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Structural SSDA SEARS Conditions Report

Nepean Hospital Development – Stage 2 Tower & Future Developments Structural

Project Reference: 12260-01

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Prepared For:

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REV	ISSUE/AMENDMENT	AUTHOR/S	REVIEWER/S	DATE
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B	SSDA SEARS Conditions Report, structural	Eva Movassaghi	Janaraj Thangarajah	18.08.2021
C	SSDA SEARS Conditions Report, structural	Eva Movassaghi	Neal Foye	10.11.2021

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1 Executive Summary

Health Infrastructure NSW (HI) is the applicant for the proposed Stage 2 Redevelopment of Nepean Hospital in PenrithLocal Government Area (LGA).

The proposal is State Significant Development (SSD) for the purposes of the *Environmental Planning and AssessmentAct 1979* (EP&A Act) and clause 14(a) of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP SRD) as it involves development for the purposes of a hospital with a capital investment value in excess of $30 million.

The Stage 2 Redevelopment seeks to deliver significantly enhanced acute services, as well as a new campus main entry and drop-off area. It complements the recent Stage 1 Redevelopment (SSD 8766) approved in February 2019 anddue for completion by early 2022.

The proposed Stage 2 Tower will be located west of, and connected to, the Stage 1 Tower. Portions of the North Block(north section) will be demolished with the remaining sections of the North Block (to the south of the Stage 2 Tower) toremain operational.

Departments to be provided in the Stage 2 Tower include:

- Front of House, including retail;
- Education and Training Centre;
- Transit Lounge;
- Medical Imaging;
- Interventional Radiology;
- Intensive Care Unit and Close Observation Unit;
- In-Centre Dialysis and Renal Inpatient Unit;
- Paediatric In-patient Unit;
- Plant areas;
- Clinical Support areas; and
- Kitchen.

The Stage 2 Redevelopment project scope includes:

- The Stage 2 Tower, being predominantly a 7-storey building, with roof plant;
- Demolition of parts of the existing North Block and other satellite buildings directly within the Stage 2 Towerfootprint (excluding other buildings already approved under the Stage 1 SSD consent);
- Demolition of the Total Asset Management (TAM) facility;
- Reconfiguration of the loading dock area and back of house functions;
- Landscaping and other associated at-grade works within the Stage 2 Tower's immediate vicinity; and
- Barber Avenue upgrade and access road to the Stage 2 Tower's forecourt, port cochere, and front of housearea.

The Stage 2 Redevelopment's SEARs was issued by the Department of Planning, Industry and Environment on 22 April2021.

2 Planning Secretary’s Environmental Assessment Requirements

Section 4.12(8) of the Environmental Planning and Assessment Act 1979
Schedule 2 of the Environmental Planning assessment Regulation 2000

<table>
<tr><td colspan="2">Application Number</td><td colspan="2">SSD-16928008</td></tr>
<tr><td colspan="2">Project Name</td><td colspan="2">Nepean Hospital Redevelopment Project – Stage 2</td></tr>
<tr><td colspan="2">Location</td><td colspan="2">Derby Street, Kingswood</td></tr>
<tr><td colspan="2">Applicant</td><td colspan="2">Health Administration Corporation</td></tr>
<tr><td>Items</td><td colspan="2">General Requirements Key Issue or Agency Advice</td><td>Reference / Location within this report.</td></tr>
<tr><td>Plans and Documents</td><td colspan="2">The EIS must include all relevant plans, architectural drawings, diagrams and
relevant documentation required under Schedule 1 of the Regulation. Provide
these as part of the EIS rather than as separate documents. Any plans and
diagrams included in the EIS must include key dimensions, RLs, scale bar and
north point.
In addition to the plans and documents required in the General Requirements and
Key Issues sections above, the EIS must include the following:
• Section 10.7(2) and (5) Planning Certificates (previously Section 149(2) and
(5) Planning Certificate).
• Design report to demonstrate how design quality would be achieved in
accordance with the above Key Issues including:
o architectural design statement.
o diagrams, structure plan, illustrations and drawings to clarify the design
intent of the proposal.
o detailed site and context analysis.
o analysis of options considered to justify the proposed site planning and
design approach.
o summary of feedback provided by GANSW and NSW State Design Review
Panel (SDRP) and responses to this advice.
o summary report of consultation with the community and response to any
feedback provided.
• Geotechnical and Structural Report.
• Accessibility Report.</td><td>This is Structural Report.</td></tr>
</table>

3 Existing Site Conditions

3.1 Location

The proposed development is located on the existing Nepean Hospital Campus, Kingswood NSW adjacent to the currently under construction Stage 1 Tower (see Figure 3.1-A). The Stage 2 Tower will be located to the west of the currently under construction Stage 1 Tower. Its footprint will require demolition works to the existing North Block.

The campus is bordered by Parker Street to the west, Barber Avenue and the Great Western Highway to the north, Somerset Street to the east and Derby Street to the south. The proposed site is located within the Penrith City Council Local Government Area (LGA).

