

APPENDIX **S**

Geotechnical Baseline Report





THE NORTHERN BEACHES HOSPITAL (STAGE 2)

STATE SIGNIFICANT INFRASTRUCTURE APPLICATION SSI_6792
(STAGE 2)

Environmental Impact Statement

Appendix S: Geotechnical Baseline Report

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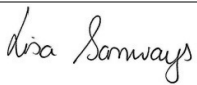


THIESS PTY LTD

STAGE 2 NORTHERN BEACHES HOSPITAL

State Significant Infrastructure Application SSI_6792 (Stage 2)

Environmental Impact Statement Appendix S: Geotechnical Baseline Report

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1 EXECUTIVE SUMMARY

Hyder Consulting has prepared a Geotechnical Baseline Report for the proposed Northern Beaches Hospital (NBH) for the following buildings and retaining structures.

- Hospital building with one level of basement
- New Car Park building of eight levels with two levels of basement at the western side of the Hospital building
- New on-grade car park with perimeter retaining walls together with an underground detention tank also in the north eastern sector.

This report documents a Geotechnical Report that is required by the Stage 2 Director Generals Requirements (DGRs) for the project. The geotechnical report has been developed to provide an overall assessment of the geotechnical investigation carried out by Douglas Partners for Health Infrastructure and issued to Healthscope during the Request for Proposal phase.

The Stage 2 buildings foundation and retention systems described in this report are compatible with the recommendations from geotechnical investigation and recommended design parameters from the report have been adopted for the foundation and retention designs.

2 INTRODUCTION

The NBH Project aims to establish a partnership between the NSW State Government and a health services provider for the provision of a new hospital facility to service the Northern Beaches community. Health Infrastructure NSW (HI) has issued a Request for Proposals (RFP) to design, construct, commission, operate and maintain the proposed hospital.

Thiess Pty Ltd has requested Hyder Consulting to undertake a Geotechnical Baseline Report for the project which is based on Douglas Partners' preliminary geotechnical investigation for the site.

The purpose of this report is to consider the content and data within the Douglas Partners report, their correctness, impact of the recommended parameters if they are appropriate, suitability and adequacy in terms of normal practice for a project of this nature, risk factors etc.

This report does not include design, design analysis, calculations, interpretative analysis, etc.

2.1 SITE LOCATION

The site for the proposed NBH is located approximately 15 km north of the Sydney CBD (refer **Figure 2-1**) within the suburb of Frenchs Forest and Warringah Council Local Government Area (LGA).

