 eastbound 767 westbound | 900 (one-way) ⁽²⁾ 900 (one-way) ⁽²⁾ | D D |
| Bagnall Beach Rd (North of Salamander Way) | AM peak | 559 northbound 723 southbound | 900 (one-way) ⁽³⁾ | A A |
| | PM peak | 695 northbound 650 southbound | 900 (one-way) ⁽³⁾ 900 (one-way) ⁽³⁾ | A A |
| School Access (South of Salamander Way) | AM peak | 418 northbound 455 southbound | 600 (one-way) ⁽²⁾ 600 (one-way) ⁽²⁾ | C C |
| | PM peak | 319 northbound 294 southbound | 380 (one-way) ⁽²⁾ 380 (one-way) ⁽²⁾ | B B |

Notes: 1. Peak flow from 2nd June 2016 traffic survey results by Mark Waugh Pty Ltd
 2. RTA 2002, Urban Road Conditions, One Lane, Level of Service (Refer Table 5.2 below)
 3. RTA 2002, Urban Road Conditions, Two Lanes, Level of Service (Refer Table 5.2 below)

The results shown in Table 6.1 indicate that forecast flows generally remain at or better than the acceptable Level of Service range (LoS 'D') for urban flow conditions. It is noted though that flows in the PM peak period eastbound on Salamander Way are approaching the LoS 'D' threshold of 900 vehicles per hour in a single lane. Given the nature of school activity peaks being quite sharp for around 30 minutes, the short term capacity limit is likely to be under pressure, even though the full hour flows may be within the capacity limits. Austroads estimates the typical capacity of a single lane at between 1200 to 1400 vehicles per hour per lane. This type of flow level can be achieved were there is limited disruption to the traffic flow stream. However given the increase in parking that will be available adjacent to the main school entrance it is anticipated that the level of school activity occurring on Salamander Way will reduce.

Appendix D. SIDRA⁷ Traffic Modelling Summaries

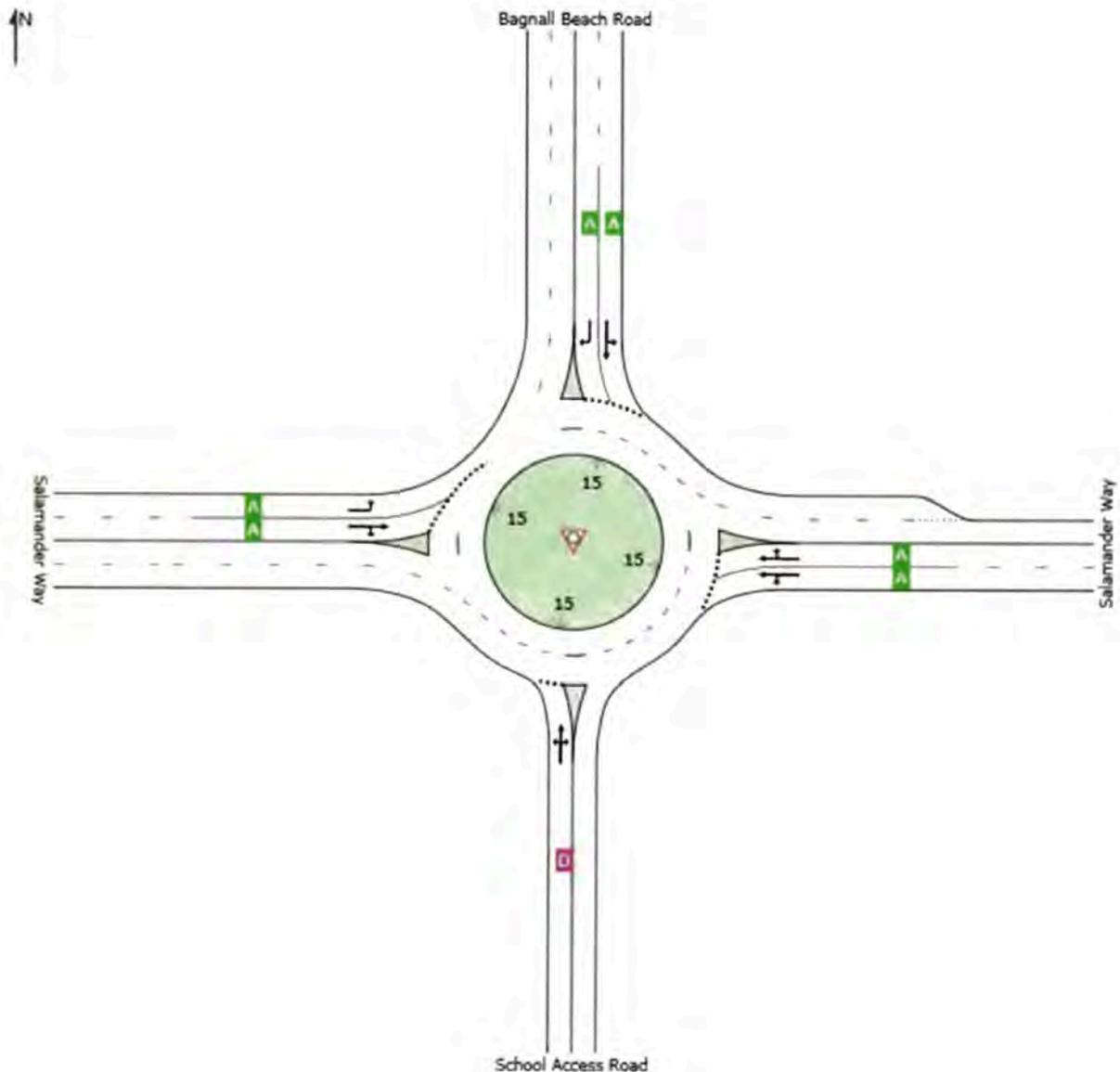
Lane Level of Service

Site: 101 [Salamander Way & Bagnall Beach Rd AM 30 Mins 2016 +Dev't]

Forecast AM 30 Minutes Roundabout Control

All Movement Classes

| | South | East | North | West | Intersection |
|-----|-------|------|-------|------|--------------|
| LOS | D | A | A | A | B |



Site Level of Service (LOS) Method: Delay (RTA NSW).

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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Appendix E. Traffic Movement Surveys - June 2016



QUALITY ENDORSED COMPANY BY AS/NZS ISO 9001:2008
OHS SYSTEM CERTIFIED TO AS/NZS ISO 4801:2001

TURNING MOVEMENT SURVEY

Bagnall Beach Road and Salamander Way, Nukaba
Thursday, 12 May 2016

| | |
|-----------|------------------|
| Weather: | Overcast |
| Suburban: | Nukaba |
| Customer: | Better Transport |

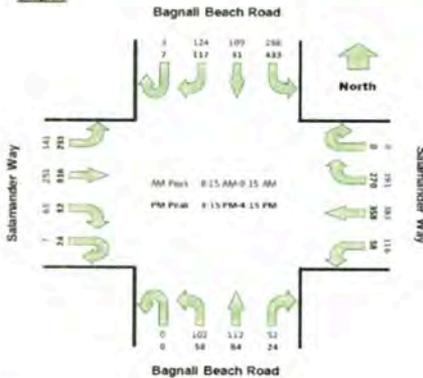
| | |
|--------------|-----------|
| Survey Start | AM: 8:00 |
| | PM: 14:30 |

| | |
|----------|---------------------|
| Peakhour | AM: 8:15 AM-9:15 AM |
| | PM: 3:15 PM-4:15 PM |

| Time | North Approach Bagnall Beach Road | | | | East Approach Salamander Way | | | | South Approach Bagnall Beach Road | | | | West Approach Salamander Way | | | | Hourly Total | Peak |
|-------------|-----------------------------------|----|----|-----|------------------------------|----|-----|----|-----------------------------------|----|----|----|------------------------------|----|----|----|--------------|------|
| | U | R | SB | L | U | R | WB | L | U | R | NB | L | U | R | EB | L | | |
| 8:00-8:15 | 0 | 24 | 19 | 92 | 0 | 32 | 64 | 13 | 0 | 4 | 7 | 8 | 0 | 12 | 52 | 25 | 1937 | |
| 8:15-8:30 | 2 | 34 | 58 | 69 | 0 | 46 | 91 | 48 | 0 | 13 | 41 | 39 | 0 | 26 | 58 | 39 | 1942 | Peak |
| 8:30-8:45 | 0 | 22 | 38 | 69 | 0 | 38 | 89 | 59 | 0 | 24 | 50 | 48 | 0 | 28 | 54 | 41 | 1760 | |
| 8:45-9:00 | 1 | 43 | 9 | 70 | 0 | 56 | 114 | 5 | 0 | 12 | 16 | 14 | 4 | 8 | 69 | 30 | 1512 | |
| 9:00-9:15 | 0 | 25 | 4 | 78 | 0 | 51 | 89 | 4 | 0 | 3 | 5 | 1 | 3 | 3 | 60 | 31 | 1061 | |
| 9:15-9:30 | 0 | 32 | 4 | 88 | 0 | 58 | 101 | 1 | 0 | 1 | 1 | 2 | 3 | 1 | 59 | 31 | | |
| 9:30-9:45 | 0 | 34 | 2 | 54 | 0 | 38 | 67 | 1 | 0 | 1 | 0 | 0 | 7 | 6 | 56 | 37 | | |
| 9:45-10:00 | 0 | 38 | 5 | 63 | 0 | 41 | 97 | 6 | 0 | 0 | 0 | 0 | 4 | 4 | 72 | 44 | | |
| 14:30-14:45 | 0 | 36 | 7 | 92 | 0 | 45 | 84 | 4 | 0 | 1 | 3 | 7 | 8 | 8 | 80 | 36 | 1867 | |
| 14:45-15:00 | 1 | 26 | 24 | 75 | 0 | 35 | 85 | 12 | 0 | 0 | 1 | 0 | 9 | 11 | 64 | 49 | 1890 | |
| 15:00-15:15 | 2 | 34 | 20 | 100 | 0 | 40 | 74 | 37 | 0 | 6 | 26 | 20 | 5 | 10 | 70 | 38 | 2006 | |
| 15:15-15:30 | 2 | 25 | 11 | 119 | 0 | 54 | 69 | 28 | 0 | 11 | 66 | 45 | 3 | 15 | 75 | 59 | 2042 | Peak |
| 15:30-15:45 | 2 | 31 | 4 | 85 | 0 | 56 | 96 | 14 | 0 | 5 | 10 | 5 | 5 | 2 | 69 | 50 | 1870 | |
| 15:45-16:00 | 2 | 30 | 9 | 115 | 0 | 87 | 94 | 3 | 0 | 6 | 2 | 3 | 9 | 5 | 81 | 62 | | |
| 16:00-16:15 | 0 | 31 | 7 | 114 | 0 | 73 | 99 | 13 | 0 | 2 | 6 | 5 | 7 | 10 | 91 | 60 | | |
| 16:15-16:30 | 2 | 29 | 5 | 62 | 0 | 73 | 104 | 4 | 0 | 1 | 3 | 0 | 6 | 4 | 68 | 49 | | |

| Peak Time | North Approach Bagnall Beach Road | | | | East Approach Salamander Way | | | | South Approach Bagnall Beach Road | | | | West Approach Salamander Way | | | | Peak total |
|------------------|-----------------------------------|-----|-----|-----|------------------------------|-----|-----|-----|-----------------------------------|----|-----|-----|------------------------------|----|-----|-----|------------|
| Period Start/End | U | R | SB | L | U | R | WB | L | U | R | NB | L | U | R | EB | L | |
| 8:15-9:15 | 3 | 124 | 109 | 286 | 0 | 191 | 383 | 116 | 0 | 52 | 112 | 102 | 7 | 65 | 251 | 141 | 1942 |
| 15:15-16:15 | 7 | 117 | 31 | 433 | 0 | 270 | 358 | 58 | 0 | 24 | 84 | 58 | 24 | 32 | 316 | 231 | 2043 |

Graphic



Cyclists

| Time | North Approach Bagnall Beach Road | | | | East Approach Salamander Way | | | | South Approach Bagnall Beach Road | | | | West Approach Salamander Way | | | | |
|-------------|-----------------------------------|---|----|---|------------------------------|---|----|---|-----------------------------------|---|----|---|------------------------------|---|----|---|---|
| | U | R | SB | L | U | R | WB | L | U | R | NB | L | U | R | EB | L | |
| 8:00-8:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8:15-8:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8:30-8:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 8:45-9:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:00-9:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:15-9:30 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 9:30-9:45 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 |
| 9:45-10:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 14:30-14:45 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 14:45-15:00 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15:00-15:15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 15:15-15:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15:30-15:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15:45-16:00 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16:00-16:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16:15-16:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Pedestrians

| Time | North Approach | | East Approach | | South Approach | | West Approach | |
|-------------|----------------|-----------|---------------|-------|----------------|-----------|---------------|-------|
| | Eastbound | Westbound | North | South | Eastbound | Westbound | North | South |
| 8:00-8:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8:15-8:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8:30-8:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8:45-9:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:00-9:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:15-9:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:30-9:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9:45-10:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14:30-14:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14:45-15:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15:00-15:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 15:15-15:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 15:30-15:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 15:45-16:00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16:00-16:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16:15-16:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

BETTER TRANSPORT FUTURES

Appendix D – Geotechnical Report

Undertaken by Barker Harle – 10th March 2017



**PROPOSED PERFORMING ARTS
CENTRE, ST PHILLIP'S CHRISTIAN
COLLEGE SALAMANDER CAMPUS**

ACOR Consultants Pty Ltd
Salamander Bay

GEOTWARA21231AA-AB
16 February 2010

16 February 2010

St Philip's Christian College
C/- ACOR Consultants Pty Ltd
PO Box 459
NEWCASTLE NSW 2300

Attention: Richard Kidd

Dear Richard

**RE: PROPOSED PERFORMING ARTS CENTRE
ST PHILIP'S CHRISTIAN COLLEGE SALAMANDER CAMPUS
GEOTECHNICAL INVESTIGATION**

Please find enclosed a report describing geotechnical investigations carried out on the above site.