Figure 3.1-A - Nepean Hospital Campus (Approximate Extent of Stage 1 & 2 Towers Shown – Source: Nearmaps)

3.2 Geotechnical

Several geotechnical investigations have been undertaken on and around the proposed development site (including historical borehole logs from previous developments). These investigations include:

- JK Geotechnics Report December 2020 - Ref: 33570LTrpt
- JK Geotechnics Report March 2020 - Ref: 29845L5
- JK Geotechnics Report September 2018 - Ref: 29845L3rpt
- JK Geotechnics Report February 2017 - Ref: 29845Lrpt
- JK Geotechnics Report February 2017 - Ref: 29845L1rpt MWCDB
- Golder Associates July 2010 - Ref: 107622059_002_R_Rev1

- Golder Associates June 2010 - Ref: 107622058_002_R_Rev0
- Golder Associates July 2009 - Ref: 097622055_002 Rev1
- Golder Associates January 2009 - Ref: 087623133_003_R Rev1

The most recent investigation conducted in December of 2020 included boreholes within the footprint of the Stage 2 Tower (shown in red outline in Figure 3.2-A below).

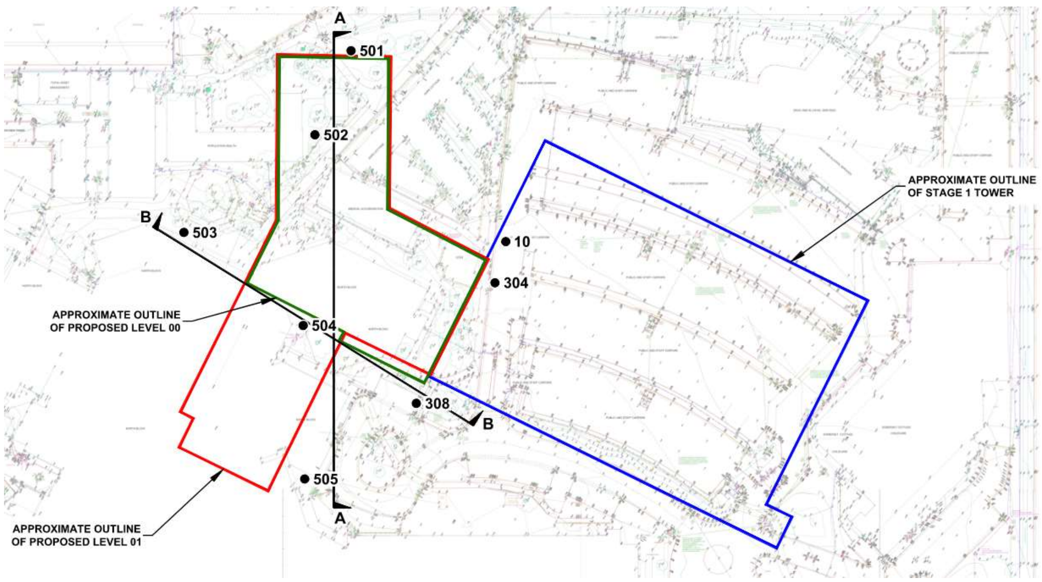

Figure 3.2-A - Latest Geotechnical Investigation (JK Geotechnics - 33570LTrpt)

3.3 Existing Documentation

The following relevant existing documentation has been used to develop the engineering designs:

- North Block Structural drawings
- On-grade Carpark Civil drawings

3.4 Existing Buildings

Hope Cottage, Doctor's Accommodation, Population Health, Asset Management and part of North Block will be demolished to make way for the Stage 2 Tower. Existing site plan is shown below in Figure 3.3-A.

Figure 3.3-A – Existing Nepean Hospital Campus Site Plan (Source: BVN)

4 Proposed Development

4.1 General Description

The proposed development comprises of a new 8 storey acute services building adjacent to the currently under construction Stage 1 Tower ('Main Tower'). An allowance has also been made in the design for potential future 3-storey vertical expansion to the building.

