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PENRITH HEALTH CAMPUS REDEVELOPMENT STAGE 3

Preliminary Contamination and Geotechnical Investigation Report

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REPORT



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Executive Summary

Golder Associates Pty Ltd. ("Golder") was instructed by Health Infrastructure NSW Health (ABN: 89 600 377 397) on 26 November 2008 to conduct a Preliminary Contamination and Geotechnical Investigation for the Penrith Health Campus Redevelopment Stage 3.

The Penrith Health Campus Redevelopment Stage 3 is in the concept design stages but principally comprises construction of a new multi-level East Block following demolition of the existing buildings ("Main Site"), expansion of the Intensive Care Unit (ICU) in the existing North Block ("ICU Site"), and additional major and minor enhancement and refurbishment to associate existing infrastructure.

The scope of works for this investigation can be summarised as follows.

- Document review including geological maps, regulatory records, land title, planning certificate and historic aerial photographs;
- Site reconnaissance to identify limitations to the proposed development, contamination issues, and likely impact to surrounding land and structures; and
- Reporting, to include findings of the above and a discussion of the potential impact on the proposed development, and recommendations for additional investigations required to assess subsurface conditions at the site.

The Main Site comprises the existing East Block and adjacent pre-fabricated buildings, car park, access road and landscaping forming a roughly semi-circular area of approximately 1.1Ha. The ICU Site comprises part of the existing North Block currently occupied by a courtyard, access corridor and existing hospital facilities forming a square area of approximately 900m².

The Site is situated at the northern end of a N-S trending ridge. The surrounding area is characterised by gently undulating topography ranging between 50-60m AHD. The Main Site area slopes from the southwest corner (~58m AHD) radially at an approximate 1-5° gradient to the north and east to a low of ~52m AHD at the eastern end of the proposed development.

The underlying geology is mapped as mid-Triassic Bringelly Shale sequences with podzolic / massive clay soils of the Luddenham Group. A moderate salinity potential is indicated for this area. This is further evidenced by the presence of suspected salt crystals on the lower row of bricks at the north-eastern corner of the East Block.

Bore data indicates that groundwater is found in discrete horizons typically hosted in relatively shallow (>5m) unconsolidated clays and deeper fractured shale and more permeable sandstone. Groundwater is often recorded as salty or brackish. The Site is located in the Nepean River catchment area with storm water drains ultimately discharging into the Nepean River at an unknown location.

The Site has remained in use as a hospital since early construction began in the 1950s. Prior to this the land was used for rough grazing. Since the 1950s the hospital has undergone several phases of expansion and re-development.

The East Block was constructed in the 1950s and extended to the east prior to 1970. This part of the building now hosts the boiler room. The East Block comprises a three storey building of brick wall and tile roof construction with its axis oriented approximately east to west. According to anecdotal reports, the East Block has been used as nurse's accommodation, offices and training facilities.

The East Block building is showing some minor evidence of foundation settlement, which is expected given the age of the building. More extensive settlement of the subsurface soils of up to about 70mm was observed near the north-eastern corner of the building, beneath steel support poles for the northern 1st floor



balconies. Ongoing shrinking and swelling of the subsurface soils at this location as a result of moisture variations may be considered a possible cause for the settlement.

Site Contamination

No significant potential sources of contamination (past or present) have been identified at the Site. Potentially contaminating past activities could have included the generation, storage and disposal of wastes produced at the hospital. Waste types may have included clinical, general / domestic, construction, demolition and excavation, and boiler ash waste.

A single fragment of suspected cement bound asbestos partially buried in exposed soil to the south of East Block may indicate the presence of residual waste materials from previous phases of demolition and construction.

The potential contaminants of concern (PCoC) associated with possible past activities include the following heavy metals (including arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and asbestos fibres and asbestos containing materials (ACMs).

The risk to construction workers and future users of the Site from these potential contaminants is likely to be low. The risk to surface and groundwater from these potential contaminants is likely to be negligible.

Suspected cement bound asbestos has been identified within the eaves of the East Block. Given the age of the structures additional asbestos containing materials and other potentially hazardous materials (including lead based paint) are suspected within the building.

An intrusive investigation should be designed and implemented to confirm the conclusions of this report. The investigation should include a number of boreholes or test pits to determine the nature and distribution of fill materials beneath the site, and provide sufficient soil samples for laboratory testing. Soil testing should include the potential contaminants of concern identified, and an assessment of soil waste classification for future excavations.

The PCoC should be reviewed following intrusive ground investigations and visual inspection of the underlying soils to ensure testing includes all appropriate contaminants.

The risks to construction workers, future site users, surface water and groundwater should be reviewed based on the results of the intrusive investigation. Remedial action or further post-demolition investigations should be prescribed accordingly.

A hazardous material (HazMat) survey should be conducted prior to planning the demolition of the existing East Block building. A post-demolition sampling programme may be required to confirm the successful removal of hazardous materials identified.

Geotechnical

The site is likely underlain by shallow residual soils, typically less than 2 m in depth, comprising stiff to very stiff clay of medium to high plasticity in a dry to moist condition, containing some ironstone gravel. The underlying Bringelly Shale is expected to be extremely to highly weathered and of typically very low to low strength, gradually decreasing in weathering and increasing in strength with depth.