Guidance on the uses and limitations of this report is presented in the attached document, *'Important Information about your Coffey Report'*, which should be read in conjunction with this report.

If you have any further questions regarding this or any other project, please do not hesitate to contact Shannon Kelly or the undersigned on 02 4016 2300.

For and on behalf of Coffey Geotechnics Pty Ltd



Arthur Love

Senior Principal

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Pavement Thickness Design Summary Sheet

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Appendices

Appendix A: Results of Field Investigations

Appendix B: Results of Laboratory Testing

1 INTRODUCTION

This report presents the results of geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) for the proposed Performing Arts Centre at St Philip's Christian College Salamander Bay. The work was commissioned by Chris Walkling of St Philip's Christian College in an authorisation to proceed form dated 3 December 2009.

The site of the proposed performing arts centre is located within the existing college grounds. The proposed development is understood to involve construction of a new single storey structure with slab on ground construction on the western side of the existing cluster of college buildings. It is also understood a car park and driveway will be constructed southwest of the new building. Concept site plans for the proposed development including an existing site layout plan marked up with the approximate development areas were provided by the client.

The scope of work included providing recommendations on:

- Site preparation;
- Excavation conditions;
- The suitability of the site soils for use as fill an on fill construction procedures;
- Site classification in accordance with AS2870 Residential Slabs and Footings;
- Alternative footing types and founding depths, including recommendations as to allowable bearing pressure and probable settlements;
- Retaining wall design parameters;
- A site factor for earthquake design;
- Special requirements for construction procedures and or site drainage;
- Advice on the presence of groundwater;
- Pavement design parameters and construction recommendations.

The following report presents the results of field investigations and laboratory testing and provides discussion and recommendations relevant to the above scope of work.

2 PREVIOUS EXPERIENCE

Previous experience by Coffey at the site includes:

- Geotechnical assessment undertaken in July 1996 for the school development which assisted design and construction of the existing structures at the site. The investigation included seven hand augered boreholes and dynamic penetrometer tests which generally encountered a deep (>4m) profile of medium dense to dense sand judged to be of alluvial origin, with a groundwater table at roughly RL4m AHD;
- Geotechnical services and testing undertaken in late 1996 during and following Stage 1B site regrading activities. It was noted that clean sand sourced from cuts and stockpiles at the site was placed to depths ranging from 0.0m to 2.0m. 32 dynamic penetrometer tests were undertaken in the controlled fill area comprising the northern side of the Lot to confirm that fill compaction had resulted in sufficient density indexes (>70%) being achieved.

3 FIELD WORK

Field work was carried out on 14 December 2009 and comprised of the following:

- Observations of surface features on the property and the surrounding area by an experienced Engineering Geologist;
- Drilling of three boreholes using hand auger methods to depths of between 2.1m to 2.9m, with samples of represent materials taken for subsequent laboratory testing;
- Dynamic Penetrometer (DCP) tests were carried out adjacent to each borehole and at five other locations across the site to assess the in-situ density of site soils.

All field work was carried out in the full time presence of an Engineering Geologist from Coffey who located the boreholes, carried out the sampling and testing and produced engineering logs of the boreholes. Engineering logs of the boreholes are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation. Borehole locations were obtained by tape measurements relative to surface features, and are shown on Figure 1.

4 SITE CONDITIONS

4.1 Surface Conditions

The proposed building area is located on the western side of St Philip's Christian College, at Salamander Bay. The college is located on the site of a former sand mining lease and is bounded by a Christian Outreach Centre to the north and old sand mining leases along the east, west and south. A wetland is situated about 25m to 50m west of the site.

Topographically the site is located on a low lying sand plain associated with Tertiary sand beds of the area. The site is flat to slightly sloping at about 1° to the west, towards the wetlands.

Drainage appeared to be by both overland flow to the west, and via infiltration into the sandy soils.

Vegetation on the site included established lawns. Part of the site was not vegetated and was occupied by a driveway and car park comprising unsealed pavement.

4.2 Subsurface Conditions

Reference to the 1:250,000 scale Newcastle Coalfield Regional Geological Series Sheet indicates the site is underlain by the Shoal Bay sands.

The soil profile encountered in the boreholes HA101 to HA103 generally included an upper layer of FILL which comprised fine to medium grained sand to a depth of 1.0m in HA101. In HA102 and HA103 the FILL comprised Sandy Gravel to depths of about 0.2m. The FILL was assessed to be underlain by Alluvial Sands extending to the maximum depth of investigation of 2.9m (HA101).

Based on the results of dynamic penetrometer testing, the sands encountered at the three boreholes and other areas of the site where DCP tests were carried out, were judged to generally be dense to very dense from the ground surface to depths of about 1.0m to 1.8m below the surface. The dense to very dense sands were assessed to be underlain by medium dense to dense sands with loose layers in some places. It is possible that the upper sands had been compacted during previous site activities including regrading and compaction works carried out in 1996, and compaction of driveway and car park pavements.

The subsurface profiles encountered at the borehole locations are presented on the appended engineering logs and have been divided into geotechnical units as summarised in Table 1.

TABLE 1 – SUMMARY OF SOIL TYPES

| GEOTECHNICAL UNIT | MATERIAL TYPE | DESCRIPTION |
|--------------------------|----------------------|--|
| UNIT 1 | FILL | SAND fine to medium grained, brown to dark brown, trace gravel fine to medium grained. and, Sandy GRAVEL, fine to coarse grained, brown to dark brown. Typically medium dense and dense. |
| UNIT 2 | ALLUVIUM | SAND, fine to medium grained, brown to dark brown, typically dense to very dense becoming medium dense to dense at depth. |

Table 2 contains a summary of the distribution of the above units in the borehole locations.

TABLE 2 - SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED AT EACH BOREHOLE LOCATION

| LOCATION | UNIT 1 | UNIT 2 | END OF HOLE |
|-----------------|------------------------|---------------|--------------------|
| | DEPTH IN METRES | | |
| HA101 | 0.00 - 1.00 | 1.00 - 2.90 | 2.90 |
| HA102 | 0.00 - 0.20 | 0.20 - 2.10 | 2.10 |
| HA103 | 0.00 - 0.20 | 0.20 - 2.40 | 2.40 |

Groundwater inflow was encountered depths of 2.5m, 1.9m to 1.9m in HA101 to HA103, respectively during the limited time that they remained open on the day of the investigation. It should be noted that fluctuations in groundwater levels may occur as a results of seasonal variations, temperature, rainfall or other similar factors, the influence of which may not have been apparent at the time of the assessment.

5 LABORATORY TESTING

Samples obtained during the field investigations were returned to Coffey's NATA registered Newcastle Laboratory for testing. To obtain information required for pavement design and construction, CBR (Californian Bearing Ratio) was carried out on a sample from the proposed car park area to assess the suitability of the existing gravel for re-use in pavement construction.

Full results of the geotechnical laboratory testing are presented in Appendix B with compaction and CBR results summarised in Table 3 below.

TABLE 3 – SUMMARY OF LABORATORY CBR TEST RESULTS

| LOCATION | MATERIAL | MAXIMUM DRY DENSITY (t/m ³) | OPTIMUM MOISTURE CONTENT | FIELD MOISTURE CONTENT | 4-DAY SOAKED CBR 5.0mm (%) |
|----------------------|--------------|---|--------------------------|------------------------|----------------------------|
| HA102 0.0 to 0.2m | Sandy GRAVEL | 2.00 | 6.6% | 2.4% | 70 |

These results indicate that the gravel Fill may have a CBR value in the order of 70% which would be considered suitable for use as Select Fill for pavement construction.

6 DISCUSSION AND RECOMMENDATIONS

6.1 Site Preparation and Fill Construction Procedures

Site preparation and earthworks suitable for structure and pavement support should consist of:

- Prior to construction of roads and placement of any fill, the proposed areas should be stripped to remove all vegetation, topsoil, root affected or other potentially deleterious material, including decommissioned buried pipes and cables, and a stripping inspection made prior to fill placement and compaction;
- Following stripping, the exposed subgrade should be proof rolled to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved clean granular material;
- Approved fill beneath access roads or car parks should be placed in layers not exceeding 300mm loose thickness and be compacted to a minimum density index of 70%, in accordance with AS1289 5.6.1 or equivalent for granular material, or a minimum density ratio of 95% Standard Compaction in accordance with AS1289 5.1.1 or equivalent for cohesive material. Clay subgrade fill should be placed and maintained at 60% to 90% of Optimum Moisture Content (OMC);
- The top 300mm of natural subgrade below pavements or the final 300mm of road subgrade replaced should be compacted to a minimum density index of 80% for granular material, or a minimum density ratio of 100% Standard Compaction or equivalent for cohesive material within the above stated moisture range;

- Site fill beneath structures should be compacted to a minimum density index of 70%, in accordance with AS1289 5.6.1 or equivalent for granular material, or a minimum density ratio of 95% Standard Compaction in accordance with AS1289 5.1.1 or equivalent within $\pm 2\%$ of OMC for cohesive material;
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;

Site preparation should include provision of drainage and erosion control as required as well as sedimentation control measures.

Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 '*Guidelines for Earthworks for Commercial and Residential Developments*'.

Based on the results of subsurface investigations, it is anticipated the majority of natural Alluvial/Aeolian sands excavated from the site would be suitable for re-use as fill around building areas including re-use of clean sand as backfill for retaining wall structures.

6.2 Excavation Conditions and Batter Slopes

Where excavation is required, it is anticipated that all site materials could be excavated by conventional bulldozer blade, excavator or backhoe bucket at least to the depths indicated on the attached field logs. Excavators should be equipped with a smooth-walled "gummy" bucket to avoid over-disturbance of site soils below any required bulk excavation level. Water inflow would be expected in excavations below depths in the order of 2m. Dewatering will be required to lower the water table during any unsupported excavation below the water table.

Care must be taken not to cause relaxation of ground supporting nearby structures during excavations on site. Measures involving temporary earthworks batters or shoring systems should be employed where necessary. Permanent and temporary earthworks batters in the existing site materials may be formed at angles no steeper than 1V:2.5H and 1V:2H, respectively.

6.3 Site Classification

The site was generally assessed to have a variable depth of sand fill overlying natural sand of similar characteristics. The density of the sand was evaluated at eight locations by means of the dynamic penetrometer driven to a maximum depth of 3.4m below the surface. The dynamic penetrometer is a qualitative assessment of density index.

Correlations have been estimated between the results of the dynamic penetrometer and density index for sands similar to those occurring on-site. These correlations indicate that the density of the sand fill in the area of the test locations was generally greater than 70% density index to depths of 2.0m or more. The sand below these depths was assessed to be generally medium dense or better. A density index of 70% is usually regarded as being in excess of a density ratio of 95% based on Standard Compaction.

Due to possible variability in density of the upper sand profile, the proposed building area is classified as Moderately Reactive, Class M, as defined in AS2870-1996. Footings for the proposed structure may be designed for a maximum free surface movement of 20mm to 40mm. The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection for the design value for differential movement.

The classification presented above assumes that:

- All footings are founded in controlled fill (if applicable) or in natural soils below all uncontrolled fill, topsoil material and root zones, and fill under slab panels meets the requirements of AS2870-1996, in particular, the root zone must be removed prior to the placement of fill materials beneath slab floors;
- The performance expectations set out in AS2870-1996 are acceptable;
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, 'Foundation Maintenance and Footing Performance: A Homeowner's Guide', a copy of which is attached;
- All structural footings (including edge beams, internal beams and load support thickenings) are to be founded outside of or below all zones of influence resulting from existing or future service trenches. That is service trenches backfilled with uncontrolled fill do not extend below a line extending out and down at 45° from the ground surface at the edge of the building.

Foundations should be designed and constructed in accordance with the recommendations and advice of AS2870-1996, '*Residential Slabs and Footings*'.

6.4 Foundations

6.4.1 Shallow Footings

Shallow footings such as strips and pads founded within the sands may be proportioned for a maximum allowable base bearing pressure of 100kPa. Prior to pouring, all footing locations should be tested by dynamic penetrometer to confirm the density profile of sands beneath the footprint. If loose zones are encountered, the area should either be improved by vibratory compaction or the footing can be supported by localised use of timber mini piles.

6.4.2 Deep Footings

Piled footing systems may include the following options:

- Displacement type 'Atlas' Screw Piles or driven timber / precast concrete piles founded into Unit 2 materials;
- Non-Displacement type Bored (progressively cased), Grout Injected or Screw Piles founded into Unit 2 materials.

