396 Lane Cove Road, Macquarie Park. Preliminary geotechnical and structural impact assessment on ECRL infrastructure

September 2010

WINTEN PROPERTY GROUP

AUSTRALAND

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Project Manager	Reuben Lamack	Principal Engineer		27/08/10

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A	Issue for client comment	27/08/10	P.Hewitt and R. Lamack
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Executive summary

This report presents an initial assessment of the potential impact associated with construction of a proposed commercial development at 396 Lane Cove Road and 1 Giffnock Avenue, Macquarie Park on the Epping to Chatswood Rail Link (ECRL) Infrastructure.

The proposed development is sited within 10m of the existing RailCorp rail corridor and within 15m of the Epping to Chatswood Rail Link (ECRL) Macquarie Park Station.

Winten Property Group and Australand in joint venture (WAJV) has submitted a preliminary environmental plan and subsequently, the Department of Planning has declared the project as a Major Project, to which Part 3A of the Act applies and has authorised the submission of a concept plan.

The proposed development western boundary is sited approximately 10m from the RailCorp rail corridor. With respect to SEPP(Infrastructure 2007) Clause 88, the proposed development falls within the horizontal distance of 25m from RailCorp corridor hence triggering the need to provide an impact assessment as outlined in the NSW Department of Planning 'Development Near Rail Corridors and Busy Roads- Interim Guideline 2008'.

The guideline requires an impact assessment study be undertaken by the developer and to be submitted with the Project Plan application. WAJV has appointed Parson Brinckerhoff (PB) to provide a preliminary impact assessment to be included in the Concept Plan submission.

This report is limited to highlighting the possible geotechnical and structural impacts to the existing ECRL infrastructure. The proposal has been designed to minimise impact by adopting basement works with maximum clearances as possible and limiting the depth of the excavation. Additionally the development does not encroach into the RailCorp stratum boundary. The developer and associated consultants have initiated a consultative meeting with RailCorp and have incorporated advice received on the concept plan design. The project plan submission stage will include a detailed geotechnical and structural assessment report, noise and vibration report and electrolysis impact report.

The findings in this report indicate that construction associated with the proposed development will have to be studied in more detail during the next stage of design development. Based on the preliminary review of the station drawings and preliminary numerical modelling, it is anticipated that the construction of the proposed commercial building is unlikely to have an adverse impact on the existing ECRL infrastructure. This conclusion is subject to assessment of the available tolerance of ECRL supporting elements.

This report provides conclusions which will assist in providing initial confidence to stakeholders that the development can proceed without impacting RailCorp existing infrastructure and provides a basis for obtaining RailCorp's non-objection to the proposed concept plan of the development.

It anticipated that on obtaining the concept plan approval, the developer will further engage the geotechnical consultant to develop the geotechnical models, review the station drawings, monitoring data and continued liaison with RailCorp asset management engineers prior to submission of the Project Plan. This will ensure that RailCorp is fully aware of the design development and limitations of the proposed development and will ensure all issues are addressed early on resulting in a timely approval of the Project Plan submission.

1. Introduction

1.1 Background

This report presents an initial assessment of the geotechnical and structural impacts of a proposed multi-storey development at 396 Lane Cove Road and 1 Giffnock St Macquarie Park on the adjacent ECRL Macquarie Park Station and running tunnels.

The study was commissioned by Winten Property Group & Australand (WAJV). WAJV has also commissioned Enstruct Group Pty Ltd as the Structural Engineers.

The development is adjacent to the Epping to Chatswood Line (ECRL) along the north western site boundary on Waterloo Road. Concept drawings of the development indicate up to 15m excavation (to RL 45.2m) is anticipated along the north western property boundary.

The proposed development is approximately between 19 m from the underground cavern station and 15m from the West Entry access shaft (Refer Figure 1-1).

The primary purpose of this report is to:

- outline the proposed development boundary and spatial distance from ECRL infrastructure
- examine possible geotechnical and structural impacts of the multistorey development on the existing ECRL infrastructure
- provide initial confidence to RailCorp that the development impacts are acceptable to obtain RailCorp's non-objection for the concept submission.