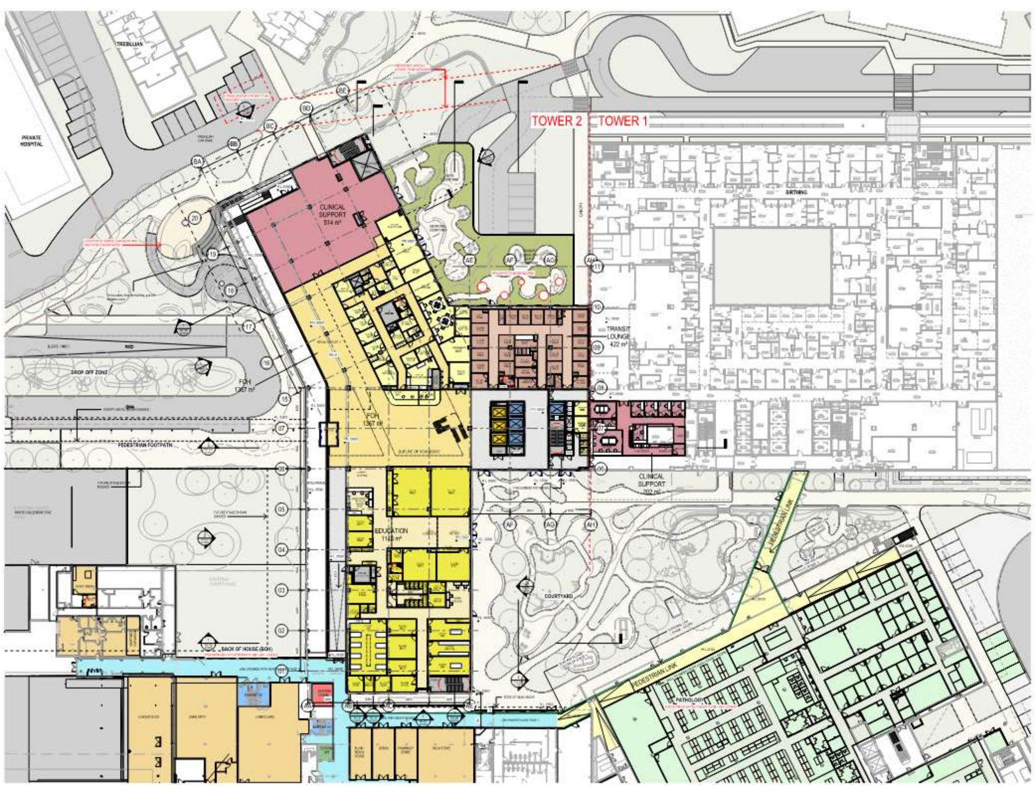

Figure 4.1-A - Level 01 General Arrangement Plan (Source: BVN)

The refurbishment and demolition of adjacent buildings including North Block, Pathology are not covered in detail in this report. Hope Cottage, Doctor's Accommodation, Population Health, Asset Management and part of North Block will be demolished to make way for the Stage 2 Tower.

4.2 Structural Works – Stage 2 Tower

The Stage 2 Tower has been designed as an 8-storey high tower (with an allowance for 3 floors potential vertical expansion). The building has been designed as structurally independent of the Stage 1 Tower. Structural drawings are provided in Appendix-A.

4.2.1 Foundations

The structure of the new building is to be supported on a piled foundation founded into rock. Piles have also been utilised beneath each core pad footing. The level of the bedrock ranges from RL50.7m to RL46.5m and generally dips to the north (JK Geotechnics - 33570LTpt). Level 00 will be constructed at RL49.02m.

The geotechnical report (JK Geotechnics - 33570LTpt) provides the following bearing and skin friction design parameters for the various classes of rock on site. Figure 4.2-B shows the geotechnical parameters for the job.

Summary Table of Maximum Allowable and Ultimate End Bearing Pressures and Skin Friction Values

Rock Class	Maximum Allowable End Bearing Pressure (kPa)	Ultimate End Bearing Pressure (kPa)	Maximum Allowable Skin Friction (kPa)	Ultimate Skin Friction (kPa)
Class V Claystone (Shale)	700	1,500	50	70
Class IV Claystone (Shale)	1,000	3,000	100	150
Class III Claystone (Shale)	3,000	20,000	250	500
Class V Sandstone	1,000	3,000	100	150
Class IV Sandstone	1,500	4,000	150	300
Class III Sandstone	3,500	30,000	350	800

Figure 4.2-A - Summary Table of Maximum Allowable and Ultimate Bearing Pressure and Skin Friction Values

4.2.2 Retention System

A hybrid retention system has been proposed for L00 of the Stage 2 Tower. This system will consist of a Dincel wall retention system along the north end of the building footprint and a soldier pile shoring wall along the west of the building footprint.

The Dincel retaining system has been used where the natural soil height is not more than 1-1.5m to prevent a wider batter that would be required. For deeper soil region soldier pile retention system was proposed due to the presence of a protected tree and neighbouring building in nearby area.

Additional early works will be required between the Stage 1 and Stage 2 Towers in the shoring walls.

As part of the in-ground works, Meinhardt-Bonacci is suggesting that a burrow pit be excavated in the soil towards the north of Stage 2 Tower, beneath L00, as somewhere for contaminated fill to be stored. The pit location may need to shift away from the northern Dincel retaining wall to avoid requirement of wider batter which could potentially interrupt the protected trees. Figure 4.2-B - Suggested Burrow Pit Location for Contaminated FillFigure 4.2-B shows possible location for burrow pits if any contaminated materials are encountered.