The advice provided regarding pile footings is based on a maximum investigation depth of 3.5m. If it is proposed to install piles to depths within three pile diameters of or greater than 3.5m depth, additional investigation should be carried out to determine foundation conditions, in particular to check that no weaker layers are present below this depth.

Deep footings, such as bored piers, continuous-flight auger (CFA) piles and grout-injected piles, founded at depths greater than four effective diameters below natural ground level may be proportioned for a maximum allowable base bearing capacity of 1500kPa and a shaft adhesion of 25kPa based on the perimetral area of the pier throughout the natural soil horizon. These capacities are based on a serviceability criterion that settlements not exceed 1% of the effective pier diameter.

Driven piles provide resistance to load by both end bearing and shaft friction. Softwood timber mini-piles of 125mm toe diameter driven to a design set in medium dense to dense sands generally achieve working loads of about 75kN. Higher capacities may be achievable using larger diameter piles or hardwood timber piles. The ultimate bearing capacity of the pile may be determined from Hiley or wave equation analyses once hammer type, size and pile size and lengths are known. There is a risk of vibration induced damage to adjacent structures if driven piles are used, and this would need to be assessed by the contractor.

6.5 Retaining Wall Design and Construction

Retaining walls for in Unit 1 or Unit 2 sand or clean free draining sand backfill may be designed based on an effective friction angle of 30° , active earth pressure coefficient k_a of 0.33, and a passive earth pressure coefficient k_p of 3.0, and a density of 1.8 t/m^3 .

Retaining walls and temporary shoring should be designed for surcharge loading from slopes or structures above and behind the walls. Adequate subsurface and surface drainage should be provided behind all retaining walls. Allowance for hydrostatic pressures due to groundwater build-up should be made where appropriate.

Where excavations are close to lot boundaries or existing structures batter slopes are not feasible. These excavations will require immediate support. If relaxation of soils at site boundaries due to movement of retaining systems is to be minimised, or the retaining wall is relatively rigid/propped, Coffey recommends that retaining wall design be based on an at-rest earth pressure coefficient (k_0) of 0.50 for the sandy site soils.

6.6 Pavement Design

Flexible pavement design has been carried out with reference to ARRB Special Report No. 41 and APRG Report No. 21. The recommended material, construction specification and pavement makeup are presented on the attached Pavement Thickness Design Summary.

Flexible pavement thickness design has been based on the adopted design traffic loading and design CBR subgrade conditions as given below:

- Design Traffic Loading 2×10^4 ESA's (Local Access Road);
- Design CBR Value 10% (Assumed based on Sand Subgrade).

ESA's –Equivalent Standard Axle Repetitions (refer Austroads 1992) assuming 1 AADHV (Average daily heavy vehicles over 40 years assuming zero growth rate and growth factor).

If the design traffic loading differs from that assumed in this pavement design, or will be subject to regular tyre/axle loading exceeding normal heavy vehicle loads for RTA roads, further advice should be sought and a revised pavement design provided for these areas.

A design CBR of 10% has been adopted assuming the top 300mm of fill beneath pavements will comprise clean sand. If fill other than sand is proposed in the top 300mm beneath pavements, laboratory CBR testing should be undertaken on the material and revised pavement thickness design calculated.

It is recommended that the pavement be boxed out to the minimum subgrade level required by the pavement thickness design. Prior to pavement construction, the exposed subgrade should be assessed by a geotechnical authority who can confirm the subgrade condition and pavement thickness requirements. The pavement thickness design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. If clean sand fill is used to raise site levels, subsoil drains are not considered to be necessary.

6.7 Earthquake Geotechnical Parameters

The earthquake design may be based on a design site sub-soil class C_e - Shallow Soil.

6.8 Special Construction Requirements

6.8.1 Disturbed Ground

Careful examination should be made in the proposed building area for the presence of footings, service trenches and other subsurface structures associated with previous development of the lot. Where such structures are encountered, their removal and remediation should be documented by a geotechnical authority at the time of bulk excavation.

6.8.2 Vibrations during Construction

Care should be taken during site earthworks not to induce ground vibrations with the potential to cause damage to nearby structures. Excavation equipment should be selected to restrict such vibrations to levels that are within acceptable limits. Maximum tolerable vibration levels depend on the type of structure affected, its condition, and its proximity to the work area.

It should be noted that there is a risk of causing vibration-induced damage to adjacent buildings or structures with driven displacement piles. Vibration monitoring may be required if driven piles are to be used at the site and a dilapidation survey should be undertaken on nearby structures prior to pile driving.

6.8.3 Acid Sulfate Soils

Reference to the Port Stephens 1:25,000 Acid Sulfate Soil risk map published by DIPNR indicates the site is situated in an Aeolian swamp setting with natural ground surface levels of about RL 4m AHD. The risk map indicates the site is near the boundary between an area having low probability of occurrence of acid sulphate soils at depths of 1m to 3m below the natural ground surface, and an area having low probability of occurrence of acid sulphate soils at depths of greater than 3m below the natural ground surface. During the 1996 investigation, based on limited pH testing it was judged that acid sulfate potential was not significant. It is therefore considered that an Acid Sulfate Soils Management Plan is not necessary where excavations on this site are to depths above the water table (to depths of about 2m or less).

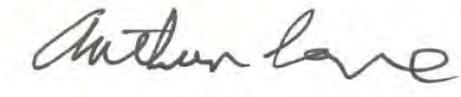
7 CONSTRUCTION RISK

The extent of testing associated with this assessment is limited to hand-augered boreholes and dynamic cone penetrometer tests at discrete locations. It should be noted that subsurface conditions between and away from the borehole and test locations may be different to those observed during the investigation and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

Contractors using this assessment as a basis for tendering should avail themselves of all relevant information before selection of equipment and materials.

For and on behalf of Coffey Geotechnics Pty Ltd

A handwritten signature in black ink that reads "Arthur Love". The signature is written in a cursive, flowing style.

Arthur Love

Senior Principal

pavement thickness design summary

| | | | |
|-------------|--|---------------|---|
| client : | ACOR CONSULTANTS PTY LTD | job no : | GEOTWARA21231AA |
| principal : | | laboratory : | NEWCASTLE |
| project: | PROPOSED PERFORMING ARTS CENTRE | report date : | 15/02/2010 |
| location : | ST PHILIPS CHRISTIAN COLLEGE SALAMANDER CAMP | designed by : | SJK |
| council : | PORT STEPHENS COUNCIL | checked by : |  |

| | | | | | |
|--------------------------------|--|-------------------|-------------------|--|--|
| road name or type: | | RIGID | RIGID | | |
| shoulder or no shoulder: | | SHOULDER | NO SHOULDER | | |
| design traffic loading: (HVAG) | | 4x10 ⁴ | 4x10 ⁴ | | |
| wearing course thickness: (mm) | | | | | |
| concrete thickness: (mm) | | 140 | 150 | | |
| sub-base thickness: (mm) | | 125** | 125** | | |
| select thickness: (mm) | | | | | |
| total thickness: (mm) | | 265 | 275 | | |
| CBR used for design: (%) | | 10 | 10 | | |

design traffic loading: Design traffic loading is the number of commercial vehicle axle groups (CVAG) in the design lane during the design period. For definitions, refer Appendix 1.1 "Pavement Design" AUSTRROADS. Refer covering letter/report.

material quality:

wearing course:

concrete: *Concrete with F'c = 40MPa, dowelled jointed or CRCP*

sub-base: ***Conforming to ARRB Special Report No 41.*

select: *Clean granular material, soaked CBR > 15%, PI < 15%*

Note: Recommended materials types may vary from those of job specification or statutory authority. Refer covering letter/report.

compaction requirements:

| | | |
|------------------|----------------------|--|
| wearing course : | | Modified: Minimum required dry density ratio, AS1289 5.4.1-1993, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent. |
| basecourse : | upper: | Standard: As above, but maximum dry density obtained using AS1289 5.1.1-2003 or equivalent. |
| | lower: | |
| sub-base : | <i>100% Standard</i> | Density Index: Minimum required Density Index AS1289 5.6.1-1998, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent. |
| select : | <i>100% Standard</i> | |
| subgrade : | | |
| fill below: | <i>95% Standard</i> | |

Note : Recommendations for compaction may vary from those of job specification or statutory authority. Refer covering letter/report.

Drainage: The design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. Refer covering letter/report.

pavement thickness design summary

client : **ACOR CONSULTANTS PTY LTD** job no : **GEOTWARA21231AA**
principal : laboratory : **NEWCASTLE**
project: **PROPOSED PERFORMING ARTS CENTRE** report date : **15/02/2010**
location : **ST PHILIPS CHRISTIAN COLLEGE SALAMANDER CAMPUS** designed by: **SJK**
council : **PORT STEPHENS COUNCIL** checked by: *asl*

| | | | | |
|--------------------------------|--|-----------------------|--|--|
| road name or type: | | FLEXIBLE | | |
| chainage interval: (m) | | MINOR ACCESS/CAR PARK | | |
| design traffic loading: (ESA) | | 2 x 10 ⁴ | | |
| wearing course thickness: (mm) | | 30* | | |
| basecourse thickness: (mm) | | 100 | | |
| sub-base thickness: (mm) | | 100 | | |
| select thickness: (mm) | | | | |
| total thickness: (mm) | | 230 | | |
| CBR used for design: (%) | | 10 | | |

design traffic loading: Design traffic loading is the number of equivalent standard axles (ESA) in the design lane during the design period. For definitions, refer Appendix 1.1 "Pavement Design" AUSTRROADS. Refer covering letter/report.

material quality:

wearing course: *Conforming to council requirements *single coat seal + 30mm AC10*
basecourse: *Conforming to ARRB Special Report No 41*
sub-base: *Conforming to ARRB Special Report No 41*
select: *Clean sand or granular material, CBR > 15%, PI < 15%*

Note: Recommended materials types may vary from those of job specification or statutory authority. Refer covering letter/report.

compaction requirements:

wearing course : *Conforming to council requirements*
basecourse : upper: **98% MODIFIED**
lower:
sub-base : **95% MODIFIED**
select : **80% DI, 100% STD**
subgrade : **80% DI, 100% STD**
fill below: **70% DI, 95% STD**

Modified: Minimum required dry density ratio, AS1289 5.4.1-2007, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.

Standard: As above, but maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.

Density Index: Minimum required Density Index AS1289 5.6.1-1998, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent.

Note: Recommendations for compaction may vary from those of job specification or statutory authority. Refer covering letter/report.

Drainage:

The design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. Refer covering letter/report.

Foundation Maintenance and Footing Performance: A Homeowner's Guide



CSIRO
BTF 18
replaces
Information
Sheet 10/91

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

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

Soil Types

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

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

Causes of Movement

Settlement due to construction

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

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

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

Erosion

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

Saturation

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

Seasonal swelling and shrinkage of soil

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

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

Shear failure

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

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

GENERAL DEFINITIONS OF SITE CLASSES

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

Tree root growth

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

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

Unevenness of Movement

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

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

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

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

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

Effects of Uneven Soil Movement on Structures

Erosion and saturation

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

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

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

Seasonal swelling/shrinkage in clay

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

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

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



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

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

Movement caused by tree roots

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

Complications caused by the structure itself

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

Effects on full masonry structures

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

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

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

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

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

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

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

Effects on framed structures

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

Effects on brick veneer structures

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

Water Service and Drainage

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

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

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

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

Prevention/Cure

Plumbing

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

Ground drainage

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

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

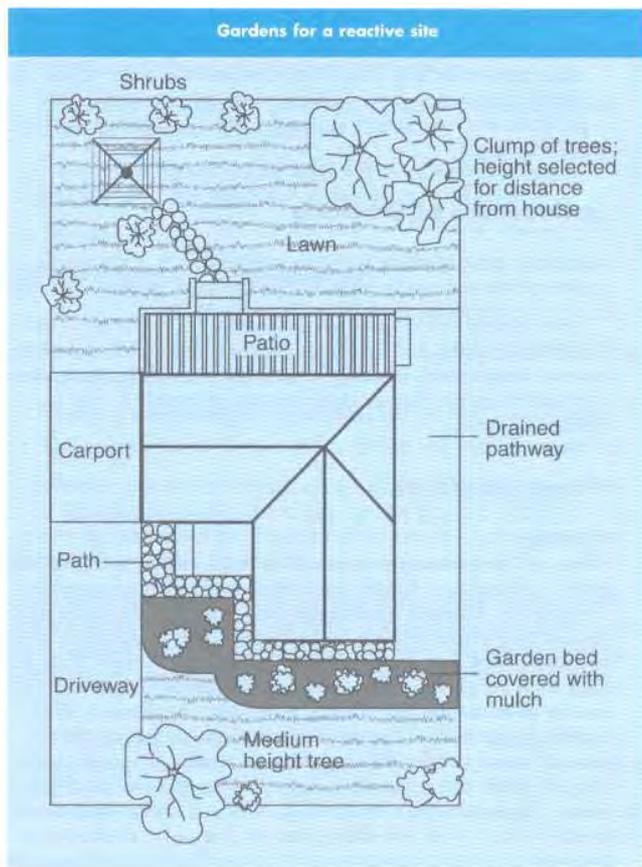
Protection of the building perimeter

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

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

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

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



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

The garden

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

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

Existing trees

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

Information on trees, plants and shrubs

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

Excavation

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

Remediation

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

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

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

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

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

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

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

Condensation

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

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

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by

earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.

Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

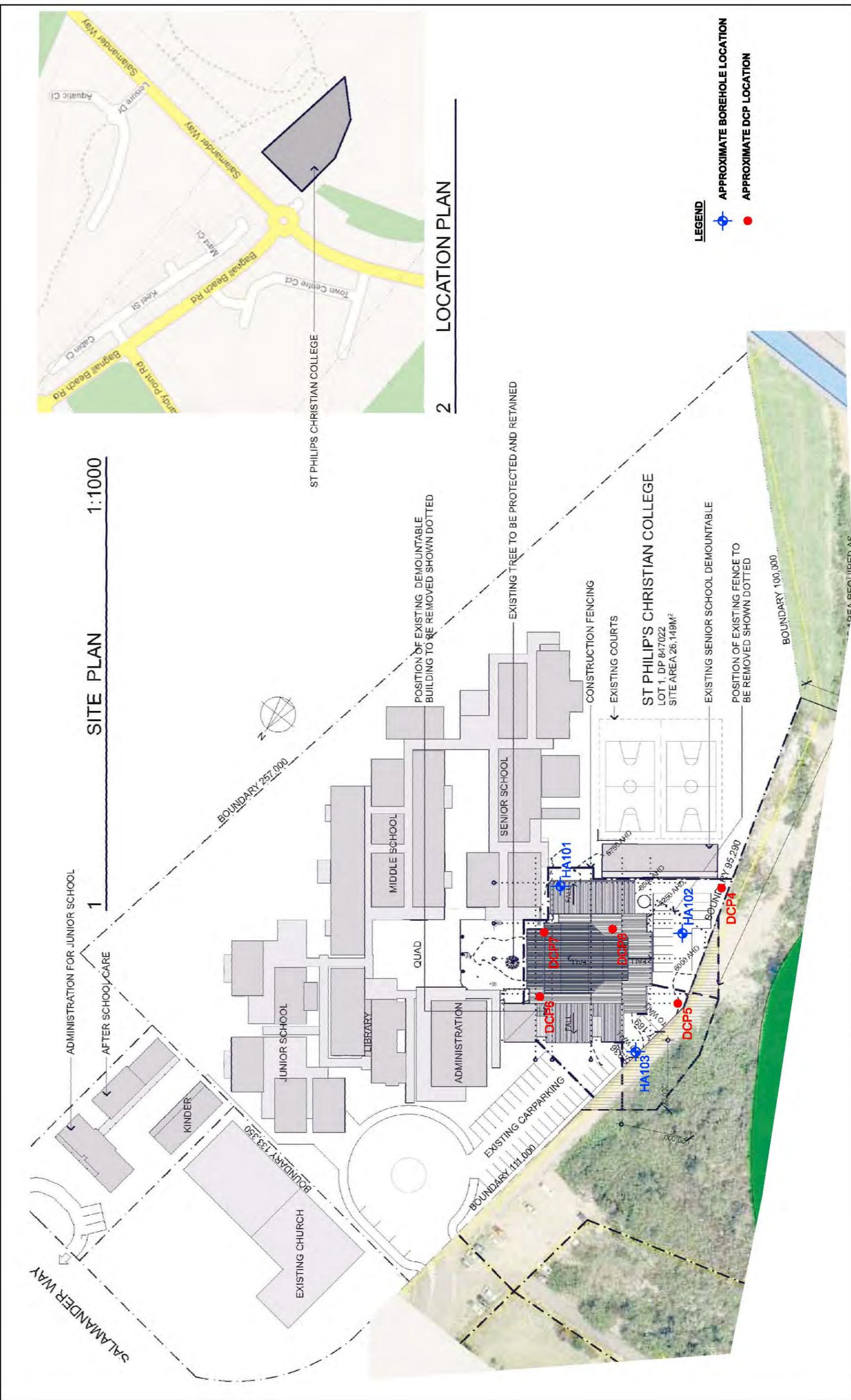
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures



1 SITE PLAN 1:1000

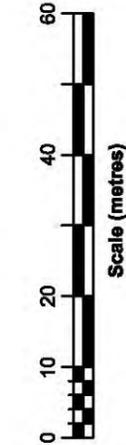
2 LOCATION PLAN

LEGEND
 APPROXIMATE BOREHOLE LOCATION
 APPROXIMATE DCP LOCATION

| revision | description | drawn | approved | date |
|----------|-------------|-------|----------|------|
| | | | | |
| | | | | |
| | | | | |

| | | | |
|---------------|----------|-------------|---|
| drawn | NLS | client: | ACOR CONSULTANTS PTY LTD |
| approved | CJA | project: | PROPOSED PERFORMING ARTS CENTRE |
| date | 14-12-09 | project: | ST PHILIP'S CHRISTIAN COLLEGE SALAMANDER CAMPUS |
| scale | 1:1000 | title: | APPROXIMATE TEST LOCATION PLAN |
| original size | A3 | project no: | GEOTWARA21231AA |
| | | figure no: | FIGURE 1 |

coffey geotechnics
SPECIALISTS MANAGING THE EARTH



Appendix A

Results of Field Investigations



Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

| NAME | SUBDIVISION | SIZE |
|----------|-------------|----------------------------|
| Boulders | | >200 mm |
| Cobbles | | 63 mm to 200 mm |
| Gravel | coarse | 20 mm to 63 mm |
| | medium | 6 mm to 20 mm |
| | fine | 2.36 mm to 6 mm |
| Sand | coarse | 600 μ m to 2.36 mm |
| | medium | 200 μ m to 600 μ m |
| | fine | 75 μ m to 200 μ m |

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

| TERM | UNDRAINED STRENGTH S_u (kPa) | FIELD GUIDE |
|------------|--------------------------------|--|
| Very Soft | <12 | A finger can be pushed well into the soil with little effort. |
| Soft | 12 - 25 | A finger can be pushed into the soil to about 25mm depth. |
| Firm | 25 - 50 | The soil can be indented about 5mm with the thumb, but not penetrated. |
| Stiff | 50 - 100 | The surface of the soil can be indented with the thumb, but not penetrated. |
| Very Stiff | 100 - 200 | The surface of the soil can be marked, but not indented with thumb pressure. |
| Hard | >200 | The surface of the soil can be marked only with the thumbnail. |
| Friable | - | Crumbles or powders when scraped by thumbnail. |

DENSITY OF GRANULAR SOILS

| TERM | DENSITY INDEX (%) |
|--------------|-------------------|
| Very loose | Less than 15 |
| Loose | 15 - 35 |
| Medium Dense | 35 - 65 |
| Dense | 65 - 85 |
| Very Dense | Greater than 85 |

MINOR COMPONENTS

| TERM | ASSESSMENT GUIDE | PROPORTION OF MINOR COMPONENT IN: |
|-----------|---|---|
| Trace of | Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component. | Coarse grained soils: <5% Fine grained soils: <15% |
| With some | Presence easily detected by feel or eye, soil properties little different to general properties of primary component. | Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30% |

SOIL STRUCTURE

| ZONING | | CEMENTING | |
|---------|---|---------------------|--|
| Layers | Continuous across exposure or sample. | Weakly cemented | Easily broken up by hand in air or water. |
| Lenses | Discontinuous layers of lenticular shape. | Moderately cemented | Effort is required to break up the soil by hand in air or water. |
| Pockets | Irregular inclusions of different material. | | |

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material Structure and fabric of parent rock visible.

Residual soil Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil Deposited by wind.

Alluvial soil Deposited by streams and rivers.

Colluvial soil Deposited on slopes (transported downslope by gravity).

Fill Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.

Lacustrine soil Deposited by lakes.

Marine soil Deposited in ocean basins, bays, beaches and estuaries.

Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

| FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass) | | | | USC | PRIMARY NAME | | |
|---|---|--|--|-------------------|---------------|--------------|------|
| COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm | GRAVELS More than half of coarse fraction is larger than 2.0 mm | CLEAN GRAVELS (Little or no fines) | Wide range in grain size and substantial amounts of all intermediate particle sizes. | GW | GRAVEL | | |
| | | | Predominantly one size or a range of sizes with more intermediate sizes missing. | GP | GRAVEL | | |
| | | GRAVELS WITH FINES (Appreciable amount of fines) | Non-plastic fines (for identification procedures see ML below) | GM | SILTY GRAVEL | | |
| | | | Plastic fines (for identification procedures see CL below) | GC | CLAYEY GRAVEL | | |
| | SANDS More than half of coarse fraction is smaller than 2.0 mm | CLEAN SANDS (Little or no fines) | Wide range in grain sizes and substantial amounts of all intermediate sizes | SW | SAND | | |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing. | SP | SAND | | |
| | | SANDS WITH FINES (Appreciable amount of fines) | Non-plastic fines (for identification procedures see ML below). | SM | SILTY SAND | | |
| | | | Plastic fines (for identification procedures see CL below). | SC | CLAYEY SAND | | |
| FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm (A 0.075 mm particle is about the smallest particle visible to the naked eye) | IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm. | | | | | | |
| | SILTS & CLAYS Liquid limit less than 50 | DRY STRENGTH | DILATANCY | TOUGHNESS | | | |
| | | None to Low | Quick to slow | None | ML | SILT | |
| | | Medium to High | None | Medium | CL | CLAY | |
| | | Low to medium | Slow to very slow | Low | OL | ORGANIC SILT | |
| | | SILTS & CLAYS Liquid limit greater than 50 | Low to medium | Slow to very slow | Low to medium | MH | SILT |
| | | | High | None | High | CH | CLAY |
| | | Medium to High | None | Low to medium | OH | ORGANIC CLAY | |
| HIGHLY ORGANIC SOILS | Readily identified by colour, odour, spongy feel and frequently by fibrous texture. | | | Pt | PEAT | | |

• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

| TERM | DEFINITION | DIAGRAM | TERM | DEFINITION | DIAGRAM |
|-----------------|--|---------|---------------|---|---------|
| PARTING | A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed. | | SOFTENED ZONE | A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere. | |
| JOINT | A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length. | | TUBE | Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter | |
| SHEARED ZONE | Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks. | | TUBE CAST | Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented. | |
| SHEARED SURFACE | A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect. | | INFILLED SEAM | Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints. | |

Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.

Defect Discontinuity or break in the continuity of a substance or substances.

Mass Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME Simple rock names are used rather than precise geological classification.

PARTICLE SIZE Grain size terms for sandstone are:
 Coarse grained Mainly 0.6mm to 2mm
 Medium grained Mainly 0.2mm to 0.6mm
 Fine grained Mainly 0.06mm (just visible) to 0.2mm

FABRIC Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:

Massive No layering or penetrative fabric.

Indistinct Layering or fabric just visible. Little effect on properties.

Distinct Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

ROCK SUBSTANCE STRENGTH TERMS

| Term | Abbreviation | Point Load Index, I _{s50} (MPa) | Field Guide |
|----------|--------------|--|--|
| Very Low | VL | Less than 0.1 | Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure. |

| | | | |
|-----|---|------------|--|
| Low | L | 0.1 to 0.3 | Easily scored with a knife; indentations 1mm to 3mm show with firm blows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling. |
|-----|---|------------|--|

| | | | |
|--------|---|------------|---|
| Medium | M | 0.3 to 1.0 | Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty. |
|--------|---|------------|---|

| | | | |
|------|---|--------|--|
| High | H | 1 to 3 | A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer. |
|------|---|--------|--|

| | | | |
|-----------|----|---------|---|
| Very High | VH | 3 to 10 | Hand specimen breaks after more than one blow of a pick; rock rings under hammer. |
|-----------|----|---------|---|

| | | | |
|----------------|----|--------------|--|
| Extremely High | EH | More than 10 | Specimen requires many blows with geological pick to break; rock rings under hammer. |
|----------------|----|--------------|--|

CLASSIFICATION OF WEATHERING PRODUCTS

| Term | Abbreviation | Definition |
|------------------------------|--------------|--|
| Residual Soil | RS | Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported. |
| Extremely Weathered Material | XW | Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible. |
| Highly Weathered Rock | HW | Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores. |
| Moderately Weathered Rock | MW | The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable. |
| Slightly Weathered Rock | SW | Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance. |
| Fresh Rock | FR | Rock substance unaffected by weathering. |

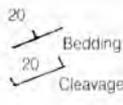
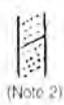
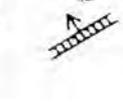
Notes on Weathering:

- AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
- Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

Notes on Rock Substance Strength:

- In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
- The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
- The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (I_{s50}). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