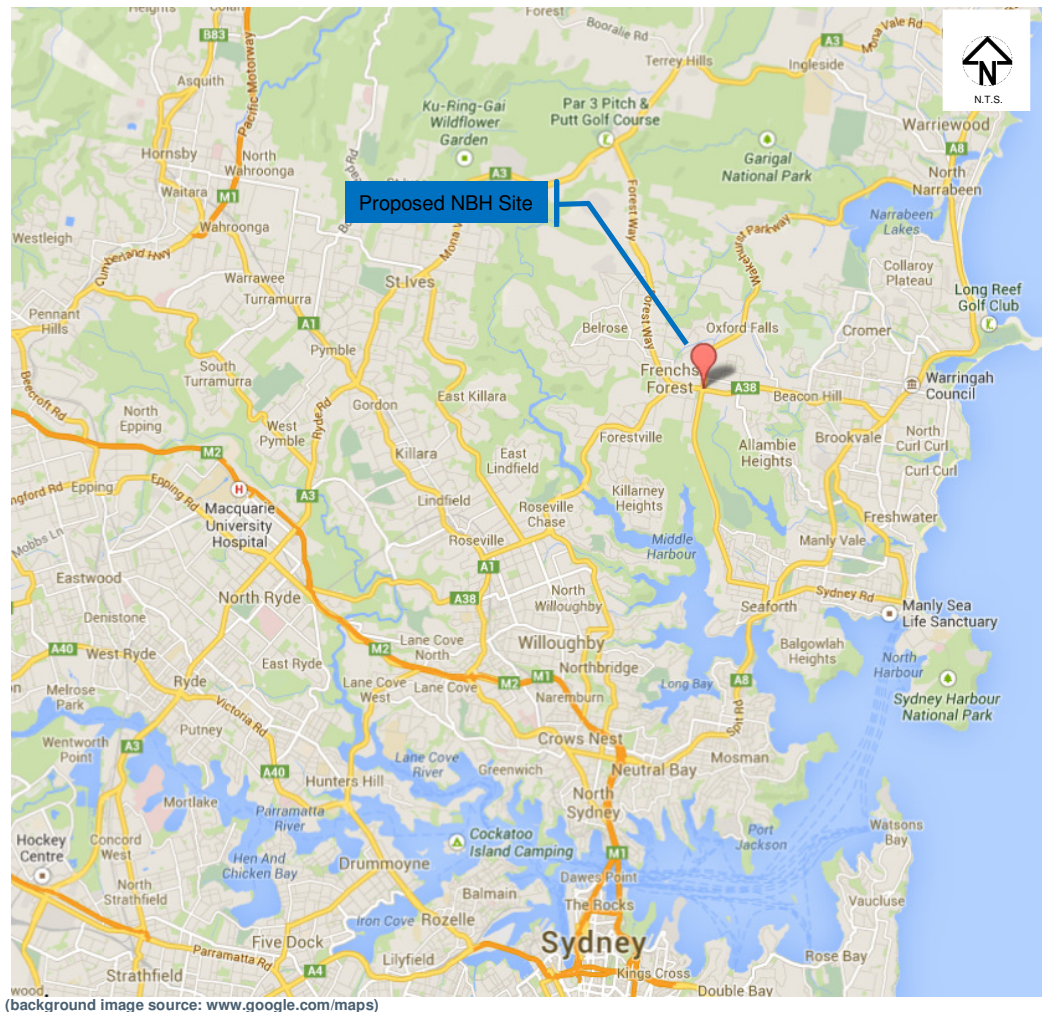


Figure 2-1: Locality Map

The site is bound by Frenchs Forest Road West, Warringah Road, Wakehurst Parkway and The Forest High School (refer **Figure 2-2**) and has a total area of approximately 6.3 ha.



(background image source: www.google.com/maps)

Figure 2-2: Site Plan

2.2 PLANNING PATHWAY

In October 2013, a Staged Infrastructure Application (SSI_5982) was lodged by Health Infrastructure (HI) for this project. The application was divided into two parts:

(i) Concept Proposal and Stage 1

- Concept Proposal for the site; and
- Stage 1 - Site clearance and preparatory works.

(ii) The proposed Stage 2 NBH development

- Bulk excavation works
- Construction of a nine storey Hospital building
- Staff, patient and visitor car parking, including construction of an eight storey multi-deck Car Park
- Site works including internal roads, pathways and landscaping
- Utility amplification works

The Director General's Requirements (DGRs) for environmental assessment were issued by Department of Planning and Infrastructure (DP&I) on 19 June 2013 for both parts of the application.

A State Significance Infrastructure Application (SSIA) and Environmental Impact Statement (EIS) was prepared to address the DGRs associated with the Concept Proposal and Stage 1 and submitted in October 2013.

Public exhibition of the SSIA and EIS closed on 28 November 2013 and a significant number of submissions were received.

A Submission Report / Preferred Infrastructure Report was subsequently prepared and lodged with DP&I in February 2014 in response to the submissions received and to seek approval for additional services diversion works.

The Stage 1 SSIA and EIS was approved by Department of Planning and Environment (DP&E) on 22 June 2014.

The DP&E advised on 10 November 2014 that the Stage 2 NBH SSIA and EIS should be lodged under project title reference 'SSI 6792'.

2.3 OBJECTIVES

The objective of this report is to provide details of the geotechnical database that has been developed for the proposed NBH Project and demonstrate compliance with item 'Plans and Documents – Geotechnical Report' of the Stage 2 DGRs.

2.4 RFP DOCUMENTS

This report is based on documentation issued by the NSW Department of Health under cover of their Request for Proposals (RFP) version 5 on the 29 November 2013.