Construction of the proposed East Block undercroft will require excavation within the western portion of the development footprint decreasing in depth towards the east. Minor filling may be required in the north east. Construction of the ICU extension and the majority of the walkway, connecting the East Block with the ICU, is expected to be at grade and will therefore not require deep excavations or filling. Considering the proposed ICU extension will be constructed over existing buildings, no excavation or filling will be required for its construction.



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Excavations are expected to intersect some minor topsoil, residual soils and some extremely to highly weathered shale of very low to low strength, which may be readily excavated using a conventional excavator of say 20 tonne capacity.

Where excavations are to extend below a depth of 0.8m, the exposed soil profile and weathered rock is to be battered back / graded at a maximum temporary slope of 1V:1H (45°) or permanent slope of 1V:2H (26°). Alternatively, the excavation faces are to be suitably retained where excavation extends into the zone of influence of surrounding existing structures/features or where there may not be sufficient room to provide permanent batter slopes.

Although groundwater is unlikely to be encountered within excavations to depths of about 3m, some minor seepage flows may be encountered within more permeable soil or rock layers. Subsurface drainage will be required at the base of and behind all retaining walls.

The use of shallow or deep footings is considered suitable for the proposed East Block and connection walkway. With regards to the proposed ICU extension, the type and layout of the existing building foundations and the condition of the foundation materials are to be further established to assess the capacity of the existing footings to carry the additional loading.

The residual clays are likely to be highly reactive to moisture condition variations and to be saline. The site is likely to be classified as a CLASS H site (high ground movement) in accordance with AS/NZS 2870-1996 "Residential Slabs and Footings". The residual soils are not suitable for re-use within the development as 'controlled fill' unless they are suitably combined with appropriate imported granular materials.

Suitable silt fencing, drainage and settlement basins are to be provided at the site during construction of the East Block and all exposed ground surfaces must be paved or vegetated immediately after completion of construction to limit risks associated with the assessed high soil erosion hazard. Suitably treated storm water flows, surface run off and collected subsurface seepage flows must be piped and discharged into Council's system or to an appropriate and Council approved discharge point down slope of the site.

A detailed geotechnical investigation is required to confirm the anticipated ground conditions and better define key geotechnical issues, including suitable soil and rock design parameters, for the design and construction of the proposed development. The investigation is to also address the effects of potential saline conditions at the site and to appropriately manage the associated risk of potential soil erosion. Further geotechnical investigations, field and laboratory testing may also be required at the location of the ICU extension, the nature of which will depend on the configuration of existing and proposed new buildings.



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1.0 INTRODUCTION

1.1 Background

Golder Associates Pty Ltd. ("Golder") was instructed by Health Infrastructure NSW Health (ABN: 89 600 377 397) on 26 November 2008 to conduct a Preliminary Contamination and Geotechnical Investigation for the Penrith Health Campus Redevelopment Stage 3 in accordance with our proposal P87623217 dated 31 October 2008.

It is understood that Penrith Health Campus Redevelopment Stage 3 is in the concept design stages but principally comprises construction of a new multi-level East Block following demolition of the existing buildings ("Main Site"), expansion of the Intensive Care Unit (ICU) in the existing North Block ("ICU Site"), and additional major and minor enhancement and refurbishment to associate existing infrastructure.

This preliminary investigation is required to address the following key assessment requirements set out in the Director General's Requirements (DGRs) under Section 75F of the Environmental Planning and Assessment Act 1979:

- A geotechnical report assessing the suitability of the site for the proposed structures with regard to erosion hazards, proposed earthworks and retention methods; and
- A contamination report assessing the potential for contamination and the suitability of the site for proposed uses.

1.2 Scope of Work

As set out in our proposal P87623217 the scope of works for this investigation can be summarised as follows.

- Planning and project management including liaison with appropriate personnel to gain access for site reconnaissance;
- Document review including geological maps, regulatory records, land title, planning certificate and historic aerial photographs;
- Site reconnaissance to identify limitations to the proposed development, contamination issues, and likely impact to surrounding land and structures; and
- Reporting, to include findings of the above and a discussion of the potential impact on the proposed development, and recommendations for additional (Phase 2) investigations required to assess subsurface conditions at the site.

The report has been prepared in general accordance with Stage 1 – Preliminary Site Investigation as described by NSW EPA *Guidelines for Consultants Reporting on Contaminated Sites* (November 1997).



2.0 SITE DESCRIPTION

2.1 Site Identification

The site locality map and current site plan are provided as Figures 1 and 2 respectively. The site is located within the Nepean Hospital compound approximately 1.5km east of Penrith, NSW.

The Main Site comprises the existing East Block and adjacent pre-fabricated buildings, car park, access road and landscaped areas. It forms a roughly semi-circular area of approximately 1.1Ha.

The ICU Site comprises an area of the existing North Block currently occupied by a courtyard, access corridor and existing hospital facilities. It forms a square area of approximately 900m².