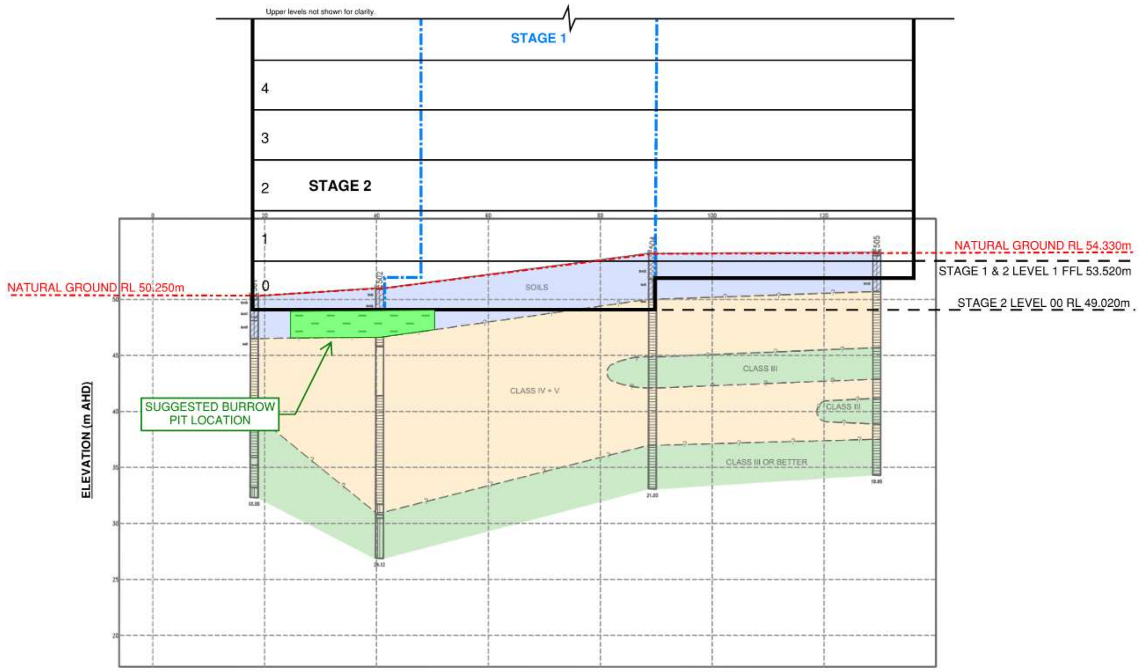

Figure 4.2-B - Suggested Burrow Pit Location for Contaminated Fill

4.2.3 Substructure

All slabs on subgrade have been designed as a suspended slab with void former under. The slab on ground on L00 has been designed as a reinforced concrete (RC) slab, as opposed to a post-tensioned (PT) slab, due to the potential difficulty in installing the PT tendons and also to prevent any shrinkage restraint cracking in the slab. These basement floor slabs/slabs on ground have been designed for construction loading.

4.2.4 Superstructure

The superstructure consists of a reinforced concrete braced frame with columns generally following a 8.4m x 8.4 grid. This grid has been adopted following the HI Design Guidelines and is intended for clinical spaces and future proofing of operating theatres. Lateral resistance is provided by 4 cores; 2 lift cores central to the tower and adjacent to Stage 1, and 2 stair cores on either end of the building.

The floor levels in Stage 2 Tower are to match the Stage 1 Tower. Since the Stage 1 Tower floor levels have been adopted the link to North Block will have to gradually ramp down towards North Block as there is a minor difference in the floor levels.

4.2.5 Floor Systems

A post-tensioned flat plate that is generally 280mm thick, has been adopted as the floor structure. The proposed slab thickness includes the 40mm of sacrificial topping outlined in the HI Design Guidance Notes.

4.2.6 Kitchen

The L00 kitchen slab was designed as RC slab with an intention to reduce the shrinkage of the slab. This RC slab will have limited restraint for coring during kitchen shell installation at the later stage. The contractor must be aware about the kitchen shell installation and requirement for additional topping, as necessary. An allowance for penetrations to be made in the detail design phase and the contractor to make allowance for the penetrations prior to construction of the slab.

4.2.7 Structural Interface to Stage 1 Tower

Stage 2 Tower has been designed to act independently of the currently under construction Stage 1 Tower, however Stage 2 tower will require a structural connection to take the slab gravity loads only.

4.2.8 North Block

Amongst the footprint of the early demolition works, the central building of North Block is affected. The following figures show the two proposed options which are cost effective and practical.

Choosing the line of demolition through the existing building depends on several factors that include other services and relocation of existing services. Few structural and civil implications are noted below:

- Allowance to be made for installation of hoarding to allow for strengthening on the underside of the L2 slab. Impacted facilities (logistics) to be considered. The strengthening to be done prior to demolition of the North Block near the end span.
- Any alteration to structural elements, including construction loading, to be liaised with Meinhardt-Bonacci engineer for review and approval.
- Allowance to be made to treat areas of structural elements which are being exposed after demolition.
- Allowance to be made for propping and supporting structure during construction by others.
- Strengthening works are required for the main core wall – temporary engineers to assess the building during the construction phase as the core walls will be partially removed. The core wall and associated inertia mass portion in between the existing CJs are considered for the core wall upgrade to comply latest earthquake standards.

A review of impact of demolition line on North Block Structural system (along the line of demolition) was analysed and documented with necessary strengthening on DWG NHR-BON-DRW-STR-TB2-PLN-0230001. In general, demolition line has been coordinated with the Architect so the Structural implications on North Block are mitigated. At the same time, the corridor has been maintained to provide access between different buildings.
Error! Reference source not found.4.3 shows a section through North Block and Stage 2 Tower and associated level differences. A localised ramp in this case and in all similar instances to be constructed to resolve the steps in connected levels.