Rock Description Explanation Sheet (2 of 2)

| COMMON DEFECTS IN ROCK MASSES | | Diagram | Map Symbol | Graphic Log (Note 1) | DEFECT SHAPE | TERMS |
|--|--|---|---|---|---|--|
| Term | Definition | | | | Planar | The defect does not vary in orientation |
| Parting | A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed. |  |  |  | Curved | The defect has a gradual change in orientation |
| Joint | A surface or crack across which the rock has little or no tensile strength, but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed. |  |  |  | Undulating | The defect has a wavy surface |
| Sheared Zone (Note 3) | Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks. |  |  |  | Stepped | The defect has one or more well defined steps |
| Sheared Surface (Note 3) | A near planar, curved or undulating surface which is usually smooth, polished or slickensided. |  |  |  | Irregular | The defect has many sharp changes of orientation |
| Crushed Seam (Note 3) | Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties. |  |  |  | Note: The assessment of defect shape is partly influenced by the scale of the observation. | |
| Infilled Seam | Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface. |  |  |  | ROUGHNESS TERMS | |
| Extremely Weathered Seam | Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place. |  |  |  | Slickensided | Grooved or striated surface, usually polished |
| Notes on Defects: | | | | | Polished | Shiny smooth surface |
| 1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip. | | | | | Smooth | Smooth to touch. Few or no surface irregularities |
| 2. Partings and joints are not usually shown on the graphic log unless considered significant. | | | | | Rough | Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper. |
| 3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms. | | | | | Very Rough | Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper. |
| | | | | | COATING TERMS | |
| | | | | | Clean | No visible coating |
| | | | | | Stained | No visible coating but surfaces are discoloured |
| | | | | | Veneer | A visible coating of soil or mineral, too thin to measure; may be patchy |
| | | | | | Coating | A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein. |
| | | | | | BLOCK SHAPE TERMS | |
| | | | | | Blocky | Approximately equidimensional |
| | | | | | Tabular | Thickness much less than length or width |
| | | | | | Columnar | Height much greater than cross section |

Borehole No. **HA101**
 Sheet 1 of 1
 Project No: **GEOTWARA21231AA**
 Date started: **9.12.2009**
 Date completed: **9.12.2009**
 Logged by: **CJA**
 Checked by: **SJK**

Engineering Log - Borehole

Client: **ACOR CONSULTANTS PTY LTD**
 Principal: **ST PHILLIPS CHRISTIAN COLLEGE**
 Project: **ST PHILLIPS CHRISTIAN COLLEGE**
 Borehole Location: **REFER TO FIGURE 1**

drill model and mounting: HA Easting: slope: -90° R.L. Surface:
 hole diameter: 75 mm Northing bearing: datum:

| drilling information | | | | material substance | | | | | | | | | |
|----------------------|-------------|---------|-------|---------------------------|----|--------------|-------------|-----------------------|---|--------------------|---------------------------|--------------------------|---------------------------------------|
| method | penetration | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material | moisture condition | consistency/density index | pocket penetrometer | structure and additional observations |
| 1 2 3 | | | | | | | | | soil type: plasticity or particle characteristics, colour, secondary and minor components. | | | 100 200 300 400 | |
| HA | | N | | | | 0.5 | | SP | FILL: SAND, fine to medium grained, brown - dark brown, trace gravels fine to medium grained. | D | D/V/D | | FILL - Appears compacted |
| | | | | D | | 1.0 | | SP | SAND: fine to medium grained, brown - dark brown. | M | MD/D | | ALLUVIAL SOIL |
| | | | | O | | 1.5 | | | | | | | |
| | | | | | | 2.0 | | | | | | | |
| | | | | | | 2.5 | | | | W | | | |
| | | | | D | | 3.0 | | | Borehole HA101 terminated at 2.9m | | | | |
| | | | | | | 3.5 | | | | | | | |
| | | | | | | 4.0 | | | | | | | |

BOREHOLE 21231AA.GPJ COFFEY.GDT 15.2.10

Form GEO 5.3 Issue 3 Rev.2

| | | | | |
|--|--|--|--|---|
| method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT | support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow | notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal | classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit | consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense |
|--|--|--|--|---|

Borehole No. **HA102**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTWARA21231AA**

Client: **ACOR CONSULTANTS PTY LTD**

Date started: **9.12.2009**

Principal: **ST PHILLIPS CHRISTIAN COLLEGE**

Date completed: **9.12.2009**

Project: **ST PHILLIPS CHRISTIAN COLLEGE**

Logged by: **CJA**

Borehole Location: **REFER TO FIGURE 1**

Checked by: **SK**

drill model and mounting: HA Easting: slope: -90° R.L. Surface:
hole diameter: 75 mm Northing bearing: datum:

| drilling information | | | | material substance | | | | | | | | |
|-----------------------------------|----------------------|------------------|---------------------------------|--------------------|-----------------|-------------|--------------------------|---|-----------------------|-------------------------------|--|--|
| method | penetration 1 2 3 | support water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro- meter KPa 100 200 300 400 | structure and additional observations |
| HA | | N | Bs | | 0.5 | | GP | FILL: Sandy GRAVEL, fine to medium grained, sand fine to medium grained, brown-dark brown. | D | DVD | | FILL |
| | | | Bs | | 1.0 | | SP | SAND: fine to medium grained, dark brown - brown. | M | | | ALLUVIAL SOIL |
| | | | D | | 1.5 | | | | | MD | | |
| | | | D | | 2.0 | | | | W | | | |
| Borehole HA102 terminated at 2.1m | | | | | | | | | | | | |
| | | | | | 2.5 | | | | | | | |
| | | | | | 3.0 | | | | | | | |
| | | | | | 3.5 | | | | | | | |
| | | | | | 4.0 | | | | | | | |

| | | | | |
|--|---|--|--|---|
| method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger OT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT | support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow | notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal | classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit | consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense |
|--|---|--|--|---|

Borehole No. **HA103**
 Sheet 1 of 1
 Project No: **GEOTWARA21231AA**
 Date started: **9.12.2009**
 Date completed: **9.12.2009**
 Logged by: **CJA**
 Checked by: **SOJK**

Engineering Log - Borehole

Client: **ACOR CONSULTANTS PTY LTD**
 Principal: **ST PHILLIPS CHRISTIAN COLLEGE**
 Project: **ST PHILLIPS CHRISTIAN COLLEGE**
 Borehole Location: **REFER TO FIGURE 1**

| drill model and mounting: HA | | Easting: | | slope: -90° | | R.L. Surface: | | | | | |
|--|----------------------|--|---------------------------------|--|-------------|--|---|---|-------------------------------|--|--|
| hole diameter: 75 mm | | Northing | | bearing: | | datum: | | | | | |
| drilling information | | | | material substance | | | | | | | |
| method | penetration 1 2 3 | support water | notes samples, tests, etc | depth metres | graphic log | classification symbol | material soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro- meter 100 200 300 400 kPa | structure and additional observations |
| HA | | N | | | | GP | FILL: Sandy GRAVEL, fine to coarse grained, sand fine to medium grained, brown. | D | MD/D | | FILL |
| | | | | 0.5 | | SP | SAND: fine to medium grained, brown - dark brown. | D/M | | | ALLUVIAL SOIL |
| | | | D | 1.0 | | | | | D | | |
| | | | | 1.5 | | | | | | | |
| | | | | 2.0 | | | | W | | | |
| | | | D | | | | | | MD | | |
| | | | D | | | | | | | | |
| | | | | 2.5 | | | Borehole HA103 terminated at 2.4m | | | | |
| | | | | 3.0 | | | | | | | |
| | | | | 3.5 | | | | | | | |
| | | | | 4.0 | | | | | | | |
| method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT | | support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow | | notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal | | classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit | | consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense | | | |

BOREHOLE 21231AA.GPJ COFFEY GDT 16.12.09

Form GEO-5.3 Issue 3 Rev.2

Dynamic Cone Penetrometer Test Results

Client: ST PHILLIPS CHRISTIAN COLLEGE
Principal:
Project:
Location: ST PHILLIPS CHRISTIAN COLLEGE
Job No: GEOTWARA21231AA
Date of Issue: 10/12/2009

Sample Details

| Test procedure: | | Test date: 9/12/2009 | | | | | | | |
|---------------------|--------------|----------------------|----|----|--------------------------------------|----|---------|----|-----------------------|
| Depth below surface | Test Numbers | | | | Readings recorded in blows per 150mm | | | | Test location/Remarks |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 150 | 3 | 35 | 10 | 10 | 8 | 8 | 3 | 5 | |
| 300 | 6 | 16 | 4 | 14 | 3 | 10 | 5 | 8 | |
| 450 | 9 | 13 | 4 | 9 | 3 | 14 | 10 | 9 | |
| 600 | 15 | 21 | 4 | 14 | 4 | 18 | 25/100* | 13 | |
| 750 | 22 | 20 | 8 | 13 | 12 | 18 | | 17 | |
| 900 | 25 | 13 | 10 | 13 | 15 | 17 | | 17 | |
| 1050 | 28 | 12 | 17 | 14 | 14 | 15 | | 17 | |
| 1200 | | 8 | 14 | 9 | 11 | 10 | | 13 | |
| 1350 | | 4 | 12 | 7 | 11 | 10 | | 12 | |
| 1500 | | 6 | 12 | 5 | 11 | 12 | | 12 | |
| 1650 | | 5 | 12 | 4 | 9 | 13 | | 9 | |
| 1800 | | 5 | 8 | 6 | 7 | 11 | | 7 | |
| 1950 | | 6 | 8 | 5 | 6 | 7 | | 9 | |
| 2100 | | 6 | 8 | 6 | 6 | 6 | | 6 | |
| 2250 | | 6 | 8 | 7 | 6 | 8 | | 6 | |
| 2400 | | 4 | 5 | 5 | 4 | 6 | | 6 | |
| 2550 | | 4 | 4 | 6 | 4 | 6 | | 5 | |
| 2700 | | 3 | 3 | 4 | 4 | 6 | | 6 | |
| 2850 | | 4 | 6 | 5 | 6 | 5 | | 5 | |
| 3000 | | 4 | 8 | 6 | 4 | 4 | | 4 | |
| 3150 | | 7 | 6 | 5 | 5 | 4 | | 5 | |
| 3300 | | 6 | 5 | 6 | 5 | 5 | | 5 | |
| 3450 | | 5 | 6 | 6 | 6 | 5 | | 5 | |
| 3600 | | | | | | | | | |
| 3750 | | | | | | | | | |
| 3900 | | | | | | | | | |
| 4050 | | | | | | | | | |
| 4200 | | | | | | | | | |
| 4350 | | | | | | | | | |
| 4500 | | | | | | | | | |
| 4650 | | | | | | | | | |
| 4800 | | | | | | | | | |
| 4950 | | | | | | | | | |
| 5100 | | | | | | | | | |
| 5250 | | | | | | | | | |

Remarks

General Information

AS 1289 6.3.2

- Drop height 510mm ± 5
- Cone tip
- Blunt tip

AS 1289 6.3.3

- Drop height 600mm ± 5

Appendix B

Results of Laboratory Testing

Report No: CBR:WARA09S-12733

Issue No: 2

This report replaces all previous issues of report no 'CBR:WARA09S-12733'

California Bearing Ratio Test Report

Client: Coffey Geotechnics (Warabrook)
 19 Warabrook Boulevard
 Warabrook NSW 2304

Principal:

Project No.: INFOWARA00548AA

Project Name: GEOTWARA21231AA - St. Philips Christian College

Lot No.: - **TRN:** -

This document is issued in accordance with NATAs accreditation requirements Accredited for compliance with ISO/IEC 17025

NATA
 WORLD RECOGNISED ACCREDITATION

Glen Richardson
 Approved Signatory: Glen Richardson
 (Senior Geotechnician)
 NATA Accredited Laboratory Number 431
 Date of Issue 15/02/2010

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Sample Details

Sample ID: WARA09S-12733

Field ID: 00001

Date Sampled: 14/12/2009

Date Submitted: 14/12/2009

Project Location: Salamander Bay

Sample Location: Onsite

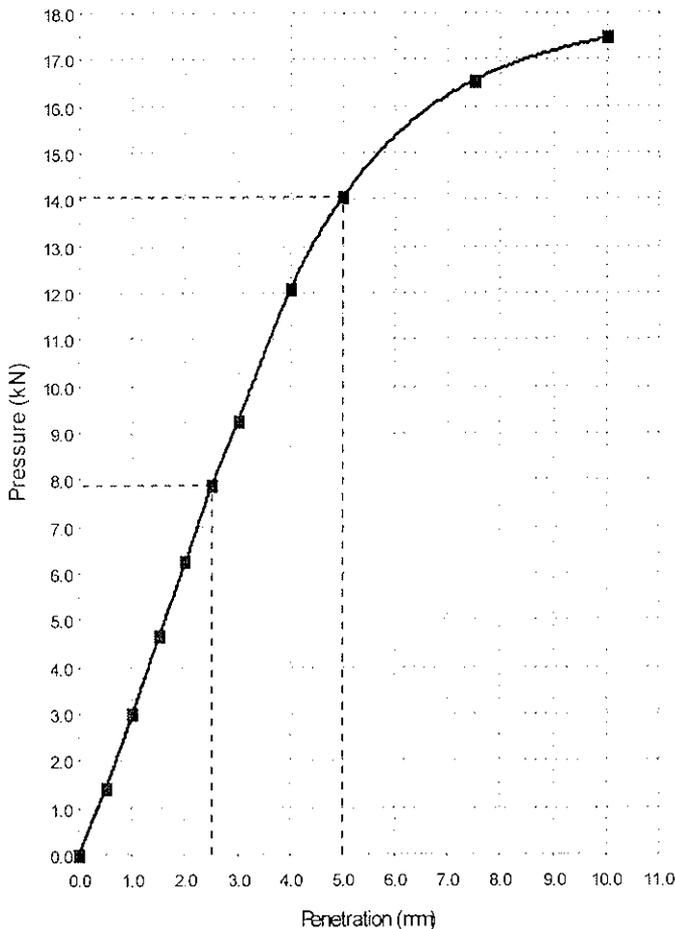
Sampling Method: Submitted by client

Material: HA102 @ 0.0 - 0.2m

Source: Salamander Bay

Specification: No Specification

Load vs Penetration



Test Results

RTA T117

| | |
|--|-----------|
| CBR At 5.0mm (%): | 70 |
| Maximum Dry Density (t/m ³): | 2.000 |
| Specified Laboratory Density Ratio (%): | 98 |
| Laboratory Density Ratio (%): | 98 |
| Optimum Moisture Content (%): | 6.6 |
| Specified Laboratory Moisture Ratio (%): | 100 |
| Laboratory Moisture Ratio (%): | 105 |
| Swell (%): | 0.0 |
| Moisture Content of Top 30mm (%): | 9.7 |
| Moisture Content of Specimen Full Depth (%): | 9.3 |
| Compactive Effort: | Standard |
| Period of Soaking (Days): | 4 |
| Oversize Material: | Excluded |
| Oversize Material (%): | 30.2 |