In particular, the following RFP documentation is referenced

Table 1: Reference documentation

Documentation		Date/Rev
Volume 1	General Information, the opportunity, general Information and instructions to respondents.	November 2013
Volume 2	NBH Requirements	November 2013
Volume 3	Information Documents	November 2013
Volume 4	Returnable Schedules	November 2013
Volume 5	Project Deed Schedules	November 2013
	▪ Schedule 5-7 - Asset and Commercial	November 2013
	▪ Schedule 37-42 - Asset and Commercial	November 2013

3 PROJECT DESCRIPTION

In preparing this report, it has been necessary to broadly understand the scope and extent of the Project. The development is comprised of:

- 1** Nine-storey Hospital building, with one basement level
- 2** Multi-storey Car Park at the western side of the Hospital building comprising an eight-storey building with two basement levels.
- 3** Eastern car park providing on-grade parking including an underground detention tank in the north eastern corner.

4 AVAILABLE INFORMATION

The documentation available in order to prepare this geotechnical baseline report is as follows:

- 1 Report on Preliminary Geotechnical Investigation, Proposed Northern Beaches Hospital, Corner of Wakehurst Parkway and Warringah Road, Frenchs Forest, Prepared for Health Infrastructure, Project 73033.00, Douglas Partners, dated 23 July 2012.
- 2 Drawings/ sketches showing the proposed retention for the deep excavations for the building basements and the proposed foundation systems for the buildings.

5 GEOTECHNICAL ASSESSMENT

5.1 GENERAL

The geotechnical assessment is based on the Douglas Partners' Preliminary Geotechnical Investigation report. The assessment is based on Hyder's sketches/drawings of retention systems for the proposed basement/retaining wall excavation and foundations supporting the building structures, as well as the cut and fill slope batters.

The preliminary geotechnical investigation provided by Douglas Partners is considered to be a standard geotechnical report at tender design.

The report indicates that, geologically, the site is primarily underlain by shale and laminate bed within the Hawkesbury Sandstone formation.

The subsurface profile adopted in Douglas Partners' reports was divided into five main strata:

- Pavement, topsoil, filling
- Residual Clay
- Weathered shale
- Laminite/Siltstone
- Sandstone.

The preliminary geotechnical investigation report provided recommendations and design parameters for some of the above stratum in relation to the following:

- 1 Suggested excavation methods
- 2 Noise and vibration controls
- 3 Displacement of excavation faces due to stress relief
- 4 Earth pressure coefficients
- 5 Trapezoidal pressure distribution for retention systems
- 6 Allowable bond stress for ground anchor design
- 7 Foundation design parameters for foundation design
- 8 Earthquake design parameters.

The groundwater level was inferred from limited locations by standpipes at boreholes BH6, BH9, BH24 and BH31 where the water depths were measured as 5.6m, 2.5m, 2.8m and 5.0m respectively.

We note that the recommendations and the geotechnical design parameters for each main stratum have been largely inferred from the past project experience as well as published data together with the limited site specific geotechnical data from available boreholes. This approach is considered to be a common geotechnical practice for tender design purpose for most projects. Although the available investigation data is unlikely to ascertain the details of the retention system and foundation design across the entire project site, we have carried out our review for each of the proposed buildings and retaining structures, with a focus on the following:

- 1 Relevant geological information available for the proposed retention system and foundation design
- 2 Assessment of the quality of the geotechnical information, analysis and interpretation of geotechnical data
- 3 Impact on the basement excavation and geotechnical design resulting from geotechnical data.

5.2 HOSPITAL BUILDING

5.2.1 BASEMENT RETENTION SYSTEM AND FOUNDATIONS

The proposed Hospital building is to be nine storeys together with one basement level.

- the bulk excavation level for the Hospital building is approximately RL 154.2m
- western soldier pile wall with temporary ground anchors
- northern soldier pile walls with temporary ground anchors runs for approximately 24 meters from each end where a basement level is required.
- shoulder pile walls for the ramp to the basement car park with permanent ground anchors along the southern perimeter of the Hospital building
- a 55 °- 60 ° shotcrete stabilised batter slope along the eastern perimeter of the Hospital building.
- a 45 ° batter slope stabilised by shotcrete, reinforcement mesh and rock bolts at the northern side of the Hospital building between pile foundations and pad footing foundations.