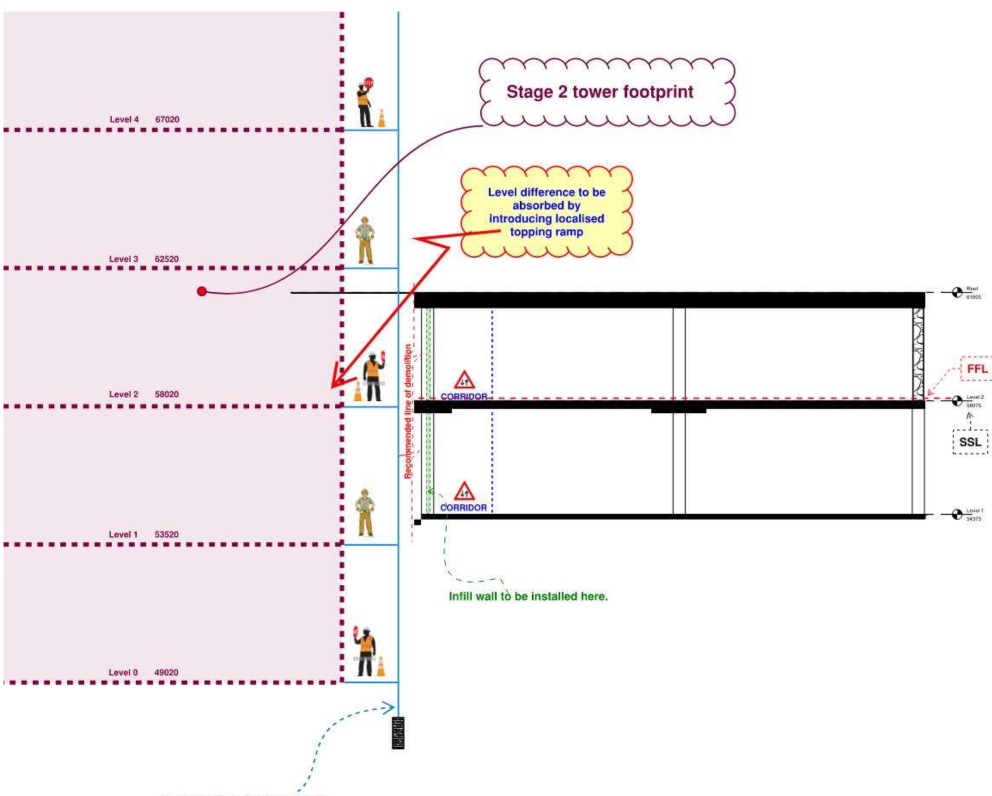

Figure 4.2-C - Section Through North Block and Stage 2 Interface Zone

4.2.9 Pathology Building

Nepean Hospital Stage 2 redevelopment includes alteration of Pathology buildings.

It is required to investigate the demolition line through existing building on remaining structures. Pathology area includes three separate structures which are either attached or detached from each other. Generator is a self-standing structure isolated from other buildings, refer to Figure 4.2-D.