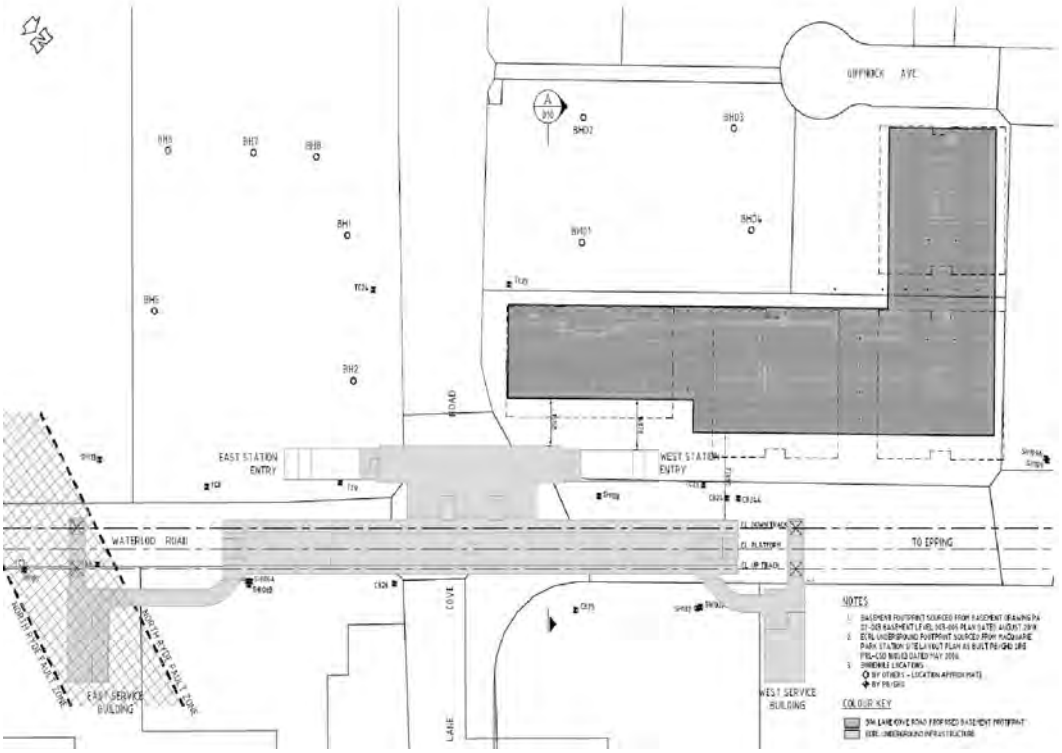

Figure 1-1 Site Plan showing the proposed basement and ECRL underground boundary

1.2 Available Information

The following information has been made available for consideration in our assessment:

1. Enstruct Group – Building Sections with concept foundation July 2010 (Appendix B).
2. PB/GHD- THJV –PRL. Macquarie Park Station – Site Layout Plan – As built –PRL-CSD-160503 Rev 4- 4 Aug 2005 (Appendix C).
3. PB/GHD- THJV –PRL. Macquarie Park Station – Cross sections D-D and EE – As built – PRL- CSD-164403- Rev 4 4 Aug 2005 (Appendix C).
4. PB/GHD- THJV –PRL. Macquarie Park Station – Typical Cavern and Concourse Cross Passage Permanent Rock Reinforcement – As built -PRL- CSD-161556- Rev 6- 4 Aug 2005 (Appendix C).
5. PB/GHD- THJV –PRL. Macquarie Park Station – Typical Cavern and Concourse Cross Passage Permanent Rock Reinforcement – As built -PRL- CSD-161555- Rev 6- 11 Dec 2007 (Appendix C).
6. PB – 396 Lane Cove Road Macquarie Park Geotechnical desktop study report (Ref 2108235A/lij/0640 dated Sept 2010).
7. Thiess Hochtief JV (PB). Parramatta Rail Link CIVSYS-1 Contract – Design report for the Excavation, Support, Water Proofing and Permanent Lining – Macquarie Park Station and Caverns –Design package –C12A – Stage III Design May 2003.
8. TIDC 2006 Guidelines for Assessing Impact of Proposed Developments on the Underground Infrastructure of the Epping to Chatswood Rail Line – 11 May 2006.
9. Winten Property Group & Australand. Architectural basement plan (ref no. PA02-001 Basement, scale 1:1000), August 2010.
10. Winten Property Group & Australand. Architectural ground plan (ref no. PA02-00 Ground plan, scale 1:1000), August 2010.
11. Winten Property Group & Australand. Typical level plan (Preferred Scheme), Section AA, Section BB, Section CC and Section DD, August 2010.

1.3 Proposed development

The proposed development consists of four (4) multi storey buildings with 5 levels of basement excavation. The tallest building (Building A) sited adjacent to the Macquarie Park Station has 17 storeys.

Figure 1-2 Proposed Development Outline

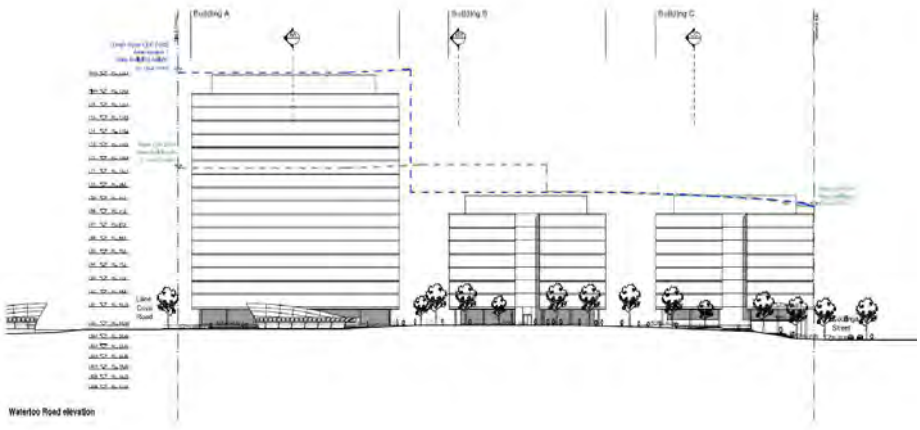

Figure 1-3 Proposed development Waterloo Road elevation

1.4 ECRL Macquarie Park Station

Macquarie Park station and the running twin tunnels intersect a sequence of Ashfield Shale, Mittagong Formation and upper Hawkesbury Sandstone (see *Figure 1-6*). The internal diameter of the tunnel is 7.2m and these tunnels are separated by a minimum of 5.5m. The tunnel excavation was completed in 2004 and the ECRL commenced operation by 2009.