The columns of the Hospital building structure are proposed to be founded on piles in the in the higher northern section and pad footings for the rest of the basement. The pile length has not been specified while the minimum allowable capacity of 2000 kPa for the pad footing has been nominated.

5.2.2 EVALUATION OF RELEVANT GEOTECHNICAL INFORMATION

The relevant boreholes to the proposed bulk excavation plan and the retention system of the Hospital building are presented as follows:

- BH6, BH7, BH12, BH14, BH16, BH18, BH20, BH22 & BH33 inside the excavation area
- BH10, BH15 & BH28 outside the excavation area but in the vicinity

Among all the above boreholes, most boreholes terminated within the top 1.5m in depth within filling and residual clay. Rock coring was carried out only at BH6, BH10, BH15 and BH24.

The depth of soil from ground level varies from 1.5m to 3.5m with SPT values in the range of 13 to 41. Below the soil, there exist layers of shale followed by laminate then sandstone. Pont Load Strength Index ($Is_{(50)}$) tests were carried out on some rock cores. The $Is_{(50)}$ values ranges from 0.1 MPa to 1.5MPa with majority of results between 0.2MPa and 0.4MPa.

Groundwater table from the standpipe installed at BH6 was at 5.6m depth (RL 153.4m) at the time of measurement in July 2012. The measured groundwater levels at BH9 and BH24, which

are in the vicinity of the building, were at RL 157.5m and RL 152.0m respectively in July 2012. However the groundwater table is expected to vary across the site, in particular during and post a high rainfall event. Groundwater conditions will be assessed by Hyder during the detail design phase.

There is no geotechnical laboratory testing for soils. The geotechnical design parameters were derived from correlations, published data or experience. The rock strength and classification and the associated geotechnical parameters were primarily based on the past project experience and published literature.

There is no detailed statistical analysis of the soil and rock data to derive the geotechnical parameters. Rather the rock mass classification was based on the estimated rock strength, defects identified and clay seams from the logged boreholes.

Given the fact that the geotechnical design parameters are based on limited information but logically relied upon past experience and published literature, the geotechnical information provided in the report is considered inadequate for detailed design but not unreasonable for preliminary design.

Further geotechnical investigation during the detail design phase will confirm the appropriate parameters to be adopted for detail design.

5.2.3 POTENTIAL DATA VARIATION AND IMPACT

Geotechnical Data Variation	Potential Impact
Temporary batter at 1H:1V above the embedded pile wall between multi-storey Car Park building and Hospital building as per Hyder's sketches/drawings	Unstable batter due to construction loadings (for example, piling rig). Need of temporary batter stabilisation
Excessive groundwater inflow during piling	Unsupported pile wall instability such as wall collapse
Shallower groundwater table than considered	Increased lateral pressure on retention system and toe instability Increased uplift on floor slabs and foundations Inadequate drainage capacity leading to flooding of basements
Clogging of strip drains between pile wall	Buildup of groundwater pressure behind pile wall leading to significant displacement or even structural failure

Geotechnical Data Variation	Potential Impact
Greater depth of soil or class V or Class IV Shale	Increase in lateral soil pressure and toe instability; Pad footing not founding on material with the required allowable bearing capacity of 2000 kPa leading to significant settlement and/or bearing capacity failure Increase in rock support requirements of the 45°-60° batter towards the eastern and northern end of the building Increase in anchor lengths which may intrude into other structures or go beyond project site boundary Increase of pile toe penetration to avoid pile toe lateral instability
Lower bond stresses for soil nails and anchors in rock	Increase in length of soil nail and anchors or closer spacing Increase in anchor lengths which may intrude into other structures or go beyond project site boundary
Less shaft adhesion and end bearing of piles	Increase of pile length
Lower end bearing for pad footing	Increase of pad size or excavation to greater depth
Change of stiffness between pile foundation and pad footings	Potential larger differential settlement between the piled superstructure and that supported by pad footings
Lower stiffness of weaker soil and rock for retention system design	Increase in lateral loading and vertical ground settlement, in turn more severe adverse impact on existing services and pavement Increase of pile toe penetration to avoid pile toe lateral instability

An additional site investigation will be undertaken by a qualified geotechnical engineer at the detail design stage and the identified potential impacts will be further assessed and mitigated where necessary.