Table 1: General Site Details

Site Name	Nepean Hospital
Street Address	Derby / Somerset Streets
City, State, Postal Code	Kingswood, NSW, 2747
Country	Australia
Legal Description	Lot 1 DP 1114090
Co-ordinates (MGA 56)	288300mE 6262100mN
Zoning	Zone 5(a) Special Uses (Hospital)
Site Setting and Surrounding Land Use	<p>The Main and ICU Sites are part of an existing and operational hospital. The hospital grounds comprise buildings, internal carriageways, car parking and landscaped areas.</p> <p>The site is bounded by the Great Western Highway to the north, Somerset Street to the east, Derby Street to the south and Parker Street to the west.</p> <p>Land to the east, south and west beyond the adjacent roads is dominated by residential development. To the north beyond the Great Western Highway the land use comprises a mixture of railway lines, industrial / commercial units, a cemetery and residential dwellings.</p>



2.2 Site Condition and Surrounding Environment

A summary description of the site condition and surrounding environment is presented in the following table.

Table 2: Site Condition and Surrounding Environment

Issue	Comments
Topography	<p>The Nepean Hospital is situated at the northern end of a N-S trending ridge. The surrounding area is characterised by gently undulating topography ranging between 50-60m AHD.</p> <p>The Main Site area slopes from the southwest corner (~58m AHD) radially at an approximate 1-5° gradient to the north and east to a low of ~52m AHD at the eastern end of the proposed development.</p>
Site boundary	<p>The boundary of the Main and ICU Sites lie within the confines of the existing hospital and is not demarcated by a fence.</p>
Visible signs of contamination	<p>The Main Site area is generally free from visible signs of contamination. Notable exceptions include a fragment of suspected cement bound asbestos in an area of exposed soil.</p> <p>The presence of suspected fibro-asbestos sheeting in the building eaves (East Block) was noted during site reconnaissance.</p> <p>There is no evidence indicating the presence of underground storage tanks (USTs) with the Main Site.</p>
Plant stress	<p>No plant stress observed.</p>
Presence of drums, waste and fill materials	<p>None observed</p>
Odours	<p>No other odours were detected.</p>



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Issue	Comments
Buildings and roads	<p>The East Block building comprises a 2-4 storey brick built construction with red-clay roof tiles. The building is oriented approximately E-W with two single storey extensions oriented N-S.</p> <p>The eastern extension to the East Block shows visible signs of stress to the balconies attached to the northern frontage. Some salt residue is evident on the ground level brickwork in the north east corner of the building.</p> <p>Additional buildings within the main site area comprise single storey pre-fabricated constructions mounted on brick pillars at the eastern (down slope) end.</p> <p>A boiler room and associated vent stacks are located at the eastern end of the East Block.</p> <p>An internal road forms the northern boundary to the development area and extends into the western end of the main site. Car parks are situated at the south west and south east corners of the main site.</p>
Surface water	<p>No surface water was evident on Site.</p> <p>Surface water currently drains from roofs, car parks and carriageways into stormwater pipes which extend away from the main site to the north.</p>
Flood potential*	<p>The land has not been identified as being below the adopted flood planning level (defined as the 1% Annual Exceedance Probability flood level plus 0.5m).</p>
Local sensitive environment*	<p>The land does not include or comprise critical habitat.</p> <p>The land is not in a conservation area.</p> <p>The land is affected by a tree preservation order.</p>

* See Section 4.1



3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Geology and Soils

The Geological Series 1:100,000 Sheet Penrith 9030 maps the underlying geology as mid-Triassic Bringelly Shale which includes undifferentiated shale, carbonaceous claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

The Soil Landscape Series 1:100,000 Sheet Penrith 9030 maps the underlying soils as the Luddenham Group. They are characterised by shallow (<1m), dark podzolic soils or earthy massive clays on crests, moderately deep (0.7-1.5m) red podzolic soils on upper slopes, and moderately deep (<1.5m), yellow podzolic soils and prairie soils on lower slopes and drainage lines.

Limitations to development exhibited by the Luddenham Group soils include high soil erosion hazards, localised impermeable highly plastic and moderately reactive subsoil. The Luddenham Group soils are recognised to have low to medium capability for urban development (Bannerman and Hazelton, 1990).

The NSW Natural Resources Atlas sourcing information from the Acid Sulfate Risk Mapping published by the Department of Infrastructure, Planning and Natural Resources (DIPNR 1994) does not indicate a risk of acid sulfate soils occurring at this Site.

The NSW Natural Resources Atlas sourcing information from the Salinity Hazard Map of Western Sydney (DIPNR 2000) does not indicate a soil salinity hazard at this site. However, the Map of Salinity Potential in Western Sydney (DIPNR 2003) indicates a moderate salinity potential for this area.

3.2 Hydrogeology

The NSW Natural Resources Atlas sourcing information from the database of groundwater bores held by the Department of Water and Energy has identified a number of locations within relatively close proximity to the Site (<3km) and with similar geological characteristics where details regarding the sub-surface geology and groundwater are available.

These records are provided in full in Appendix A, and summarised in Table 3 below.