The Macquarie Park station comprises a 14m high main platform cavern, approximately 30m deep, 200m long, and 20m wide at the arched crown springline. The concourse is 70m long, 16m wide, 7.5m high arched cavern connected to the platform cavern by a 12m wide access passageway, and to street level by twin 39m long, 13m wide and 36m deep access shafts (Rozek, 2004).

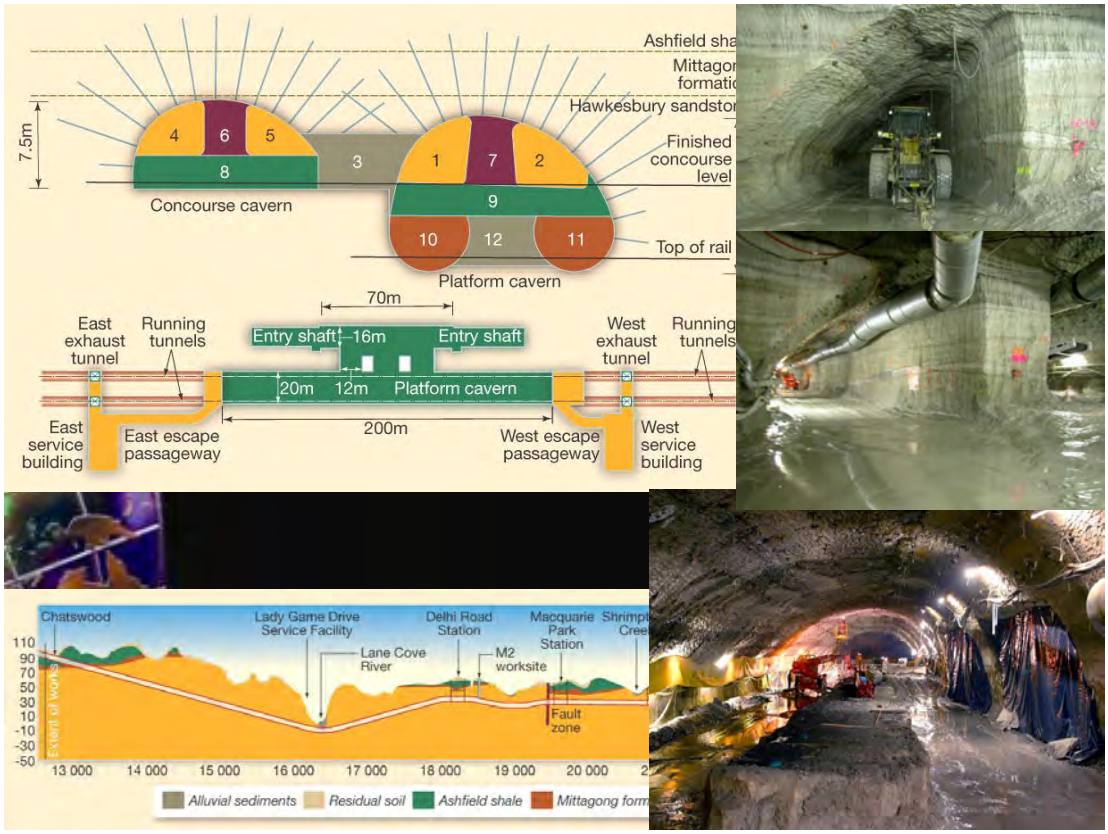

Figure 1-4 ECRL Macquarie Park Station outline details (Tunnels & Tunnelling Feb 2004)