Comments

Note: 9.0kg surcharge used during soaking and testing CBR value.
 FMC: 2.4%

Appendix E – Bushfire Threat Assessment

Undertaken by Firebird ecoSultants – 10th August 2017





**BUSHFIRE THREAT ASSESSMENT
FOR
AN INFILL DEVELOPMENT FOR A PROPOSED
SENIOR SCHOOL BUILDING
WITHIN ST PHILLIPS CHRISTIAN
COLLEGE PORT STEPHENS**

**AT
SALAMANDER WAY, SALAMANDER
BAY** PREPARED BY:

Firebird ecoSultants Pty Ltd

ABN – 16 105 985 993

PO Box 354

Newcastle NSW 2300

Mob: 0414 465 990

Ph: 02 4910 3939

Fax: 02 4929 2727

Email: sarah@firebirdeco.com.au



| Site Details: | Salamander Way, Salamander Bay | | | | | |
|----------------------|---|------------|----------|-----------|------------------------|------------|
| Prepared by: | <p>Sarah Jones B.Env.Sc.,G.Dip.DBPA (Design in Bushfire Prone Areas) FPA BPAD-A Certified Practitioner (BPD-PA-26512)</p> <p>Firebird ecoSultants Pty Ltd ABN – 16 105 985 993</p> <p>PO Box 354, Newcastle NSW 2300 M: 0414 465 990 Email: sarah@firebirdeco.com.au T: 02 4910 3939 Fax: 02 4929 2727</p> | | | | | |
| Prepared for: | <p>SHAC T 02 4961 5888 F 02 4962 2577 W shac.com.au</p> | | | | | |
| Reference No. | Salamander Bay – SHAC | | | | | |
| Version | Purpose of Document | Original | Reviewed | Date | Approved | Issue Date |
| Draft 01 | Draft for client review | R. Herbert | S. Jones | 14/6/2017 | Elizabeth Brown (Shac) | 10/08/17 |
| Final – 10/08/2017 | | | | | | |

Disclaimer

Notwithstanding the precautions adopted within this report, it should always be remembered that bushfires burn under a wide range of conditions. An element of risk, no matter how small always remains, and although the standard is designed to improve the performance of such buildings, there can be no guarantee, because of the variable nature of bushfires, that any one building will withstand bushfire attack on every occasion.



Executive Summary

A Bushfire Threat Assessment Report (BTA) has been prepared by Firebird ecoSultants Pty Ltd at the request of Shac Architecture for proposed Senior School Buildings and additional carparking as part of the existing St Philip's Christian College (SPCC).

As the development is not a stand-alone development, but rather an extension of the St Philip's Christian College facilities being senior school buildings it is considered infill development in accordance with Planning for Bushfire Protection (RFS, 2006) (PBP 2006). As the site is to be used for education purposes the proposal has been considered a Special Fire Protection Purpose (SFPP) development in accordance with Planning for Bushfire Protection (RFS, 2006) (PBP 2006).

This BTA has been undertaken to recommend Bush Fire Protection Measures (BPMs) in order for the proposal to comply with the intent and performance criteria of section 4.3.5 of PBP (RFS, 2006) 'Specifications and Requirements for Bush Fire Protection Measures for Infill Development' and Section 4.2.5 'SFPPs as Infill'.

In summary, the following is recommended for the proposal:

- The existing site does not allow for the required APZs and therefore additional measures with regard to higher construction standards, siting and design of buildings, access, water supply, landscaping and emergency planning will be required.
- In combination with the additional measures detailed in the Performance Based Assessment, the APZs outlined in Table 4.1 and Figure 4-1 are to be provided.
- The Emergency Response and Evacuation Plan for the site is to be updated and be consistent with the RFS document "A guide to Developing Bushfire Evacuation Plan" (2004).



Sarah Jones

Ecologist / Bushfire Planner

FPA BPAD-A Certified Practitioner (BPD-PA-26512)

B.Env.Sc., G.Dip.DBPA (Design for Bushfire Prone Areas)



Terms & Abbreviations

| Abbreviation | Meaning |
|---------------------|--|
| APZ | Asset Protection Zone |
| AS2419 -2005 | Australian Standard – Fire Hydrant Installations |
| AS3959-2009 | Australian Standard – Construction of Buildings in Bush Fire Prone Areas |
| BCA | Building Code of Australia |
| BPA | Bush Fire Prone Area (Also Bushfire Prone Land) |
| BFPL Map | Bush Fire Prone Land Map |
| BPMS | Bush Fire Protection Measures |
| BFSA | Bush Fire Safety Authority |
| CSO | Catholic Schools Office |
| <i>EPA Act</i> | <i>NSW Environmental Planning and Assessment Act 1979</i> |
| FDI | Fire Danger Index |
| FMP | Fuel Management Plan |
| ha | Hectare |
| IPA | Inner Protection Area |
| LGA | Local Government Area |
| OPA | Outer Protection Area |
| PBP | Planning for Bushfire Protection 2006 |
| PSC | Port Stephens Council |
| RF Act | Rural Fires Act 1997 |
| RF Regulation | Rural Fires Regulation |
| SPCC | St Philip's Christian College |



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I INTRODUCTION

Firebird ecoSultants Pty Ltd has been engaged by Shac to undertake a Bushfire Threat Assessment (BTA) at 182 Salamander Way, Salamander Bay for proposed senior school buildings and carparking as part of the extension to the existing St Philip's Christian College (SPCC) Port Stephens (refer to Figure 1-1 for site locality).

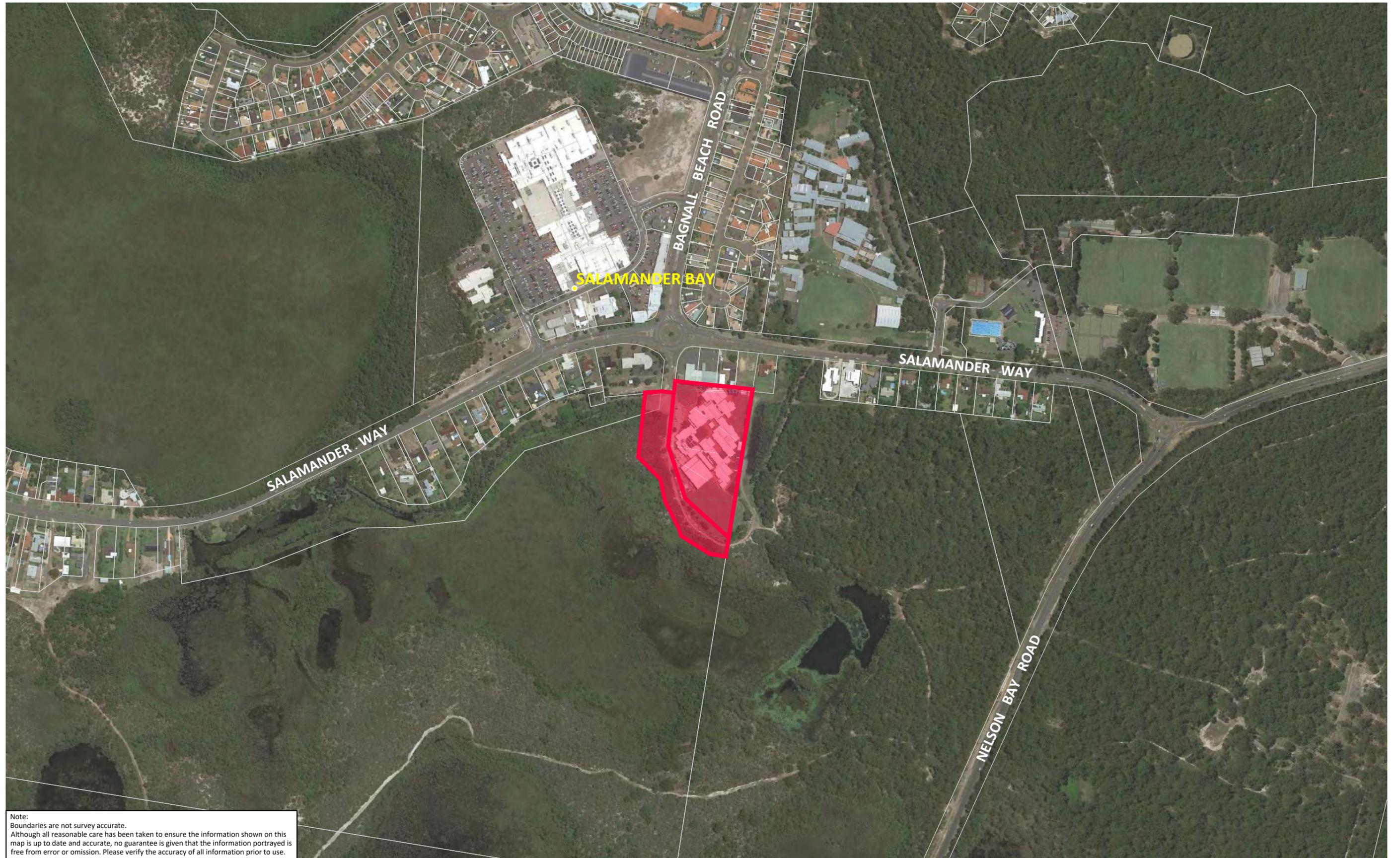
A Pre-DA meeting occurred on the 26 April 2016 with Josh Calandra (RFS - Development Assessment and Planning officer), Jason Maslen (RFS- Team Leader, Development Assessment and Planning), Sarah Jones (Firebird) and Ian Easton (Ian Easton Architects) the purpose of this meeting was to discuss additions to the existing SPCC and being SFPP Infill (See Appendix B for Pre -DA meeting notes form the RFS).

As the development is not a stand-alone development, but rather an extension part of St Philip's Christian College, the proposal for senior school buildings is considered infill development. The proposed senior school buildings is for education purposes and is thus considered Special Fire Protection Purposes (SFPP) in accordance with Planning for Bushfire Protection (RFS, 2006) (PBP 2006). As the proposal is for the extension to the existing school the senior school buildings are considered as 'SFPP as Infill' in accordance with PPB 2006.

This assessment has been undertaken to ensure that the proposed development is able to comply with the intent and performance criteria of section 4.3.5 of PBP (RFS, 2006) 'Specifications and Requirements for Bush Fire Protection Measures for Infill Development' and Section 4.2.5 'SFPPs as Infill'.

I.1 Site Particulars

| | |
|-----------------------------|---|
| Locality: | 182 Salamander Way, Salamander Bay |
| LGA: | Port Stephens Council (PSC) |
| Forest Danger Index: | 100 FDI |
| Boundaries: | The site is bound to the north by Salamander Way Road and to the east, south and west by a fire-trail /access road followed by land owned by Department of Lands. |
| History: | The site lies within a geographical area with a Fire Danger Index (FDI) rating of 100. Extreme bushfire weather is therefore associated with long periods of drought, high temperatures, low humidity and gusty often north-westerly winds. |

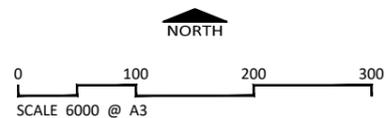


Note:
 Boundaries are not survey accurate.
 Although all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

FIGURE 1-1: SITE LOCALITY MAP

CLIENT Client
 Salamander Way Salamander Bay
 SITE DETAILS
 DATE 14 June 2017

Legend
 Subject Site



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I.2 Description of the Proposal

The proposed development is for an extension to the existing school facilities comprised of senior school buildings and additional carparking. The proposed buildings do not exceed the line of existing development towards the hazard. Refer to Attachment 1 for Site Plans.

I.3 Legislative Requirements

The site has been identified as bush fire prone land on the Port Stephens Council Bush Fire Prone Land Map (BFPLM). All development on Bush Fire Prone Land (BFPL) must satisfy the aim and objectives of PBP (RFS, 2006).

The proposed development is considered as 'SFPP as Infill' in accordance with PPB 2006. This being that the proposed buildings are an extension of the school facilities, within the existing lot and do not exceed the line of the existing development towards the hazard. The proposed development provides a better outcome than if the proposal did not proceed.



I.4 Objectives of Assessment

This BTA has been undertaken to recommend Bush Fire Protection Measures (BFPMs) in order for the proposal to comply with the intent and performance criteria of section 4.3.5 of PBP (RFS, 2006) 'Specifications and Requirements for Bush Fire Protection Measures for Infill Development' and Section 4.2.5 'SFPPs as Infill'.