Table 3: Groundwater Bores

Reference	Distance (km)	Direction	Geology (m bgl ¹)	Water Bearing Zones (m bgl)
GW019680	2.2	E	0-11.3m Clay 11.3-16.2m Clay / Shale 16.2-53.3m ⁺ Shale (with clay seams)	10.9-11.2m (salty) 44.1-44.7m (salty) 52.4-53.3m (salty)
GW020069	2.2	E	0-4.6m Clay 4.6-7.3m Clay / Shale 7.3-75.6m ⁺ Shale (with clay seams)	7.3-8.8m 57.9-59.4m 72.5-74.6m
GW020547	2.2	E	0-0.9m Topsoil 0.9-9.4m Clay / pebbles 9.4-91.4m ⁺ Shale	15.2-15.8m 39.6-40.2m (brackish) 43.8-44.4m (salty) 57.3-57.9m (salty)
GW060794	2.5	SE	0-6.2m Clay 6.2-78.1m ⁺ Slate or Shale	18.8-18.9m 75.0-75.2m
GW103764	2.5	SE	0-0.6m Topsoil 0.6-6.4m Clay 6.4-123.4m Shale 123.4-216.4m Sandstone 216.4-217.3m Shale 217.3-231.6m ⁺ Sandstone	208.0-209.5m 216.5-219.0m



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Reference	Distance (km)	Direction	Geology (m bgl ¹)	Water Bearing Zones (m bgl)
GW108906	2.9	S	0-3.0m Clay 3.0-103.0m Shale 103.0-151.0m Sandstone 151.0-154.0m Siltstone 154.0-186.0m ⁺ Sandstone	6.5-7.0m 126.0-127.0m 157.0-157.5m 181.2-181.3m

¹ Meters below ground level (m bgl)

Bore data indicates that groundwater is found in discrete horizons typically hosted in relatively shallow (<15m) unconsolidated clays and deeper fractured shale and more permeable sandstone. Groundwater is often recorded as salty or brackish.

3.3 Hydrology

The Site is located in the Nepean River catchment area. According to signs, local council storm water drains discharge into the Nepean River, although the point of discharge is not given.



4.0 HISTORICAL RECORDS REVIEW

4.1 Aerial Photographs

A summary of historic aerial photographs and satellite imagery dating from 1947 to 2007 is provided in Table 4 below.

Table 4: Site History – Aerial Photographs

Date	Description
1947	<p>Site: The site comprises grazing land crossed by numerous livestock tracks.</p> <p>Surrounding area: The surrounding area is characterised by rough grazing, crossed by unmade roads with occasional cultivated areas and dwellings</p>
1961	<p>Site: The East Block appears as one of the earliest buildings within the hospital compound.</p> <p>Surrounding area: Other significant structures include the main hospital building (current South Block) and residential dwellings to the north west. The roads bounding the hospital compound in all directions now appear metalled. Access roads lead into the hospital compound from the Great Western Highway to the north and Parker Street to the west.</p> <p>A significant proportion of the hospital site to the northeast remains undeveloped. A small open channel is evident in the north east corner of the hospital compound.</p> <p>New residential developments were present beyond the hospital compound to east, south and west.</p> <p>Possible gasometers were situated to the northwest, immediately north of the Great Western Highway.</p>
1970	<p>Site: The East Block building has been extended at the eastern end.</p> <p>Surrounding area: Extensions to the main hospital buildings to the east and south. New commercial unit to the east of the residential properties to the north west (use unknown). Areas of the main hospital compound have been allocated for car parking.</p> <p>Residential development continuing to the east, south and west. New commercial / industrial development to the north beyond the Greater Western Highway.</p>
1982	<p>Site: No changes to the East Block building. Car parking areas have been developed to the north and south of a new access road leading from Somerset Street.</p> <p>Surrounding areas: Extensions to the hospital continue to the north (North Block) and east.</p> <p>Commercial / industrial development increasing to the north (beyond the Great Western Highway).</p> <p>The possible gasometers no longer evident.</p>
1994	<p>Site: East Block remains unchanged. New pre-fabricated building directly adjacent to the south west.</p> <p>Surrounding area: Hospital extended to the south, west and north.</p>



Date	Description
2007	<p>Site: Appears unchanged to date.</p> <p>Surrounding area: Hospital extended to the northwest replacing former residential and commercial buildings, and northeast with drainage channel diverted around new construction. The central area of the hospital has undergone significant modification with several former buildings replaced by new construction and car parking.</p>

4.2 Certificates of Title

A review of historic land titles (Appendix B) has identified that the site (formerly described as Volume 5382 Folio 243 and Volume 5411 Folio 45) has been owned by the Nepean District Hospital, Penrith, since the early 1940s.

Prior to this part of the adjacent land (as referenced in Volume 5382 Folio 243) was partly owned by a "Frederick Nepean Jones a Master Tanner".

Current title lists leases that have been granted to Health Care of Australia, Telstra Corporation and the Australian Red Cross Blood Service. Prior title indicates leases previously granted to the State Bank of New South Wales and Christensen's Complete Catering Service Pty Ltd.



5.0 REGULATORY RECORDS

5.1 Environmental Planning and Assessment Act (1979)

The Section 149 (2) planning certificate (Appendix C) has indicated that the land does not include or comprise, or is not affected by the following:

- Critical habitat;
- Conservation areas;
- Mine subsidence; or
- Policy adopted by the council that restricts the development of land because of land slip, bushfire, tidal inundation, subsidence, acid sulphate soils or any other risk (other than flooding)

The land has not been identified as being below the adopted flood planning level. However the council reserves the right to apply flood related development controls depending on the merits of any particular application.