5.3 WESTERN CAR PARK BUILDING

5.3.1 BASEMENT RETENTION SYSTEM AND FOUNDATIONS

The proposed Car Park building at the western side of the Hospital is to be eight storeys plus two basement levels. The proposed retention system for the basement excavation comprises:

- the maximum bulk excavation is expected to be between RLs 152.95m to 154.3m
- Shoulder pile wall with temporary ground anchors around the entire perimeter of the building.

All columns of the multi-storey Car Park building structure are proposed to be founded on piles around the perimeters of the building and pad footings for the rest of the basement.

5.3.2 EVALUATION OF RELEVANT GEOTECHNICAL INFORMATION

The relevant boreholes to the proposed bulk excavation plan and the retention system of the multi-storey Car Park building are presented as follows:

- none inside the excavation area
- BH1, BH31, BH32, BH34 & BH35 outside the excavation area but in the vicinity.

Among all the boreholes enlisted above, most boreholes terminated within the top 1.5m in depth within filling and residual clay. Rock coring was carried out only at BH1 and BH31.

The depth of soil from ground level is estimated to be consistent at approximately 2.5m within their SPT values in the range of 20 to 24. Below the soil, there exist layers of shale followed by laminate/siltstone then sandstone. Pont Load Strength Index ($Is_{(50)}$) tests were carried out on some rock cores. The $Is_{(50)}$ values ranges from 0.1MPa to 4.4MPa.

Groundwater table from the standpipe installed at BH31 was at 5.0m depth (RL 155.8m) at the time of measurement in July 2012. However this is expected to vary across the site, in particular during and post a high rainfall event.

There is no geotechnical laboratory testing for soils. The geotechnical design parameters were derived from correlations, published data or experience. The rock strength and classification and the associated geotechnical parameters were primarily based on the past project experience and published literature.

There is no detailed statistical analysis of the soil and rock data to derive the geotechnical parameters. Rather the rock mass classification was based on the estimated rock strength, defects identified and clay seams from the logged boreholes.

Given the fact that the geotechnical design parameters are based on limited information but logically relied upon past experience and published literature, the geotechnical information provided in the reports is considered inadequate for detailed design but not unreasonable for preliminary design.

Further geotechnical investigation during detail design phase will confirm the appropriate parameters to be adopted for detail design

5.3.3 POTENTIAL DATA VARIATION AND IMPACT

Geotechnical Data Variation	Potential Impact
Temporary batter at 1H:1V above the embedded pile wall between Car Park building and Hospital building as per Hyder's sketches/drawings	Unstable batter due to construction loadings (for example, piling rig). Need of temporary batter stabilisation
Excessive groundwater inflow during piling	Unsupported pile wall instability such as wall collapse
Shallower groundwater table than considered	Increased lateral pressure on retention system and toe instability Increased uplift on floor slabs and foundations Inadequate drainage capacity leading to flooding of basements
Clogging of strip drains between pile wall	Buildup of groundwater pressure behind pile wall leading to significant displacement or even structural failure
Greater depth of soil or class V or Class IV Shale	Increase in lateral soil pressure and toe instability; Pad footing not founding on material with the required allowable bearing capacity of 2000kPa leading to significant settlement and/or bearing capacity failure Increase in anchor lengths which may intrude into other structures or go beyond project site boundary Increase of pile toe penetration to avoid pile toe lateral instability
Lower bond stresses for soil nails and anchors in rock	Increase in length of soil nail and anchors or closer spacing Increase in anchor lengths which may intrude into other structures or go beyond project site boundary
Less shaft adhesion and end bearing of piles	Increase of pile length
Lower end bearing for pad footing	Increase of pad size or excavation to greater depth

Geotechnical Data Variation	Potential Impact
Lower stiffness of weaker soil and rock for retention system design	Increase in lateral loading and vertical ground settlement, in turn more severe adverse impact on existing services and pavement Increase of pile toe penetration to avoid pile toe lateral instability

An additional site investigation will be undertaken by a qualified geotechnical engineer at the detail design stage and the identified potential impacts will be further assessed and mitigated where necessary.