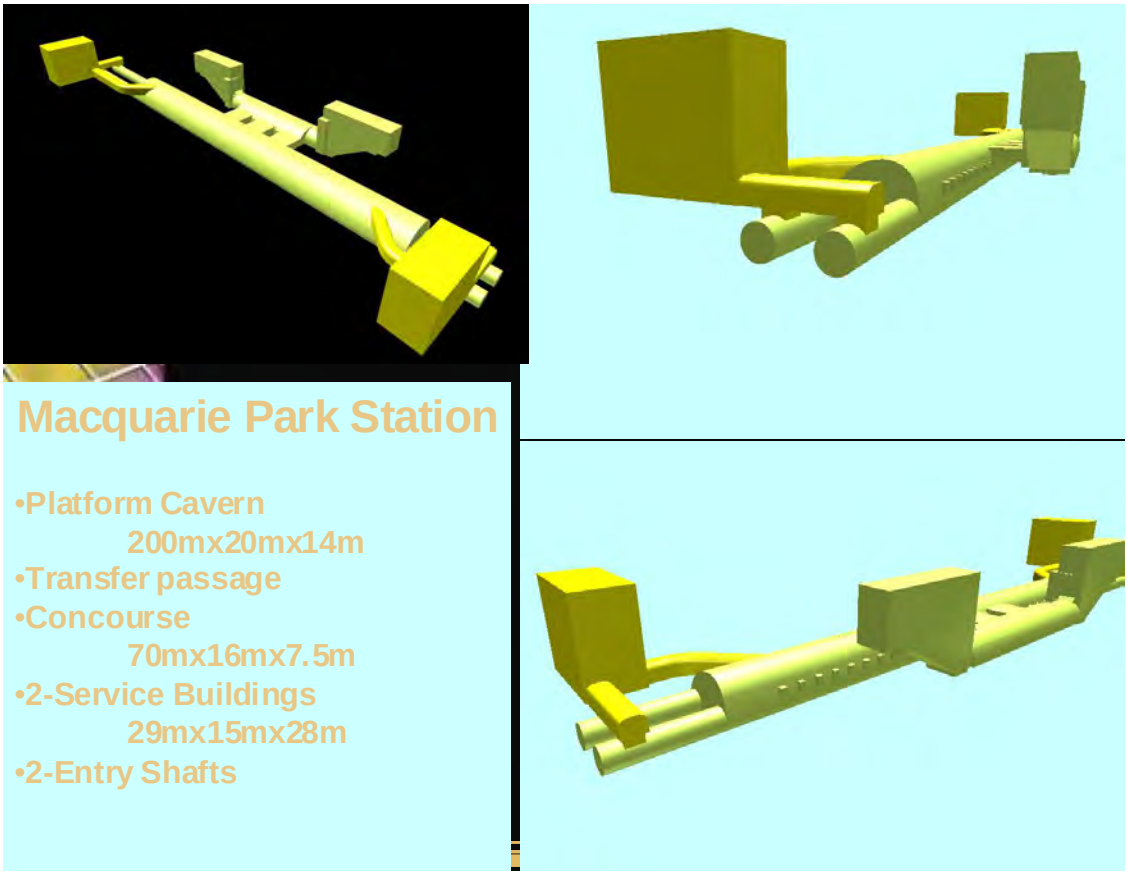

Figure 1-5 ECRL Macquarie Park Station outline details in 3D

The running tunnel permanent lining comprises circular-formed un-reinforced concrete, minimum 200mm thick, with a design compressive strength of 32MPa at 28 days. Temporary support consists of rockbolts and shotcrete lining. The tunnel invert consists of a level horizontal slab constructed 3m below the tunnel's centre.

2. RailCorp consultation

2.1 General

Transport Infrastructure Development Corporation (TIDC) has transferred ownership of ECRL to RailCorp on commencement of ECRL operations hence all development assessments adjacent to ECRL are to be reviewed by RailCorp. The developer and consultants attended a consultative meeting with RailCorp asset management engineers on the 28th of July 2010. In this meeting the concept plan was discussed in detail. RailCorp confirmed that they have not further developed specific guidelines for the ECRL project. At the time of this report no new specific guidelines has been the provided by RailCorp and PB has referred to the previously issued guidelines by TIDC.

TIDC Guidelines for Assessing Impact of Proposed Developments on the Underground Infrastructure of the Epping to Chatswood Rail Line (TIDC, 2006) require that the potential impact of a proposed building development in the vicinity of the ECRL underground infrastructure be assessed in terms of potential effects on stress distribution, deformation and groundwater movement.

2.2 Station support zones

The support zone for the station is defined in the TIDC guidelines as 8m vertically or horizontally from the finished internal surface of the station (Figure 2-1).

2.3 Station influence zones

The TIDC guidelines define the influence zone for the station as 15m vertically above the crown of the cavern. The influence zone is bounded by a line tangent to the outside of the lining extending outwards at a slope of 2 vertical: 1 horizontal (Figure 2-1)