The land has not been declared an investigation or remediation area under Part 3 of the Contaminated Land Management (CLM) Act 1997, and is not the subject of an investigation or remediation order. The land is not the subject of a voluntary investigation proposal or site audit statement as defined by the CLM Act 1997.

The Section 149 (5) planning certificate (Appendix C) indicates that the land is affected by a tree preservation order.

5.2 Protection of the Environment Operations Act (1997)

A search of licences issued under the POEO Act 1997 has identified the following licences issued for premises in close proximity to the development site but which are no longer in force. No licences have been identified within the proposed development area.

Table 5: Summary of POEO Licenses

Licence #	Licensee	Location	Licensed Activity	Waste Types
11417	Healthscope Ltd	Corner of Gt Western Hwy and Parker St	Hazardous, Industrial or Group A Waste Generation or Storage (>10 – 100t per annum)	Clinical and related wastes (R100) Waste pharmaceuticals, drugs and medicines (R120) Cytotoxic wastes (R130)
11253	Sydney West Area Health Service	Corner of Derby St and Parker St	Hazardous, Industrial or Group A Waste Generation or Storage (>10 – 100t per annum)	Clinical and related wastes (R100) Waste pharmaceuticals, drugs and medicines (R120) Cytotoxic wastes (R130)



5.3 Dangerous Goods Licensing

A search of the Stored Chemical Information Database (SCID) under Dangerous Goods Licence 35/003838 (Nepean Hospital) has identified no documents held by WorkCover NSW that relate to storage of dangerous goods in the East Block building or on adjacent land affected by the proposed development.

The search has identified a number of locations at the hospital where dangerous goods or have been stored. These occur at locations down slope to the south and west of the East Block, and are therefore unlikely to impact the proposed development.



6.0 SITE RECONNAISSANCE

A site reconnaissance visit was conducted on 27th November 2008 by the authors. Photographs taken at the time are presented in Appendix D.

Observations recorded during the site reconnaissance included:

- ICU Extension
 - The proposed new ICU extension will extend into an area that is paved partly by brick pavers and partly by crushed aggregate that forms a courtyard within the central area of the main hospital grounds.
 - The proposed new ICU extension will partly if not entirely be underlain by existing buildings, the extent of which could not be ascertained during the site walk over.
 - The courtyard is elevated about 3m above the West Block basement level as a result of cutting of the land during development of the West Block.
- Connecting Walkway
 - The proposed walk way connecting the East Block with the ICU extension will extend through existing hospital buildings and traverse a lawn garden also containing some gum trees and a paved courtyard enclosed by the existing hospital buildings. A one storey chapel is located near the western end of the walkway. It is unclear how far existing buildings extend beneath western end of the proposed walkway.
- East Block
 - The existing East Block comprises a three storey building of brick wall and tile roof construction with its axis almost east to west.
 - The East Block building is showing some minor evidence of foundation settlement, which is expected given the age of the building. More extensive settlement of the subsurface soils of up to about 70mm was observed near the north-eastern corner of the building, beneath steel support poles for the northern 1st floor balconies. Ongoing shrinking and swelling of the subsurface soils at this location as a result of moisture variations may be considered a possible cause for the settlement.
 - Development of the East Block buildings, the internal road and near-level car parking platforms surrounding the buildings has required some local cutting and filling of less than 1m depth. Some deeper cutting and filling has been undertaken for the construction of the existing north block, ICU and West Block as well as the below-ground car park to the west of the West Block.
 - The land between the existing main hospital buildings and the East Block (and existing road) has been battered back at a grade of between 15° and 20° as a result of cutting for the basement of the main hospital building.
 - Potential salt crystals are present on the lower row of bricks at the north-eastern corner of the East Block, indicating the potential presence of saline conditions.
 - A boiler room is located at the eastern end of the East Block. A chimney stack is evident on the external elevation. The boilers are reportedly powered by mains natural gas.
 - Suspected cement bound asbestos (fibro) sheeting has been observed within the eaves of the building. Given the age of the structures additional asbestos containing materials and other potentially hazardous materials (including lead based paint) are suspected within the building.



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- A fragment of suspected cement bound asbestos was observed within exposed soils to the south of East Block. Exposed soils do not indicate the presence of widespread fill materials.



7.0 SITE CHARACTERISATION

7.1 Conceptual Site (Contamination) Model

7.1.1 Potential Sources

The site has been in continual use as a hospital since the 1950s. Anecdotally, (telephone conversation with Mr Andrew Skinner, 05 December 2008) the East Block has been used principally for nurse's accommodation, offices and training facilities during this period. The hospital has undergone continual expansion with occasional periods of demolition and re-development.

Activities at the hospital that may have given rise to present day contamination are likely to be associated with the generation, storage and disposal of wastes produced at the hospital. Waste types could include clinical, general / domestic, construction, demolition and excavation waste. A single fragment of suspected cement bound asbestos partially buried in exposed soil to the south of East Block may indicate the presence of residual waste materials from previous phases of demolition and construction.