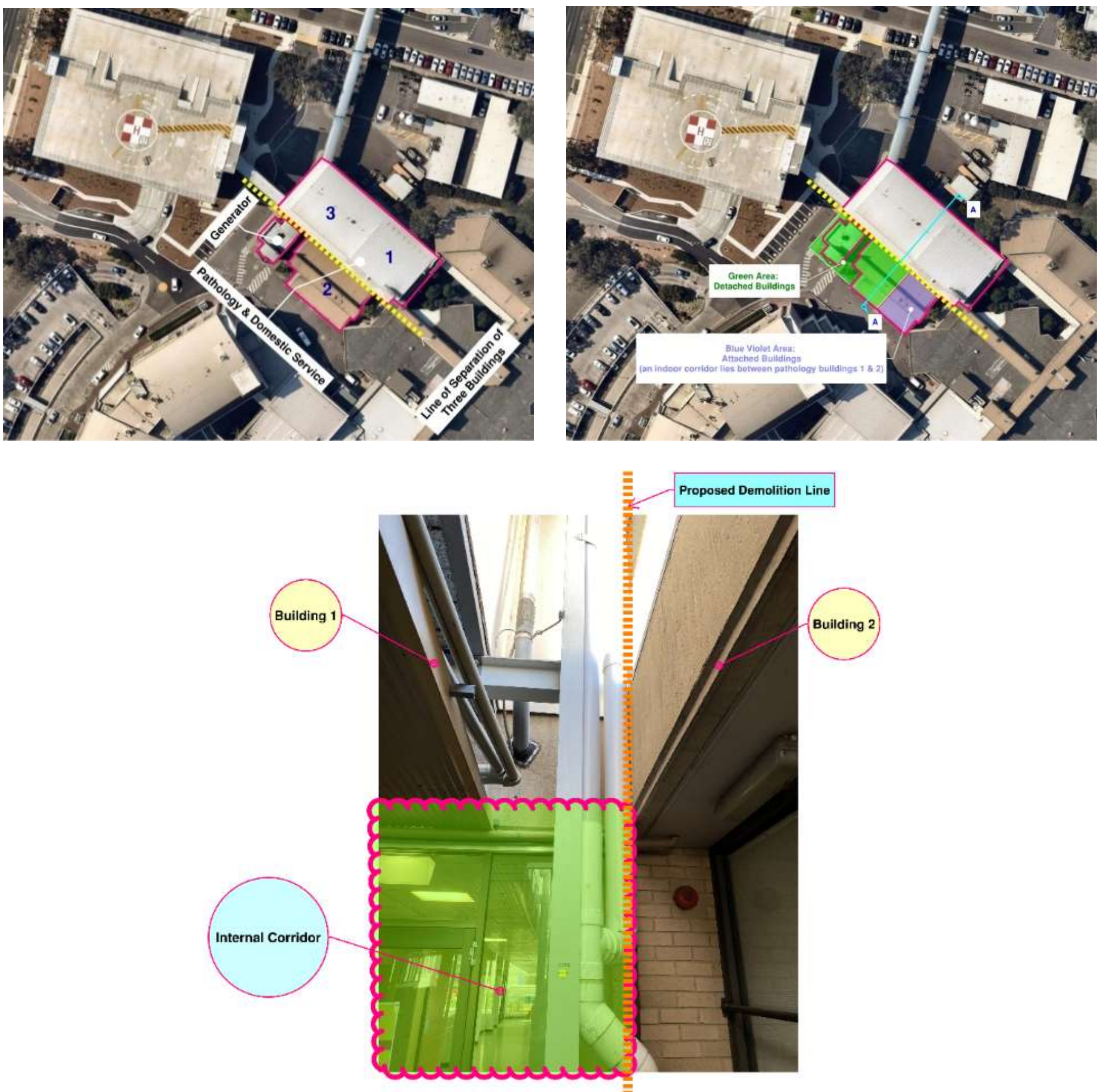

Figure 4.2-D - Connection Corridor Between Pathology Buildings

Extent of connection between Building 1 & 2 and walkway falling between them is depicted in reference Figure 4.2-D**Error! Reference source not found.** Since these buildings have been constructed in different period of time, connection between them assumes to be completed separately. Therefore, it would have minimal impact to introduce the demolition line through those buildings.

4.2.10 **Back of House (BoH) Area Upgrade**

This region requires an additional loading dock. This was proposed on pile foundation given the soil is exposed to outside hence movement of reactive soil could cause differential settlement on the slab. 200 thick slab was proposed with 15kPa Live loading in the proposed region.

The proposed loading dock has screw piles with RC slab as the soil class is categorised as highly reactive. An alternative option of retaining wall with slab on ground can be adopted subjected to geotechnical engineer input. shows the BOH upgrade.

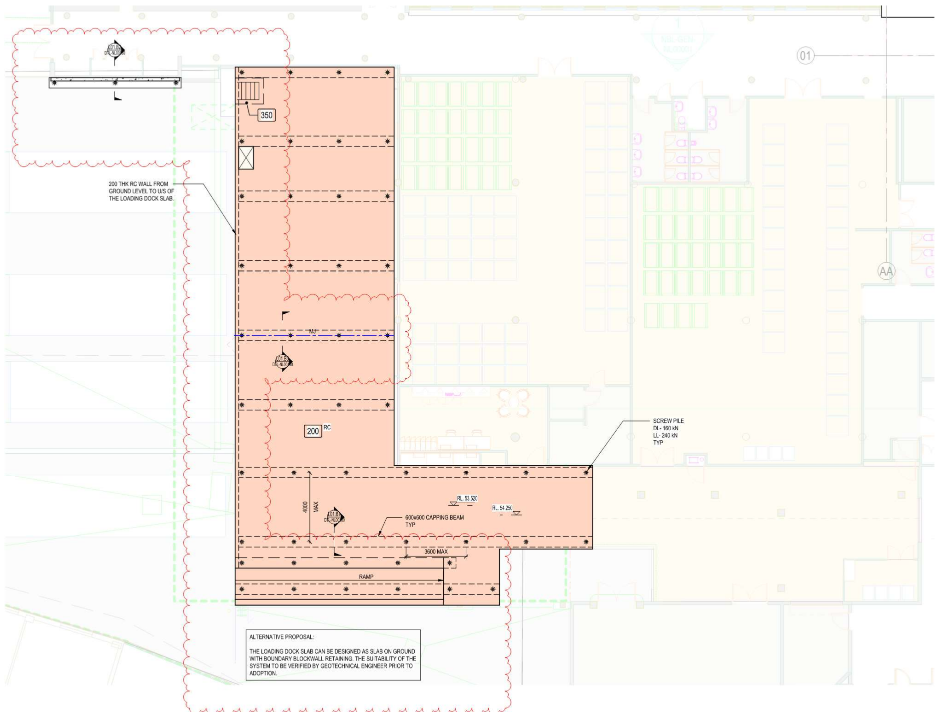

Figure 4.2-E - New Loading Dock for BoH

4.2.11 **Main Loading Dock and Access Overhead Bridge**

The existing loading dock has been expanded in the refurbishment. Finished floor level of the loading dock has been set at RL 54.25. The standard height of the loading dock is 1.2m which makes level at the loading apron RL 53.00. The existing levels around the loading apron is RL 53.05 and small height differences may also result from variations in the design of a truck chassis, or even the weight of its load. A hydraulic leveller will be permanently embedded in the concrete of the Loading Dock for this level difference. This results in civil works associated with the regrading of loading dock, semi-trailer loading bay and existing area around substation. Part of existing North Block will be demolished and regraded to loading apron levels of RL 53.00. Refer **Error! Reference source not found.**4.2-G below.