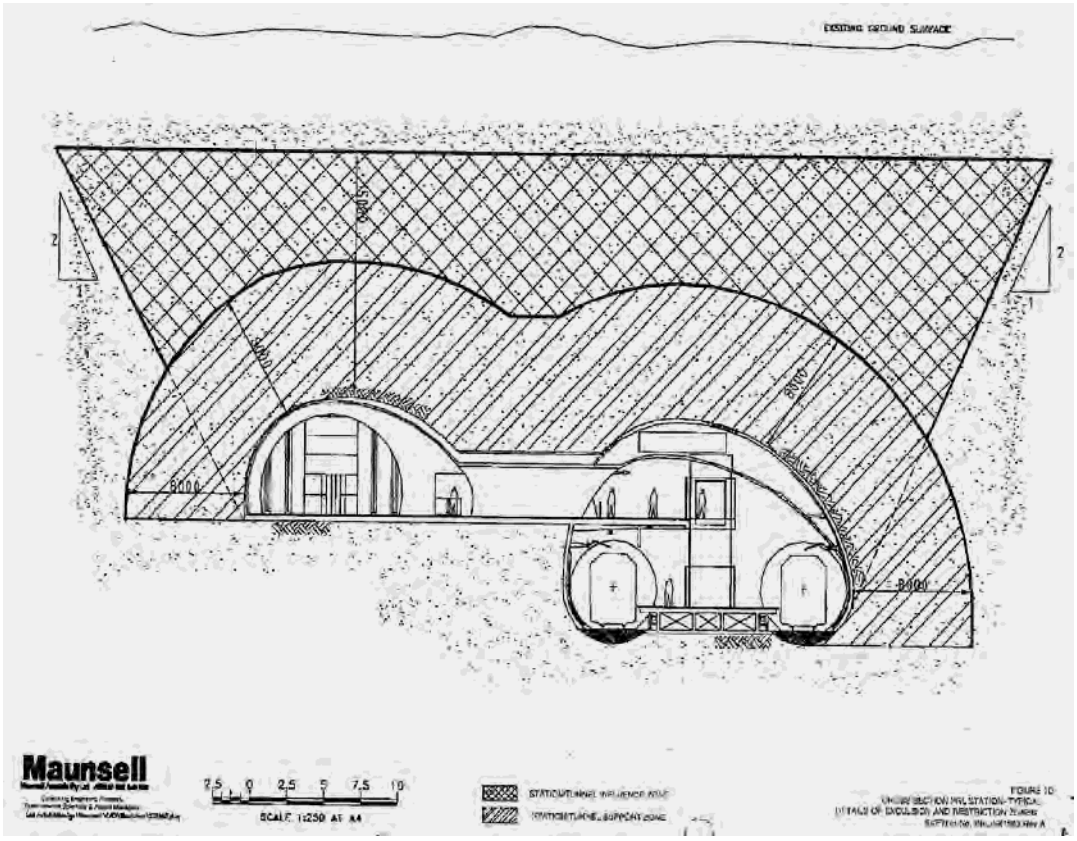

Figure 2-1 ECRL Station Protection and Support Zones

2.4 Information for RailCorp to review

The TIDC guidelines require the following information (TIDC, 2006) be provided for any proposed development or associated foundation element that falls within the tunnel influence zone:

- assessment carried out by a suitably experienced geotechnical engineer on the predicted impact of the proposed development on the ECRL underground structure
- setting out details of the foundations for the proposed development including survey reference marks co-ordinated in MGA coordinates and all founding levels in AHD
- all dimensions of the foundation elements including anchor fixed and free lengths
- schedule of loads for all foundation elements including anchor lock off loads and design loads
- details of any foundation testing proposed at the site
- construction staging and foundation installation sequence, including any dewatering works.

3. Development site

3.1 Site geology

The basement excavation for the proposed building development intersects, in descending order, fill materials, residual clays, (highly weathered shale) stiff to hard consistency, Ashfield Shale of varying strength from very low to medium strength with increasing depth, Mittagong Formation of medium to high strength, grading into Hawkesbury Sandstone.

The adjacent Macquarie Park platform and concourse caverns are located in Hawkesbury Sandstone. The concourse cavern has a roof elevation of approximately RL41.5m and invert at RL34m while the platform cavern roof is at approximately RL40m with invert at RL28m. The overlying Mittagong Formation occurs approximately 2 to 3 metres above the roof of the platform cavern and concourse.

Based on reports produced for the Macquarie Park Station as part of the ECRL design, the following profile was identified at the approximate centre of the station:

- residual soil from approximately RL58 to 54m
- Ashfield Shale from approximately RL54 to RL46m
- interbedded/interlaminated siltstone and sandstone (Mittagong Formation) from approximately RL46 to 42m
- Hawkesbury Sandstone from below RL42m

It should be noted that the elevation of these geotechnical units varies across the length of the station caverns as the topography and underlying weathering profile is inclined gently upwards from the SE to the NW. There is also a gentle dip of the Ashfield Shale and Mittagong Formation units to the north.

Bedding in the Mittagong Formation and the Hawkesbury Sandstone is sub-horizontal, with bedding planes typically spaced at 100-300mm throughout the sandstone units within the Mittagong Formation, ranging to 1.0m or greater, in the siltstone units and in the Hawkesbury Sandstone. Hawkesbury Sandstone is also characterised by cross-beds dipping typically between 15 to 30 degrees, generally towards the north-east.

The station area is also characterized by two orthogonal E-W and N-S striking joint sets. Another geological feature present in the vicinity of the proposed development site is the North Ryde Fault Zone which is located approximately 150m away from the eastern end of the proposed development.

Figure 3-1 shows the inferred geological cross-section that can be expected to be encountered at the site.