Between 1961 and 1970 the East Block was extended at the eastern end to accommodate a new boiler room. Currently, the boilers are fuelled by mains gas. The dangerous goods register does not indicate the use of petroleum type fuel sources, however the use of coal fired boilers cannot be ruled out. This may have led to disposal of boiler ash on land adjacent to the buildings.

The site reconnaissance identified the possible presence of potentially hazardous materials (asbestos fibres, lead paints) within the East Block buildings. These could present a potential source of contamination during and following demolition of the buildings.

Prior to the ownership of the Nepean District Hospital, part of the land (or adjacent land) was owned by a "Master Tanner". However, aerial photographs do not indicate the presence of a tannery or an adjacent water source required for such processes.

7.1.2 Potential Contaminants of Concern

The potential contaminants of concern (PCoC) associated with the potential sources discussed in Section 7.1.1 include the following.

- Heavy metals (including arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc);
- Polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated biphenyls (PCBs); and
- Asbestos fibres and asbestos containing materials (ACMs)

There are numerous potential contaminants (e.g. biological and radioactive contaminants) associated with hospitals that are not included in this list. Therefore, it is recommended that the list be reviewed following intrusive ground investigations and visual inspection of the underlying soils.

7.1.3 Potential Pathways

The potential human health exposure pathways associated with the PCoC that may exist following completion of the proposed development include:

- Direct soil and dust ingestion;
- Direct soil particulate inhalation;
- Inhalation of fibres / vapours;
- Direct soil dermal contact



Migration pathways by which the PCoC could be released into the wider environment include:

- Diffuse migration in the shallow groundwater table and subsequent discharge into sensitive watercourses or the regional aquifer; and
- Surface run-off into sensitive water course;

7.1.4 Potential Receptors

The potential receptors that may exist during and following the proposed development could include:

- Construction workers;
- Hospital employees and grounds maintenance staff;
- Groundwater; and
- Surface water

7.1.5 Potential Risks

A potential risk from contamination may exist where there is a link connecting a potential receptor to a potential source via a potential pathway (pollutant linkage). The risk can be estimated qualitatively in terms of the magnitude of consequences, and the probability of consequences associated with a particular pollutant linkage.

This assessment of potential risk focuses on the redevelopment of the East Block where there is likely to be the greatest disturbance and exposure to potentially contaminated soils.

The proposed development involves the demolition and excavation, and construction of a new East Block to provide an Ambulance Procedure Centre and Surgical Inpatient Unit with undercroft at grade. Human health exposure pathways for the development can be sub-divided into short term (construction workers) and long term (hospital employees and grounds maintenance staff).

- Short term exposure;
 - The PCoC that have been identified are unlikely to occur at concentrations that could have significant consequences to construction workers when exposed over relatively short periods of time (weeks to months). The risk is therefore likely to be low.
 - Precautions including dust management, the wearing of gloves / masks and provision of hand washing facilities for should provide adequate for individuals likely to be exposed to contaminated soils / dust during excavations and ground preparation and further reduce the risk.
- Long term exposure;
 - The PCoC that have been identified are unlikely to occur at concentrations that could have significant long term consequences to site users. Long term exposure to contaminated soils may be reduced further by importation of soils for landscaped areas. The risk is therefore likely to be low.
- Surface water;
 - No significant potential sources of contamination have been identified by this investigation. Surface run-off from the site is most likely to flow into local storm water drains and is therefore likely to be diluted by surface water flow from off site sources before discharging into a surface water course (Nepean River). The risk is therefore likely to be negligible.
 - Erosion and sediment control should be provided during site construction work to prevent the release of soils (contaminated or otherwise) into the local drainage system.



- Groundwater;
 - Groundwater is likely to occur in discrete water bearing zones at depths greater than 5m below surface and separated by relatively impermeable clay and shale sequences. As no significant potential sources of contamination have been identified by this investigation, it is unlikely that groundwater beneath the proposed development has been impacted. The risk of offsite migration of contaminated groundwater is therefore likely to be negligible.

7.2 Preliminary Geotechnical Model

Our site observations confirm the site to be underlain by a residual soil profile, the parent rock being Bringelly Shale. The residual soils are likely to be shallow, typically less than 2 m in depth, and to comprise stiff to very stiff clay of medium to high plasticity in a dry to moist condition, containing some ironstone gravel. The underlying Bringelly Shale is expected to be extremely to highly weathered and of typically very low to low strength, gradually decreasing in weathering and increasing in strength with depth.

Construction of the existing buildings on the campus has required some excavation. This is evidenced by an about 0.8 m deep cut at the western end of the East Block, an about 2 m battered cut on the eastern side of the North Block and a 3 m to 4 m deep cut for the West Block and associated below-ground car park. We anticipate that fill has been placed in certain areas of the campus to provide a level building platform. The extent of such filling is not known. As a result of the excavation and filling, shale bedrock may have been exposed at foundation level for structures located in cuts, while residual soils or fill may be present at foundation levels for structures located elsewhere on site.