There are six key BPMS in a development assessment context being:

- The provision of clear separation of buildings and bush fire hazards, in the form of fuel-reduced APZ (and their components being Inner Protection Areas (IPA's) and Outer Protection Areas (OPA's));
- Construction standards and design;
- Appropriate access standards for residents, fire-fighters, emergency workers and those involved in evacuation;
- Adequate water supply and pressure;
- Emergency management arrangements for fire protection and / or evacuation; and
- Suitable landscaping, to limit fire spreading to a building.

It is believed that the implementation of the measures and recommendations forwarded within this report would contribute to the amelioration of the potential impact of any bushfire upon the site, but they do not and cannot guarantee that the area will not be affected by bushfire at some time.



2 BUSHFIRE THREAT ASSESSMENT

2.1 Methodology

2.1.1 Vegetation Assessment

Vegetation surveys and vegetation mapping carried out on the site has been undertaken as follows:

- Aerial Photograph Interpretation to map vegetation cover and extent.
- Site Inspection

2.1.2 Slope Assessment

Slope assessment has been undertaken as follows:

- Aerial Photograph Interpretation in conjunction with analysis of electronic contour maps with a contour interval of 10m.
- Site survey



3 SITE ASSESSMENT

The following assessment has been undertaken in accordance with the requirements of PBP (RFS, 2006).

3.1 Vegetation and Slope Assessment

In accordance with PBP (RFS, 2006), an assessment of the vegetation that may be considered a bushfire hazard over a distance of 140m in all directions from the proposed extension / additions to the existing school.

In accordance with PBP (RFS, 2006), an assessment of the slope affecting the bushfire behaviour was undertaken for a distance of 100m from the edge of the bushfire hazard. The slopes leading away from the site have been evaluated to identify both the average slope and by identifying the maximum slope present. These values help determine the level of gradient which will most significantly influence the fire behaviour of the site and the results are presented in Table 3-1 and Figure 3-1.

Table 3-1: Vegetation & Slope Assessment

| Direction from Proposed Building | Vegetation Type within 140m of the proposed building | Slope | Distance Vegetation is from proposed Building | Distance from the existing buildings |
|----------------------------------|--|----------------------|---|--------------------------------------|
| North | N/A –existing development | N/A – developed Land | N/A – developed Land | N/A – developed Land |
| East | Forested Wetland followed by Open Forest | Flat / upslope | 47m | 47m |
| South | Forested Wetland | Flat | >60m | >60m |
| West | Forested Wetland and Scrub for the purposes of this assessment the highest fuel load being Open Forest has been used | Flat | >49m | 28m |

It is noted that the proposed school facilities / building lines do not exceed the line of the existing development towards the hazard. Refer to Figure 3-1 Vegetation Classification Map.

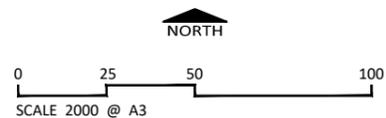


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FIGURE 3 - 1: VEGETATION MAP

CLIENT Client
 SITE DETAILS Salamander Way Salamander Bay
 DATE 1 June 2017

- Legend
- Subject Site
 - 100m Buffer
 - 60m APZ
 - Open Forest
 - Forested Wetland
 - Proposed Outdoor Area



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4 BUSHFIRE PROTECTION ASSESSMENT

Pursuant to Section 4.2.5 SFPPs as Infill, PBP (RFS, 2006), the circumstances of this development make it difficult to achieve the preferred standards for SFPP development. The proposed senior building are an addition to the existing facilities of the SFCC, occurs within the same site and is no closer to the hazard than the existing buildings and hence meet the definition of infill development. Accordingly, the objectives of Section 4.2.3 are to be followed. This includes providing BPM in combination as a principle. The proposal provides a combination of BPM, including opportunity for safe emergency evacuation procedures, provision for the needs of the senior school building occupants, multiple points of access for fire fighting through the school grounds and adjacent fire trail with readily defensible space, and location of the emergency exit away from the hazard.

The proposal seeks to demonstrate the requirement for exceptional circumstance as due to the infill development of an existing building as part of the overall school, the proposal requires a reduction in APZ. The following details establish the relevant existing circumstances and the justification for the reduction in APZ. It is considered that with the factors listed below and the combination of BPM proposed that in this circumstance the proposal meets the intent of the objectives for SFPP.

4.1 Determination of APZs for the proposed Senior School Building

The current BFPM includes maintaining all school buildings in accordance with BCA and bushfire requirements. The school has existing emergency management arrangements for fire protection and / or evacuation and these will be revised to incorporate the proposed senior school building. The revision will allow additional consideration to an overall emergency response plan that incorporates both onsite and offsite emergency evacuation options. Ongoing maintenance of vegetation surrounding the school is undertaken by the school as part of the existing APZs. It is noted that some school buildings/classrooms are located closer to the bushfire vegetation threat than the proposed senior school building and establish a precedent for consideration when undertaking *infill development* such as the proposed additional facilities to the school. Taking such matters into account, the school will undertake to substantially develop a comprehensive Bushfire Emergency Evacuation Plan that has clear early warning triggers for evacuation to allow a significant opportunity to fully evacuate any danger areas in the school grounds in the event of a bushfire danger triggering the need for evacuation.

In addition to the school Bushfire Emergency Evacuation Plan, the vegetation adjacent to St Philip's Christian College has an existing fire trail that will be widened and occurs between the vegetation that runs around the entire perimeter of the school. Combining this access with the existing cleared land between the school buildings and the existing vegetation, the site provides excellent opportunity to allow fire fighters access to combat any bushfire threat. Therefore, taking into account several existing matters



such as adequate access to defend the site, secondary access within the existing vegetation through the fire trail and adept Emergency Evacuation Planning, the proposed senior school building and entire school can readily be defended with unfettered access during a bushfire threat. In addition to this the access to the proposed senior school building and school is directly onto a main distribution road (Salamander Way) that allows escape paths away from the bushfire threat area.

Combining all of these matters with the geographical position of the bushfire threats, to the east, south and west at grade and slightly upslope from the site, the proposed senior school building and school is considered well placed in this circumstance to seek 'exceptional circumstance' consideration based on the merits of the proposal and to seek inclusion of bushfire protection measures that will provide appropriate protection even though it cannot meet the requirement for 'new' SFPP APZs.

Table 4-1 details the APZs for 'new' SFPP using Table A2.6 of PBP 2006 and the APZs that can be provided for the proposal. Figure 4-1 shows the location of the proposed APZs.

As the proposal is considered an 'exceptional circumstance' and the acceptable APZs cannot be readily provided for, an assessment has been undertaken in accordance with Section 4.3.5 of PBP 2006. Refer to Section 7 of this report. The proposal places a greater emphasis on construction standards, access, landscaping and emergency and evacuation planning.

Table 4-1: Recommended APZs for the Proposed Senior School Building

| Direction from Proposed ELC/School | Vegetation Classification within 140m | Effective Slope (within 100m) | Setback (APZ) required for NEW SFPP in accordance with PBP | Setback (APZ) that can be achieved |
|------------------------------------|---|---|--|------------------------------------|
| North | N/A – Developed Land | N/A – Developed Land | N/A – Developed Land | N/A – Developed Land |
| East | Open Forest and Forested wetland | The Open forest occurs on flat land and upslope | 60m | >47m |
| South | Forested Wetland | The Open forest occurs on flat land | 60m | >60m |
| West | Forested Wetland and Scrub for the purposes of this | The Open forest occurs on flat land | 60m | >49m |



| Direction from Proposed ELC/School | Vegetation Classification within 140m | Effective Slope (within 100m) | Setback (APZ) required for NEW SFPP in accordance with PBP | Setback (APZ) that can be achieved |
|------------------------------------|--|-------------------------------|--|------------------------------------|
| | assessment the highest fuel load being Open Forest has been used | | | |

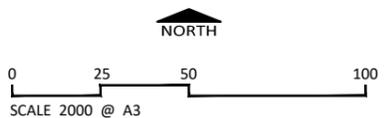


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FIGURE 4 - 1 : APZ MAP

CLIENT Client
 SITE DETAILS Salamander Way Salamander Bay
 DATE 1 June 2017

- Legend
- ▬ Subject Site
 - - - 100m Buffer
 - - - 60m APZ
 - Open Forest
 - Forested Wetland
 - Proposed Outdoor Area



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5 BUSHFIRE ATTACK ASSESSMENT

5.1 Building Design & Construction for the Proposal

On 6 March 2009, Council of Standards approved the revised Australian Standard AS3959-2009 *Construction of buildings in bushfire prone areas* (AS3959-2009). This standard was published by Standards of Australia on 10 March 2009 and replaces the 1999 version of the document.

AS3959-2009 was formally adopted by the BCA as the national standard on 1 May 2010. The BCA 2010 references AS3959-2009 as the deemed-to-satisfy (DTS) solution for construction requirements in bush fire prone areas for NSW.

In NSW, the bush fire protection provisions of the BCA are applied to Class 1, 2, 3 buildings, Class 4 parts of buildings, some Class 10 structures and Class 9 buildings that are Special Fire Protection Purposes (SFPPs).

The Bushfire Attack Level (BAL) for the proposed senior school buildings was determined using an FDI of 100, the information relating to vegetation, slope and according to Table 2.4.2 of AS3959-2009 Table 5-1 illustrates the BAL determined for the site.

Table 5-1: Determination of BALs for the Proposed Senior School Building

| Vegetation Type & Direction | Average Slope of Land (degrees) | Separation Distance | Bushfire Attack Level (BAL) |
|--|--|----------------------------|------------------------------------|
| Open Forest to the east | Flat / Upslope | >47m | BAL-12.5 |
| Forested Wetland to the south | Flat | >60m | BAL-12.5 |
| Open Forest to the west | Flat | >49m | BAL-12.5 |

The proposed Buildings are to be built to BAL-12.5



6 EMERGENCY & EVACUATION MANAGEMENT PLAN

The assessment does not provide an Emergency Response or an Evacuation Plan within this document. However, a detailed plan will be prepared consistent with the RFS document *A Guide to Developing a Bushfire Evacuation Plan* (2004) and as outlined in Section 4.1.

To Note: As part of the licensing requirements for the school the school staff must be able to have all students outside of the premises and to a safe evacuation point within 2 minutes of an alarm sounding. This will be detailed in the plan prepared for the site.



7 BUSH FIRE PROTECTION MEASURES FOR INFILL DEVELOPMENT FOR THE PROPOSAL

The intent of the BPM's is to minimise the risk of bush fire attack and provide protection for emergency services, personnel, residents and others assisting firefighting activities.

There are six BPM's these are:

- APZ's;
- Construction standards and design;
- Appropriate access standards for residents. Fire fighters, emergency service workers and those involved in evacuation;
- Adequate water supply and pressure;
- Emergency management arrangements for fire protection and / or evacuation; and
- Suitable landscaping, to limit fire spreading to a building.

7.1 Asset Protection Zones

In order to comply with the intent and performance criteria of section 4.3.5 the development proposal must achieve the following:

In relation to Asset Protection Zones (APZ) – a defensible space is provided onsite, and an APZ is provided and maintained for the life of the development.

The bushfire threat is located to the east, south and west of the site.

The entire site will be managed as an IPA. Approximately 46m of open area exists adjacent to the proposed senior school building site to the east, approximately 56m of open area exists adjacent to the proposed senior school building site south, and approximately 51m of open area exists adjacent to the proposed senior school building site west. These areas have been historically maintained by the school since it opened nearly 20 years ago and will continue to be maintained. As discussed previously a fire trail runs around the entire perimeter of the school, parts of the fire trail west be widened to the west. Combining this access with the existing cleared land between the school and the existing vegetation, the site provides excellent opportunity to allow fire fighters access to combat any bushfire threat.

To Note the parking area proposed to the west of the site increases the bushfire protection to the existing school buildings by removing the vegetation in this area and increasing the APZ distance between retained vegetation to the west and the existing buildings within the site.



7.2 Construction Standards and Design

In relation to siting and design – *buildings are sited and designed to minimise the risk of bush fire attack.*

Plan shape

Review of the proposed layout has shown that the proposed extension has been designed to achieve a simple plan shape with as few re-entrant corners as possible. Refer to Appendix A for proposed layout. The design of the building ensures that there are safe escape routes for occupants and fire fighters away from the direction of a bushfire threat, with the site and building exit / entry point being located away from the proposed hazard and allowing the building to shield this area.

Roof profile

The roofline has been simplified to remove any ember and burning debris accumulation points. The roof profile is sloping in order to shed any litter.

Walls

External walls are constructed from brick and the proposed extension will include metal cladding. The wall construction reduces the potential for ignition by heat radiation, direct flame contact and ignitions by embers and burning debris driven by the wind.

Doors, windows and vents

External doors shall be fitted with draught excluders and tight fitting door screens fitted with Bronze or Corrosion resistant steel. These measures will reduce ignitions by embers and burning debris by wind prevent entry of embers and burning debris by the wind, reduce ignitions by heat radiation and by flame contact and reduce wind damage.

Vents and weepholes shall be protected with spark guards made from 1.8mm mesh that is either bronze or corrosion resistant steel. These measures will reduce ignitions by embers and burning debris by wind prevent entry of embers and burning debris by the wind, reduce ignitions by heat radiation and by flame contact and reduce wind damage.

It is considered that even though the proposal forms part of the larger school, the opportunity to ember proof the building is still very good.