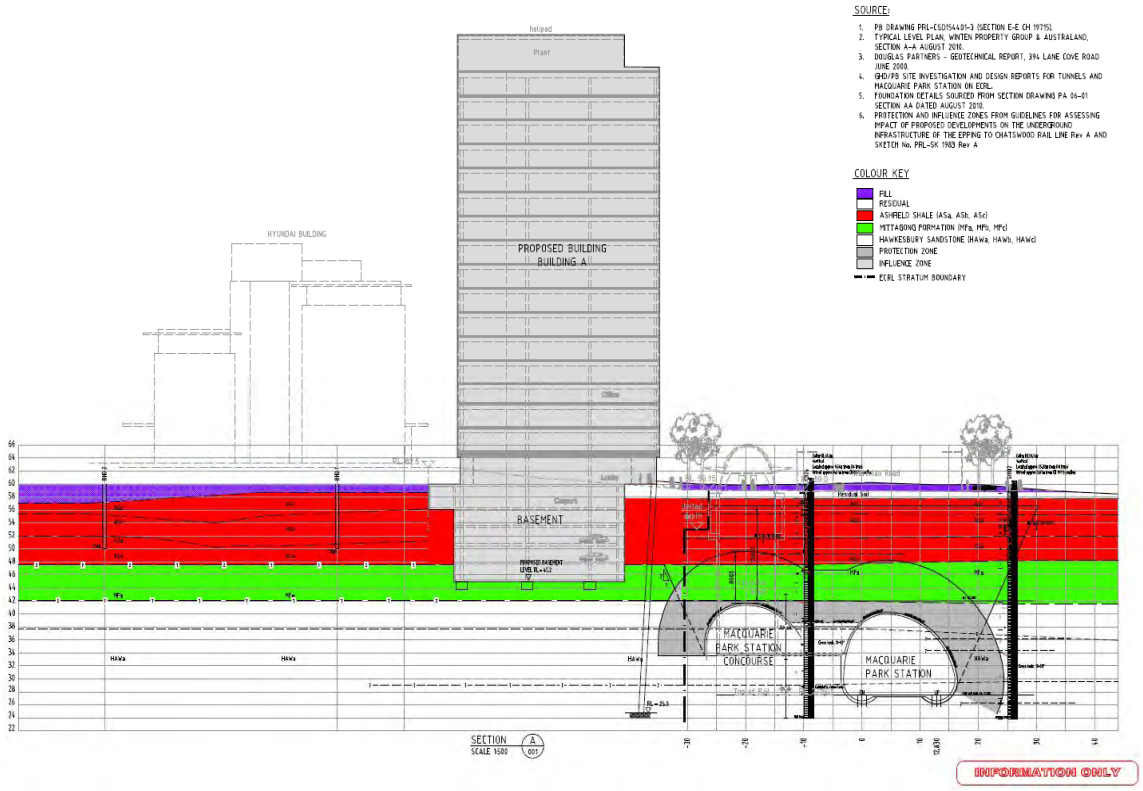

Figure 3-1 Geological cross-section of site

3.2 Site hydrogeology

Ground water monitoring which occurred prior to the construction of ECRL tunnels and associated station indicated that groundwater table occurred at or just below approximately RL49m, within the base of weathered Ashfield Shale. Locally perched groundwater may also occur within the residual clay unit.

Drawdown of water table due to the construction of the station caverns would have occurred and would extend beyond the boundary of the proposed development site. It is noted that the station was designed as a drained station which normally result in the permanent lowering of the water table.

4. Geotechnical and structural impacts

4.1 General

Issues associated with assessment of interaction between the proposed development and the existing RailCorp infrastructure includes:

- stress redistribution effects around the proposed deep basement and impacts on the existing underground station, entry shafts and running tunnels
- ground movement effects
- foundation loads stresses on existing RailCorp infrastructure
- loads from temporary/or ground anchors and other support
- construction impacts including vibration and staging
- variation in the groundwater regime

4.2 Stress redistribution and ground movement

The development's basement excavation will alter the in-situ stress regime (causing stress relief or concentration) in surrounding rock strata thereby causing displacements within the rock mass which will generally be concentrated along geological structures.

One option for site retention system will comprise soldier piles founded in competent rock with concrete/shotcrete infill panels, supported by temporary anchors and followed by strut bracing. Excavation within the competent rock will involve temporary rock anchors/bolts followed by strut bracing from permanent works.

This method limits ground movement at the edges of the excavation in the upper weathered materials. Movement of ground deformation will be restricted to ensure no damage occurs to adjacent buildings and public infrastructure.