Additional surface runoff from the demolished north block building is diverted to grated drain at the eastern edge of loading apron. A crest has been introduced at the entrance of main Loading dock to prevent external overland flow from flowing into the main loading dock. The stormwater runoff from loading dock will be captured through a series of grated drains and existing stormwater network whereas, the external overland flows will be directed to the northern emergency overland flow path.

An assessment of the underground pipe system around the area is being conducted to make sure that the underground pipe system has adequate capacity to convey flows during a 100 year ARI storm event. An emergency overland flow path is provided at the northern boundary of waste management area.

In the event that the underground pit and pipe system is surcharged, it would overflow to stormwater sag pits along eastern (internal) road, keeps flowing to the northern kerb and overtops it to discharge to the existing overflow path north of the Tower 2.

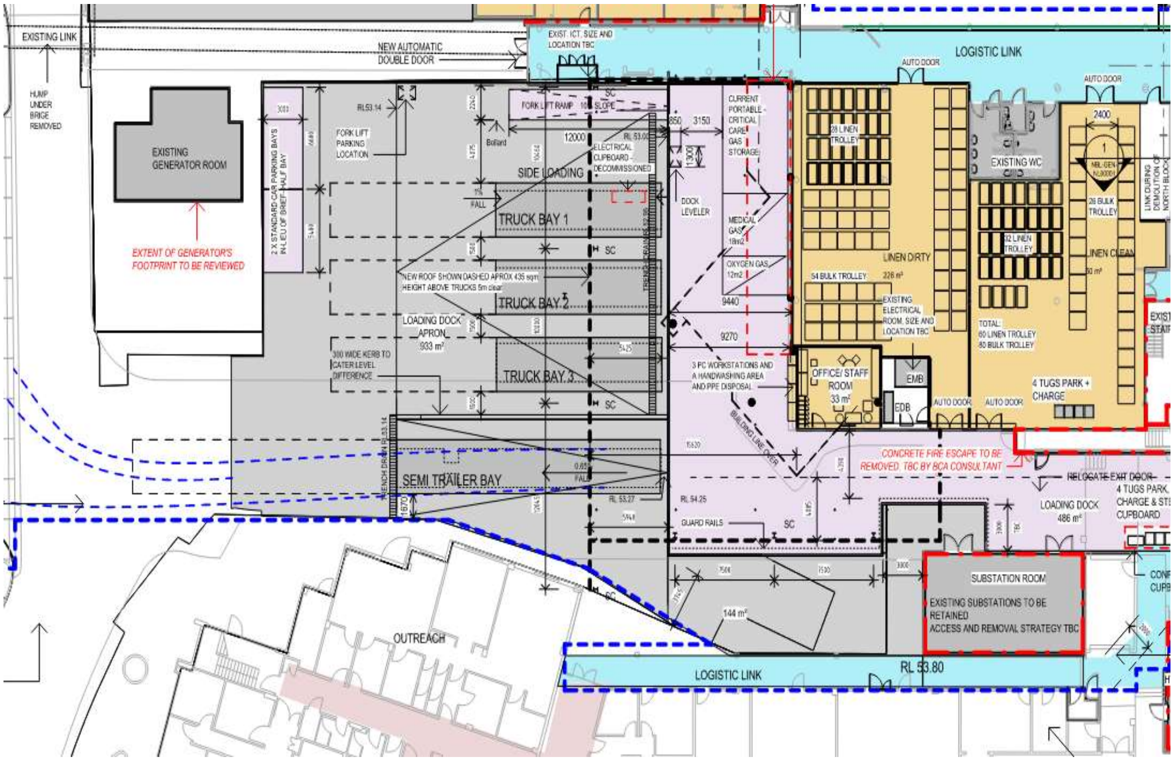

Figure 4.2-G- Main Loading Dock Expansion

4.3 Structural Design Parameters and References

4.3.1 Importance Factor

As with the Stage 1 Tower, an Importance Level 4 has been used for the structure as per the NCC (2019) and AS 1170.0 (2002).

4.3.2 Design Loads

Below are examples of the typical loads adopted for the floors based on various uses of the building.

Table 4.1 Floor Loads

Floor Type	Uniform Imposed Load (kPa)	Imposed Point Load (kN)	Ceilings, Services Load, Partitions, Floor Finished (kPa)	40mm Sacrificial Concrete Toppings
Stairs, ramps	4.0	4.5	0.0	0.0
Corridors, circulation areas and foyer spaces	5.0	4.5	1.3	1.0
Wards (General)	3.0	4.5	1.8	1.0
Clinical areas (General)	3.0	4.5	1.8	1.0
Plant rooms	7.5	4.5	2.4	0.0

Roof (typical)	0.25	1.4	1.0	0.0
Imaging (General)	5.0	4.5	3.0	1.0
MRI (TBC with supplier)	10.0	80	3.0	0.0
Roof top water tanks	Allowance is to be made to be confirmed by Hydraulic Engineer during detail design phase.			
Façade Load	4.0 kN/m	Where applicable		
Commercial/Institutional Kitchens	5.0			
Compactus	7.5			

Loading plans are provided in the structural set indicated what loads have been adopted in specific locations. The loads above (excluding the Imaging, MRI and Façade loads) have generally been adopted as per AS1170.1 (2002).