The site is located on a watershed. Results of groundwater bores undertaken by others (See Section 3.2) in the vicinity of the site indicate ground water to be present generally in deep clays and deeper fractured bands within the Bringelly Shale at depths of greater than 5m below ground surface levels. Groundwater is therefore unlikely to be encountered within the anticipated excavations of less than 3m. However, some minor seepage flows may be encountered within more permeable soil or rock layers.

The residual soils, given the evidence of potential salt crystals at the site, are likely to be saline.



8.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

8.1 Contamination

Based on the information reviewed and collected during this investigation we conclude the following:

- The Site has been in continual use as the East Block of the Nepean Hospital since its construction in the 1950s. Prior to this it comprised rough grazing land. The East Block was extended to the east prior to 1970; this part of the building now contains a boiler room. A pre-fabricated building was constructed in the south west of the Site prior to 1994;
- The East Block has reportedly been used for nurse's accommodation, offices and training facilities;
- The Site is underlain by relatively impermeable residual clay soils (Luddenham Group) and shale sequences (Bringelly Shale). Groundwater is likely to occur in discrete water bearing horizons at depths greater than 5m below surface;
- No significant potential sources of contamination (past or present) have been identified at the Site. Potentially contaminating past activities could have included the generation, storage and disposal of wastes produced at the hospital. Waste types may have included clinical, general / domestic, construction, demolition and excavation, and boiler ash waste;
- A single fragment of suspected cement bound asbestos partially buried in exposed soil to the south of East Block may indicate the presence of residual waste materials from previous phases of demolition and construction;
- The potential contaminants of concern (PCoC) associated with possible past activities include the following;
 - Heavy metals (including arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc);
 - Polycyclic aromatic hydrocarbons (PAHs);
 - Polychlorinated biphenyls (PCBs); and
 - Asbestos fibres and asbestos containing materials (ACMs)
- The risk to construction workers and future users of the Site from these potential contaminants is likely to be low;
- The risk to surface and groundwater from these potential contaminants is likely to be negligible; and
- Suspected cement bound asbestos has been identified within the eaves of the East Block. Given the age of the structures additional asbestos containing materials and other potentially hazardous materials (including lead based paint) are suspected within the building.

Accordingly, we recommend the following:

- An intrusive investigation should be designed and implemented to confirm the conclusions of this report. The investigation should include a number of boreholes or test pits to determine to nature and distribution of fill materials beneath the site, and provide sufficient soil samples for laboratory testing;
- Soil testing should include the potential contaminants of concern identified, and an assessment of soil waste classification for future excavations;
- There are numerous potential contaminants (e.g. biological and radioactive contaminants) associated with hospitals that are not included in this list above. The list of PCoC should therefore be reviewed following intrusive ground investigations and visual inspection of the underlying soils;



- The risks to construction workers, future site users, surface water and groundwater should be reviewed based on the results of the recommended intrusive investigation. Remedial action or further post-demolition investigations should be prescribed accordingly.
- A hazardous material (HazMat) survey should be conducted prior to planning the demolition of the existing East Block building. A post-demolition sampling programme may be required to confirm the successful removal of hazardous materials identified.

8.2 Geotechnical

Construction of the proposed East Block undercroft will require excavation within the western portion of the development footprint decreasing in depth towards the east. Minor filling may be required in the north east. Construction of the ICU extension and the majority of the walkway, connecting the East Block with the ICU, is expected to be at grade and will therefore not require deep excavations or filling. Considering the proposed ICU extension will be constructed over existing buildings, no excavation or filling will be required for its construction.

8.2.1 Excavation and Retention

The preparation of the proposed East Block undercroft will necessitate excavation to anticipated depths of up to approximately 2m. Such excavations are expected to intersect some minor topsoil, residual soils and some extremely to highly weathered shale of very low to low strength in the western area of the proposed East Block footprint. These subsurface materials may be readily excavated using a conventional excavator of say 20 tonne capacity.

Where excavations for the East Block undercroft area are to extend below a depth of 0.8m, the exposed soil profile and weathered rock is to be battered back / graded at a maximum temporary slope of 1V:1H (45°) or permanent slope of 1V:2H (26°).

Alternatively, the excavation face is to be retained where excavation extends into the zone of influence of surrounding existing structures/features or where there may not be sufficient room to provide permanent batter slopes. The zone of influence is an area below a line drawn at 45° from the foundation of the structure towards the base of the excavation.

Cantilevered reinforced concrete soldier piles in conjunction with reinforced shotcrete infill panels are considered to be suitable as temporary support for the proposed East Block with the possibility of incorporating these into the permanent support design, particularly where adjacent supported areas will be subjected to minor live loads only. Alternatively, the use of soil nails or dowels in conjunction with a shotcrete cover may be suitable as temporary retention while cantilevered or anchored contiguous reinforced concrete piles are considered suitable for use as temporary or permanent retention where higher loads are imposed on the exposed materials or structure. Steel I-beams in conjunction with timber infill panels may also be considered as temporary support where excavation will be less than 2 m deep and the exposed materials are subjected to minor live loads only. All retaining structures must be appropriately engineered following more detailed geotechnical investigations of the site.

A combination of batters and retaining structures may also be considered.