5.4 ON-GRADE CAR PARK CIVIL WORKS AND INTERNAL ROAD PAVEMENTS

5.4.1 RETENTION SYSTEMS

The car park is formed on the ground and will require a retaining wall on the north eastern sides. The northern part of the car park has an underground detention tank.

5.4.2 INTERNAL ROAD PAVEMENTS

The road network within the site provides vehicular access for cars, delivery vehicles and emergency vehicles. Generally flexible pavements are proposed with rigid pavements in particular areas such as the loading dock apron.

5.4.3 UPDATE EVALUATION OF RELEVANT GEOTECHNICAL INFORMATION

The relevant boreholes to the proposed bulk excavation plan and the retention system of the Hospital building are presented as follows:

- BH11, BH13, BH15, BH17, BH19, BH21, BH24 and BH26 within the excavation area
- BH8, BH9, BH10, BH12, BH14, BH16, BH18, BH20, BH25, BH27 & BH28 close to the excavation area

Among all the boreholes enlisted above, most boreholes terminated within the top 1.5m in depth within filling and residual clay. Rock coring was carried out only at BH9, BH15 and BH24.

The depth of soil from ground level varies from 2.0m to 3.5m within their SPT values in the range of 5 to 49. Below the soil, there exist layers of shale followed by laminate/siltstone then sandstone. Pont Load Strength Index ($Is_{(50)}$) tests were carried out on some rock cores. The $Is_{(50)}$ values ranges from 0.1MPa to 1.9MPa.

Groundwater tables from the standpipes installed at BH9 and BH24 are at 2.5m and 2.8m depth (or RL 157.5m and RL 152.0 m) respectively at the time of measurement in July 2012. However this is expected to vary across the site, in particular during and post a high rainfall event.

There is no geotechnical laboratory testing for soils. The geotechnical design parameters were derived from correlations, published data or experience. The rock strength and classification, and the associated geotechnical parameters were primarily relied upon the past project experience and published literature.

There is no detailed statistical analysis of the soil and rock data to derive the geotechnical parameters. Rather the rock mass classification was based on the estimated rock strength, defects identified and clay seams from the logged boreholes.

There are no design parameters provided for pavement design in the Douglas Partners report.

Given the fact that the geotechnical design parameters are based on limited information but logically relied upon past experience and published literature, the geotechnical information provided in the reports is considered inadequate for detailed design but not unreasonable for preliminary design.

Further geotechnical investigation during detail design phase will confirm the appropriate parameters to be adopted for detail design

5.4.4 POTENTIAL DATA VARIATION AND IMPACT

Geotechnical Data Variation	Potential Impact
Temporary batter at 1H:1V above the embedded pile wall between Car Park building and Hospital building as per Hyder's sketches/drawings	Unstable batter due to construction loadings (for example, piling rig). Need of temporary batter stabilisation
Excessive groundwater inflow during temporary batter excavation	Instability of exposed temporary cut batter
Shallower groundwater table than considered	Potential instability of the temporary excavated batter and permanent blockwork retaining wall
Lower stiffness of weaker soil and rock for retention system design	Increase in lateral loading and vertical ground settlement, in turn more severe adverse impact on existing services and pavement

An additional site investigation will be undertaken by a qualified geotechnical engineer at the detail design stage and the identified potential impacts will be further assessed and mitigated where necessary.

6

SUMMARY

This Geotechnical Report is based on the preliminary geotechnical Investigation report carried out by Douglas Partners that was provided as part of the RFP documents.

As part of Stage 2 works, further specific geotechnical investigation will be undertaken. The investigation will be specific to the Stage 2 works and provide the appropriate level of information for the design of buildings and pavement areas.