Construction Loading

An allowance has been made for construction loads on both L00, L01. A construction cycle of 7 days has been assumed for the post-tensioned slab such that propping in the occupied floors below is not required. The construction loading has been determined as:

- SDL = 0.5kPa
- LL = 9.5kPa

Wind Loads

The following design parameters have been adopted for the Wind Actions as per AS1170.2 (2011).

Table 4.2 - Wind Load Design Parameters

Item	Value
Location	Region A2
Importance Level	4
Vu	48m/s
Vs	37m/s
Ms	1.0
Mt	1.0
Md	1.0
Terrain Category	3.0

Earthquake Loads

The following design parameters have been adopted for the Earthquake Actions as per AS1170.4 (2007).

Table 4.3 - Earthquake Load Design Parameters

Item	Value
Importance Level	4

Probability Factor, Kp	1.5
Hazard Factor, Z	0.08
Sub-Soil Class	Ce
Earthquake Design Category	III
Structural Ductility Factor, μ	3*
Structural Performance Factor, Sp	0.67

*This assumes that ductile shear walls are to be utilised.

4.3.3 Floor Vibrations

The response of the floor structure to footfall will be checked in accordance with the recommendations of the Concrete Centre Design Guide *"A Design Guide for Footfall Induced Vibration of Structures"* (2006) and Murray et al in the AISC (2016).

The footfall frequencies and corresponding response factors for different floor areas will be checked for compliance with those listed in HI Design Guidance Note 01, shown below in Table .

Table 4.4 - Footfall Response Factors

Facility/Equipment/Use	Design Response Factor	Footfall Frequency (Hz)
General procedure rooms, laboratories and general surgery	2	2.2
Corridors, circulation spaces, offices and other non-vibration sensitive areas (to allow for future proofing)	2	2.2
Imaging suite and operating theatres	1	1.8
General slabs over imaging suits and operating theatres	1	2.2
Plant areas*	N/A	2.2
Roof areas*	N/A	N/A
MRI suite**	0.25	1.8

**Vibration criteria and hence design response factor may be dependent on slab below if located over vibration sensitive areas (eg. Imaging suites, operating theatres, MRI suites)*
***Vibration criteria and max deflection limits to be specified by vendor*

4.3.4 Fire Rating

The following FRL's have been adopted for the Stage 2 Tower.

Table 4.5 – Fire rating

Building Element	FRL (Type 9a)
External Walls (Load Bearing)	120/60/30
External Columns	120/-/-
Load Bearing Fire Walls	120/120/120
Shafts (Non-load Bearing)	-/120/120
Other Load Bearing Walls, Beams, Trusses, Columns	120/-/-

Floors	120/120/120
Steel Framed and Metal Sheeted Roofs Not Providing Fire Separating Function	No FRL*
Steel Columns Supporting Steel Framed and Metal Sheeted Roofs Note Providing Fire Separating Function	120/-/- (TBC)

**This concession is gained as the building is to be fully sprinklered*

4.3.5 Durability

For concrete elements this will be achieved by specifying all elements in accordance with Section 4 of AS 3600 (2018) which sets out the requirements for reinforced and post-tensioned concrete structures with a design life of 40 to 60 years. Exposure classifications will be as follows:

- In-ground Structures A2
- Internal Areas A2
- External Areas B1

Protective coatings to structural steel elements shall comply with AS/NZS 2312 (Part 1 & 2) and ISO 2063 for the long-term protection category.

4.3.6 Design Standards

The structural and civil design will be in accordance with the latest revision of all relevant Australian Design Standards, Codes and other statutory requirements. As a minimum requirement, the design shall be based on but not limited to:

Table 4.6 – Structural Design Standards

Number	Edition	Title
AS/NZS 1170.0	2002	Structural Design Actions Part 0: General Principles
AS/NZS 1170.1	2002 (R2016)	Structural Design Actions Part 1: Permanent, Imposed and Other Actions
AS/NZS 1170.2	2011 (R2016)	Structural Design Actions Part 2: Wind Actions
AS/NZS 1170.4	2007 (R2018)	Structural Design Actions Part 4: Earthquake Loads
AS 2159	2009	Piling – Design and Installation
AS/NZS 2312.1	2014	Protection of Structural Steel Part 1: Paint Coatings
AS/NZS 2312.2	2014	Protection of Structural Steel Part 2: Hot Dipped Galvanising
AS 3600	2018	Concrete Structures
AS 3700	2018	Masonry Structures
AS 4100	2020	Steel Structures
AS 4600	2018	Cold-formed Steel Structures

Table 4.7 - Civil Design Guidelines and Standards

Design Element	Guideline or Standard
Site Grading	• AS1428.1:2009 Design for Access and Mobility Part 1: General Requirements for Access – New Building Works • Penrith City Council's Development Control Plan • AS2890.2 – Parking Facilities Part 2: Off-street commercial Vehicle facilities • AS2890.6 – Parking Facilities: Off-street Parking for People with Disabilities
Stormwater Management	• AS3500 Plumbing and Drainage Part 3 – Stormwater Drainage • Australian Rainfall and Runoff • Penrith City Council's Development Control Plan • College, Orth, and Werrington catchment overland flow flood study
Erosion and Sediment Control	• Soils and Construction Volume 1 (4^{th} edition), Landcom, 2004

Appendix A – Structural Engineering Drawings