Although we anticipate the excavation will not be affected significantly by groundwater, we consider subsurface drainage will be required at the base of and behind all retaining walls, particularly if part of the permanent structure. This is required to reduce water pressures within the retained materials and therefore allowing a reduction in support requirement.

8.2.2 Earthworks

Earthworks for the proposed cutting and filling shall be performed as follows:

- Excavate and remove all building rubble and existing vegetation from within the development areas and stockpile for removal from site.



- Excavate the existing topsoils from within the development footprint and stockpile these separately for either re-use for landscaping or removal from site.
- Excavate the subsurface soils in the building areas to the design level of the building pads / floor slab sub-grade. Stockpile these materials separately for removal from site or, should it be required, these soils may be suitable for re-use within the development as 'controlled fill' if they are suitably combined with appropriate imported granular materials.
- A suitably qualified Geotechnical Engineer is to be present during proof-roll testing of exposed residual soils at foundation levels for the building pads / floor slab sub-grade to assess the ability of the prepared surfaces to act both as a foundation platform for shallow footings and also as a sub-grade for the undercroft and walkway pavements. Should soft heaving areas be identified, such soils are to be removed as directed by the engineer on site and replaced using suitable granular fill material.
- Fill material is to be placed in no more than 250mm loose thickness and suitably compacted. The degree of compaction is to be verified by in-situ and laboratory testing.

The exposed residual clay soils will not be trafficable under wet conditions. Trafficked areas during the construction works need to be covered by a suitable layer of crushed gravel or concrete.

8.2.3 Foundation Construction

The use of shallow or deep footings is considered suitable for the proposed East Block and connection walkway. The footings should be designed and constructed in accordance with sound engineering principles and the following preliminary recommendations and advice:

- For the purpose of shallow footing design for the proposed development, the site is likely to be classified as a CLASS H site (high ground movement) in accordance with AS/NZS 2870-1996 "Residential Slabs and Footings". We anticipate that the material has the potential to shrink and swell in the range of 40mm to 70mm due to wetting and drying processes. This is to be confirmed with further geotechnical testing of the foundation materials.
- All footings of the proposed East Block building or walkways must found on ground of similar bearing capacity to prevent differential movement resulting from the varying foundation materials. We therefore recommend all footings to found either entirely within the residual soils or entirely at depth within the weathered shale using deepened pier footings where necessary.
- All footing excavations must be suitably cleaned free of loose debris and wet soil before construction.
- The foundation material is to be inspected at the time of footing excavation to ensure that all footings found on suitable ground with anticipated foundation conditions.
- With regards to the proposed ICU extension, the type and layout of the existing building foundations and the condition of the foundation materials are to be established to assess the capacity of the existing footings to carry the additional loading.

8.2.4 Erosion

The Luddenham Group soil landscape is considered to be a high soil erosion hazard. We therefore recommend that suitable silt fencing, drainage and settlement basins are provided at the site during construction of the East Block. Also, all exposed ground surfaces must be paved or vegetated immediately after completion of construction to limit risks associated with soil erosion.

Suitably treated storm water flows, surface run off and collected subsurface seepage flows must be piped and discharged into Council's system or to an appropriate and Council approved discharge point down slope of the site.



Further geotechnical testing of the soils at the site is required to appropriately manage the associated risk of erosion. Testing is to comprise particle size distribution of the soils and the determination of the Emerson Class Number to assess the dispersive nature of the soils.

8.2.5 Salinity

Evidence of potential salt crystals on the brickwork of the existing East Block building together with its position within an area of moderate potential for saline conditions as identified by DIPNR indicates that design and construction of the proposed development will need to address the potential saline conditions of the site.

We recommend additional geotechnical investigations and testing is undertaken to more accurately evaluate design and construction requirements to alleviate the effects of the potential saline condition of the subsurface clay.

8.2.6 Additional Investigations

A detailed geotechnical investigation is required to confirm the anticipated ground conditions, to better define the key geotechnical issues for the design and construction of the proposed development and to establish suitable soil and rock design parameters for the proposed development. The investigation scope is to get specific design and construction details for the proposed development, still to be developed.

The investigation scope is expected to consist as a minimum of:

- Excavation of boreholes to at least 2m below final excavation levels using mechanical augering equipment or a hand auger in areas not accessible by means of mechanical equipment;
- Standard Penetrometer Tests (SPTs) at regular intervals within the soil profile to assess the strength characteristic of the soil, for soil classification and for soil sample collection;
- Dynamic Cone Penetrometer (DCP) tests within areas not accessible by mechanical drilling rig to assess the strength characteristic of the soil;
- Mechanical excavation of boreholes extending through the soil profile into the underlying rock using coring techniques to obtain rock core samples that will allow assessment of the rock conditions, identification of inherent rock structure and assessment of the rock strength through point load testing; and
- Collection of soil samples from each borehole for laboratory testing, which is to include determination of particle size distribution and Atterberg limit testing of the cohesive residual clay soils and further testing to assess the salinity and aggressivity of the soils.

Further Geotechnical Investigations, field and laboratory testing may be required at the location of the ICU extension, the nature of which will depend on the configuration of existing and proposed new buildings.



9.0 LIMITATIONS

Your attention is drawn to the document "Limitations", which is included in Appendix E of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



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