7.3 Access Requirements

In relation to access requirements – *safe, operational access is provided (and maintained) for emergency services personnel in suppressing a bush fire while residents are seeking to relocate, in advance of a bushfire.*

If risk of bushfire is known prior to opening of service, families will be contacted and be told that no care will be offered due to the risk. Care will then not be offered until clearance of no further risk is provided by emergency services.



If a bushfire event occurs when the school is opened, then as soon as there is a known risk, smell smoke or the school is notified from emergency services whichever comes first, the evacuation plan will be enacted. The staff will assemble the students and exit via the northern entry / exit point in the opposite direction to any bushfire. As part of the licensing requirements for the school the school staff must be able to have all students outside of the premises and to a safe evacuation point within 2 minutes of an alarm sounding. The students will then be transported to a safe refuge area being either the church to the north of the site or a safe area within the school grounds i.e. assembly hall (more detailed information on emergency evacuation will be detailed in the emergency / evacuation plan prepared for the site). In any case the site location allows for several safe refuges in the immediate vicinity of the site while being screened by existing buildings from the bushfire threat when moving from the building to the emergency evacuation centre.

The building has direct access to Salamander Way that directs staff and students in the opposite direction to any bushfire threat. Access to the bushland for firefighters is available along the fire-trail to the east of the site, the site itself, the school grounds and from Salamander Way.

7.4 Water Supply

In relation to water and utility services - adequate water and electricity services are provided for firefighting operations. Gas and electricity services are located so as not to contribute to the risk of fire to a building.

Additional hydrants will ensure an adequate water supply is available in the event of fire occurring in the vegetation to the south and east of the development. Installed fire hydrants will be required to comply with AS2419.1 –2005. Hydrants must be located outside parking bays and should be clearly marked to ensure accessibility for fire-fighting personnel.

7.5 Emergency Management

In relation to Emergency Management – an Emergency and Evacuation Management Plan is approved by the relevant fire authority for the area

An Emergency and Evacuation Plan will be required for the site. An Emergency and Evacuation Plan requires specific details regarding the facility as follows:

- Number of employees
- Number of students
- Number of buildings



- Designation of emergency personnel
- Designation of emergency refuge and assembly areas
- Available transport & walking routes
- Site layout

This Emergency and Evacuation Plan will be prepared as per the RFS Guidelines for the Preparation of Emergency and Evacuation Plans.

It is noted that as part of the licensing requirements for the school the school staff must be able to have all students outside of the premises and to a safe evacuation point within 2 minutes of an alarm sounding. This will be detailed in the Emergency Evacuation Plan prepared for the site.

7.6 In relation to landscaping

It is designed and managed to minimise flame contact and radiant heat to buildings and the potential for wind driven embers to cause ignition.

The entire site will be managed as an IPA.



8 CONCLUSION & RECOMMENDATIONS

The development is not a stand-alone development, but rather an extension as part of the school facilities of St Philip's Christian College Port Stephens and established under a single ownership that controls St Philip's Christian College Port Stephens. The proposal is considered infill development and provides a better outcome than if the development did not proceed.

Pursuant to Section 4.2.5 SFPPs as Infill, PBP (RFS, 2006), the circumstances of this development make it difficult to achieve the preferred standards for SFPP development. The proposal seeks the creation of larger APZs being established along the western side of the school by the proposed carparking and the widening of the fire-trail with additional PFFM that achieve a better bushfire risk outcome for the school facilities than if the development did not proceed. The proposed building works will comply with AS 3959 – 2009 to ensure improved safety.

The proposal provides a combination of BPM, including opportunity for safe emergency evacuation procedures, provision for the needs of SPCC students and staff, multiple points of access for fire fighting through the school grounds and adjacent fire trail with readily defensible space, location of the emergency exit away from the hazard with protection from the existing buildings.

The proposal demonstrates the requirement for exceptional circumstance and justifies a reduction in APZ. In summary, the following key recommendations have been generated to enable the proposal to meet the requirements of Section 4.2.5 and 4.3.5 of PBP 2006:

- The existing site does not allow for the required APZ's and therefore additional measures with regard to higher construction standards, siting and design of buildings, access, water supply and emergency planning will be required.
- In combination with the additional measures detailed in the Performance Based Assessment, the APZ's outlined in Table 4.1 are to be provided.
- Additional fire hydrants should be installed within the site. Installed fire hydrants will be required to comply with AS2419.1 –2005. Hydrants must be located outside parking bays and should be clearly marked to ensure accessibility for fire-fighting personnel.
- The Emergency Response and Evacuation Plan is to be upgraded to include the proposed buildings and is to be consistent with the RFS document "A guide to Developing Bushfire Evacuation Plan" (2004).
- The proposed extensions are to be built to BAL-12.



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Rural Fires and Environmental Assessment Legislation Amendment Act 2002.

Standards Australia (2009). *AS 3959 – 2009: Construction of Buildings in Bushfire-prone Areas*.



APPENDIX A SITE PLAN

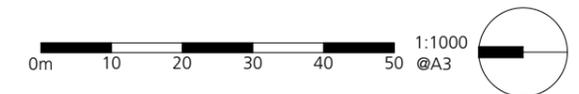
- 1. Dimensions are in millimeters unless otherwise shown.
- 2. Work to given dimensions. Do not scale from drawing.
- 3. Check all dimensions on site prior to construction and fabrication.
- 4. Bring any discrepancies to the attention of the proprietor & architect.



Drawing and design © SHAC Pty Ltd 2017. The signed control copy of this drawing is held by SHAC Pty Ltd. | Ref. Volume/Projects/003716-SPCC Port Stephens - Senior/520 DA/3716-520-13 DA.pln date: 7/07/2017 Time: 4:45 PM

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Proposed Site Plan
 St Philip's Christian College, Port Stephens Campus
 182 Salamander Way, Salamander Bay



SHAC
 Nominated Architect Justin Hamilton (6160) | ABN 32 131 584 846



APPENDIX B

PRE-DA MINUTE RFS NOTES



PRE-DA ADVICE MEETING SUMMARY

Attendees: Josh Calandra, Development Assessment and Planning Officer
Jason Maslen, Team Leader, Development Assessment and Planning
Sarah Jones, Firebird ecoSultants
Ian Eastern, Ian Eastern Architects

Subject: St Phillips School, Salamander Way Salamander Bay

Time and date: 26 April 2016 **Location:** Planning and Environment Services (East)
42 Lamb Street Glendenning

Details of the proposal:

- SFPP infill Additions to the existing St Philip's Christian College Port Stephens campus.
- Residential subdivision
- Other

Bush fire protection issues discussed:

- Hazard Assessment The bush fire vegetation that has the potential to pose a threat to the proposed development includes forested/fresh water wetlands to the west, south and east of the subject site.
- Asset Protection Zones APZs for SFPP Infill and SFPP (10kWm²) are to be demonstrated as applicable to the development.
- Access A carpark and sealed fire trail are proposed between the bush fire hazard (to the west and southwest) and the proposed development. This will be on Council lands on lease which will need to be acknowledged by both parties in writing before a Bush Fire Safety Authority would be provided.
- Construction Standards It will need to be demonstrated that the proposed development (change rooms and amenities and maintenance building) on the subject site is consistent with *Planning for Bush Fire Protection 2006*. It is proposed to be treated as SFPP infill with accompanying documentation to clearly demonstrate how the proposed additions are an extension of the existing school facilities on existing/amalgamated lots and not exceeding the line of existing development towards the hazard.
- Services The proposed development will be linked into existing services.
- Emergency and Evacuation Planning Proposed development will need to be incorporated into existing emergency and evacuation planning.

Documentation / plans referenced:

Vegetation Map prepared by Firebird dated 29 March 2016

RFS advice is based on information provided and policy and legislative requirements applicable at the time. The advice should be copied into, or referenced in, any subsequent development application.

All efforts are made to identify issues of relevance and likely concern with the preliminary proposal. However, the comments and views in this document are based only on the plans and information submitted for preliminary assessment and discussion at the pre-DA meeting. You are advised that: -

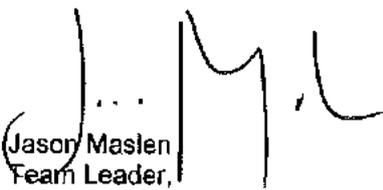
- The views expressed may vary once detailed plans and information are submitted and formally assessed in the development application process, or as a result of issues contained in submissions by interested parties;
- Given the complexity of issues often involved and the limited time for full assessment, no guarantee is given that every issue of relevance will be identified;
- Amending one aspect of the proposal could result in changes which would create a different set of impacts from the original plans and therefore require further assessment and advice;

The Pre-DA advice given does not bind Council officers, the elected Council members, or other parties to the DA process.

Signed:



Josh Calandra
Development Assessment and Planning Officer,
Planning and Environment Services (East)



Jason Maslen
Team Leader,
Planning and Environment Services (East)



APPENDIX C

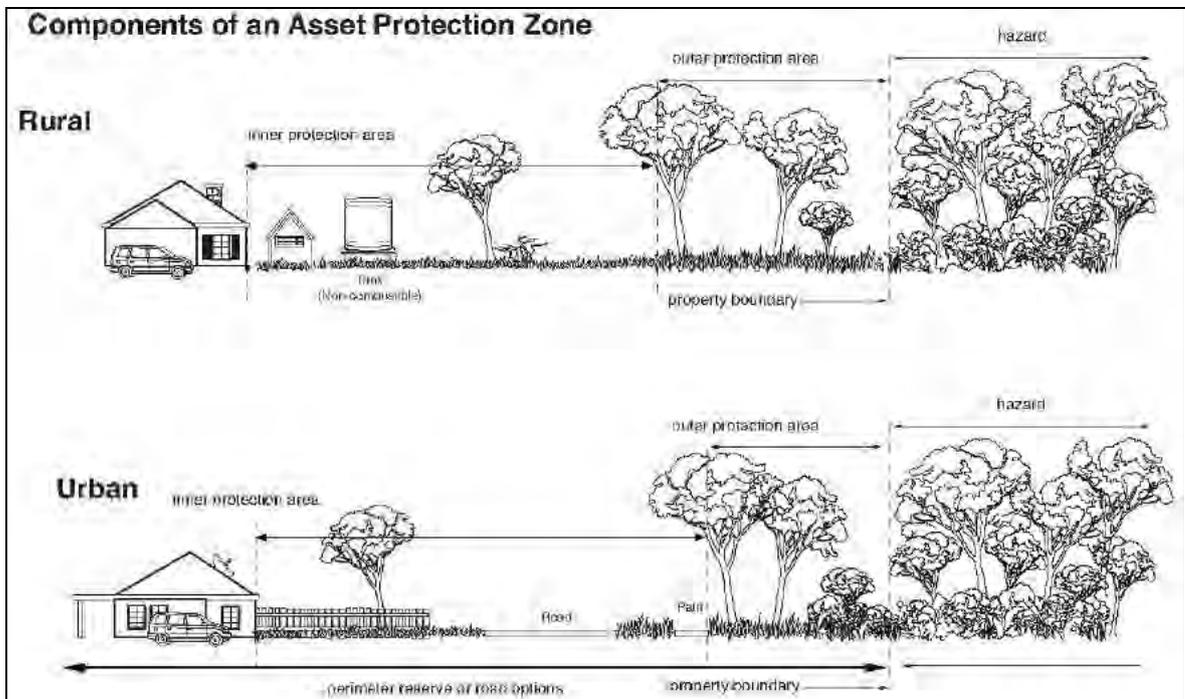
ASSET PROTECTION ZONES

ASSET PROTECTION ZONES

An Asset Protection Zone (APZ) is an area surrounding a development that is managed to reduce the bushfire hazard to an acceptable level to mitigate the risk to life and property (refer to Figure B-1 below). The required width of the APZ varies with slope and the type of hazard. An APZ can consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA). The respective IPA and OPA widths for the required APZs are as detailed in Table 5-1. An APZ can include the following:

- Lawns;
- Discontinuous gardens;
- Swimming pools;
- Driveways;
- Unattached non-combustible garages with suitable separation from the dwelling;
- Open space / parkland
- Golf courses; and
- Car parking.

Figure B-1: Components of an APZ (PBO 2006)





INNER PROTECTION AREA

The Inner Protection Area (IPA) extends from the edge of the OPA to the development. The IPA aims to ensure that the presence of fuels which could contribute to a fire event / intensity, are minimised close to the development. The performance of the IPA must be such that:

- There is minimal fine fuel at ground level which could be set alight by a bushfire; and
- Any vegetation in the IPA does not provide a path for the transfer of fire to the development – that is, the fuels are discontinuous.

The presence of a few shrubs or trees in the IPA is acceptable provided that they:

- Do not touch or overhang any buildings;
- Are well spread out and do not form a continuous canopy;
- Are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and
- Are located far enough away from any dwelling so that they will not ignite the dwelling by direct flame contact or radiant heat emission.

Woodpiles, wooden sheds, combustible material storage areas, large areas / quantities of garden mulch, stacked flammable building materials etc are not permitted in the IPA

OUTER PROTECTION AREA

The Outer Protection Area (OPA) is located adjacent to the hazard. Within the OPA any trees and shrubs should be maintained in a manner such that the vegetation is not continuous. Fine fuel loadings should be kept to a level where the fire intensity expected will not impact on adjacent developments.