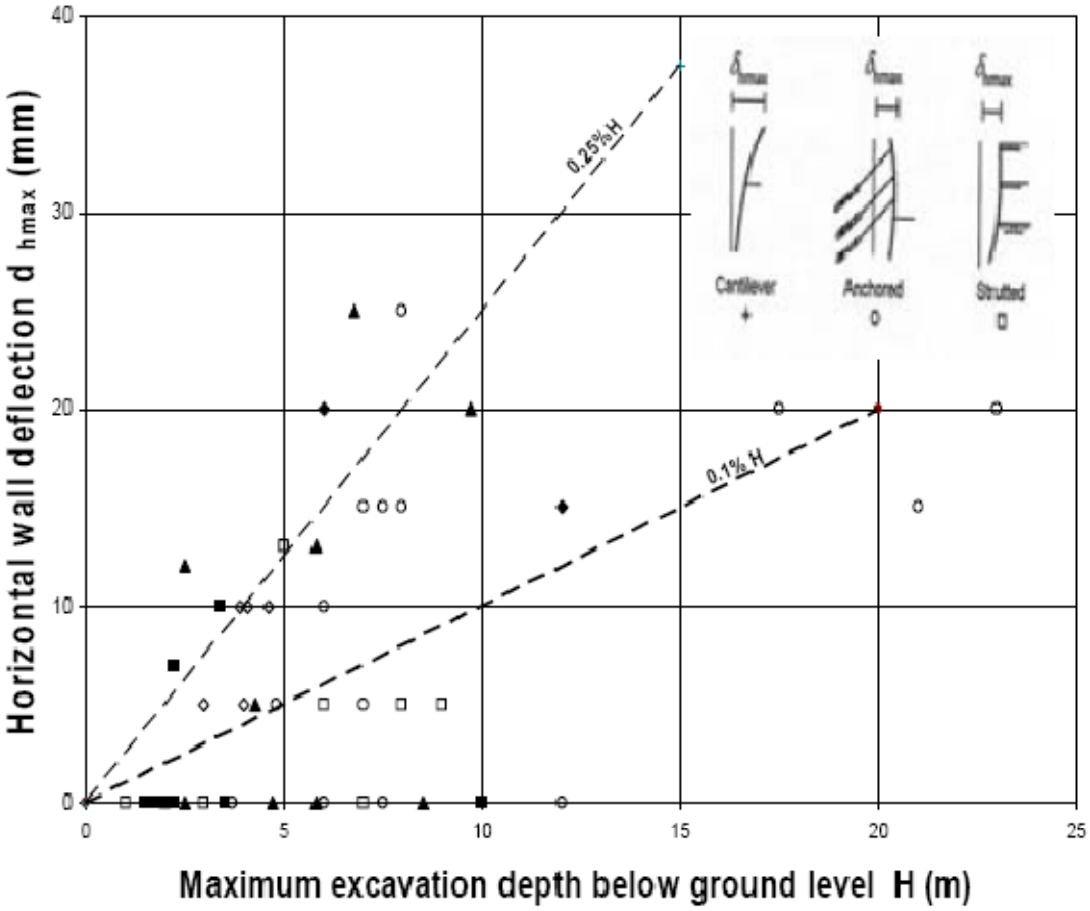

Figure 4-1 Wall deflection with respect to excavation depth

Figure 4-1(Hewitt, Burkitt & Baskaran - Ref 1) indicates the predicted maximum horizontal movement at the top of the wall. Case history date indicates that for a 15m deep excavation, the deflection range is between 15-25mm for an anchored system.

Based on published analysis of stress relief behaviour in vertical rock cuts (Glastonbury & Fell 2002 Ref 2), the horizontal stress-relief displacement induced by the basement excavation is expected to be less than 5 mm at 15m from the basement excavation.

This magnitude of displacement is not expected to have an adverse effect on the rock mass or defect shear strengths in the area surrounding the existing station cavern, entry shafts and running tunnels. That horizontal stress redistribution will have to be studied in detail as the locked in horizontal stresses are greater than the vertical stress and the due to the near horizontal bedding planes, the magnitude of movements could cause distress of the infrastructure support systems. The design limit for measured movement as set out in the Parramatta Rail Link CIVSYS-1 design report is <7mm. However an assessment of the monitoring data during the construction of caverns will need to be carried out to confirm if this limit is still applicable.

4.3 Preliminary numerical modelling

PB carried out conceptual numerical modelling work of the probable stress redistribution and provided consultation advice to the developer on the possible acceptable basement depths.

The concept modelling assumptions are as follows:

- station and concourse caverns modelled only
- two cases were analysed, RMF=2 & JSF=1 and RMF=1 & JSF=10 (Chan & Stone 2005 Ref 3)
- rockbolts support system for station & concourse cavern were incorporated
- basement excavation was simulated in 3m deep stages
- concrete liner was modelled in soft ground section extended about 0.5m in Asa rock (Class I & II shale)
- basement liner is assumed at 40MPa strength (E=32 GPa, thickness=0.1m).

The results of the analyses are summarised in Table 4.1

Table 4-1 Numerical analyses results

Case	Description	Excavation Level	Maximum predicted horizontal displacement at (mm) at crown level			
			At Station cavern	At Concourse cavern	At Excavation Level	
1	RMF=2 and JSF=1	Full excavation up to car parking level 6 (RL 41.1)	6.5	12	16	(at RL 41.1)
		Excavation up to car parking level 5 (RL 44.1)	2.3	3	9.8	(at RL 44.1)
		Excavation up to car parking level 5 (RL 45.2)	1.1	1.6	4.1	(at RL 45.2)
2	RMF=1 and JSF=10	Full excavation up to car parking level 6 (RL 41.1)	8.2	15	19	(at RL 41.1)
		Excavation up to car parking level 5 (RL 44.1)	2.5	4	12	(at RL 44.1)
		Excavation up to car parking level 5 (RL 45.2)	1	2.1	4.4	(at RL 45.2)

Figure 4-2 is a schematic of the Phase II model indicating the location of the basement excavation and caverns.

The horizontal movements for both the cases considered with respect to distance from the basement excavation are plotted in Figures 4.3 and 4.4.

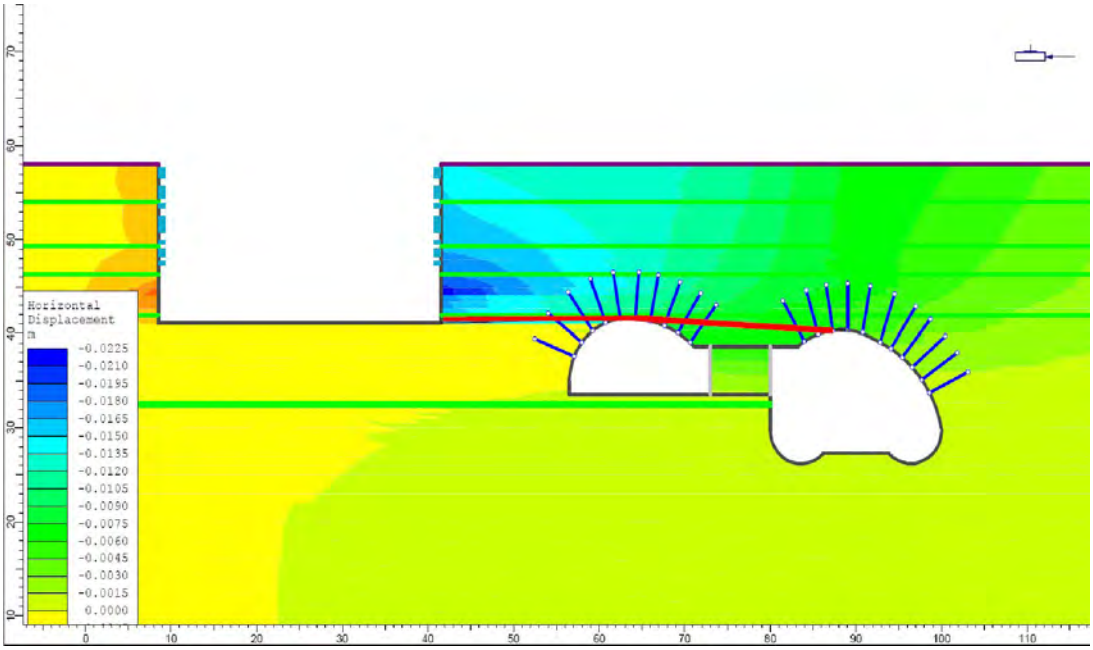

Figure 4-2 PHASE II Model

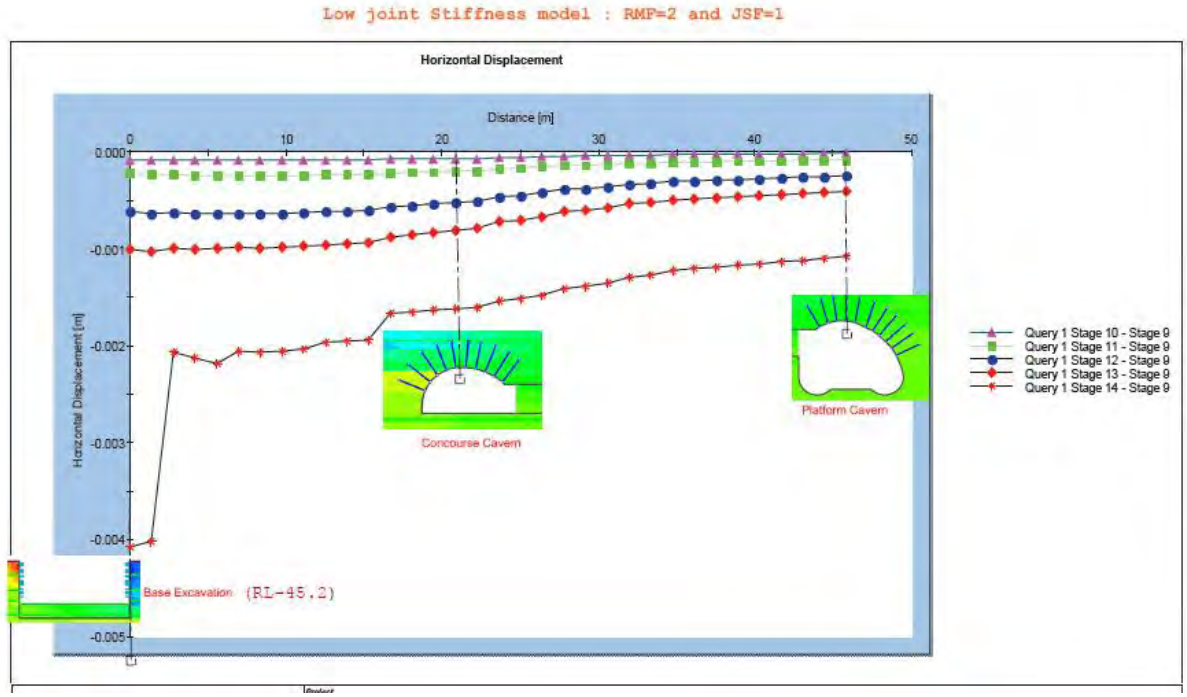

Figure 4-3 Plot of Horizontal Displacement RMF=2 and JSF =1

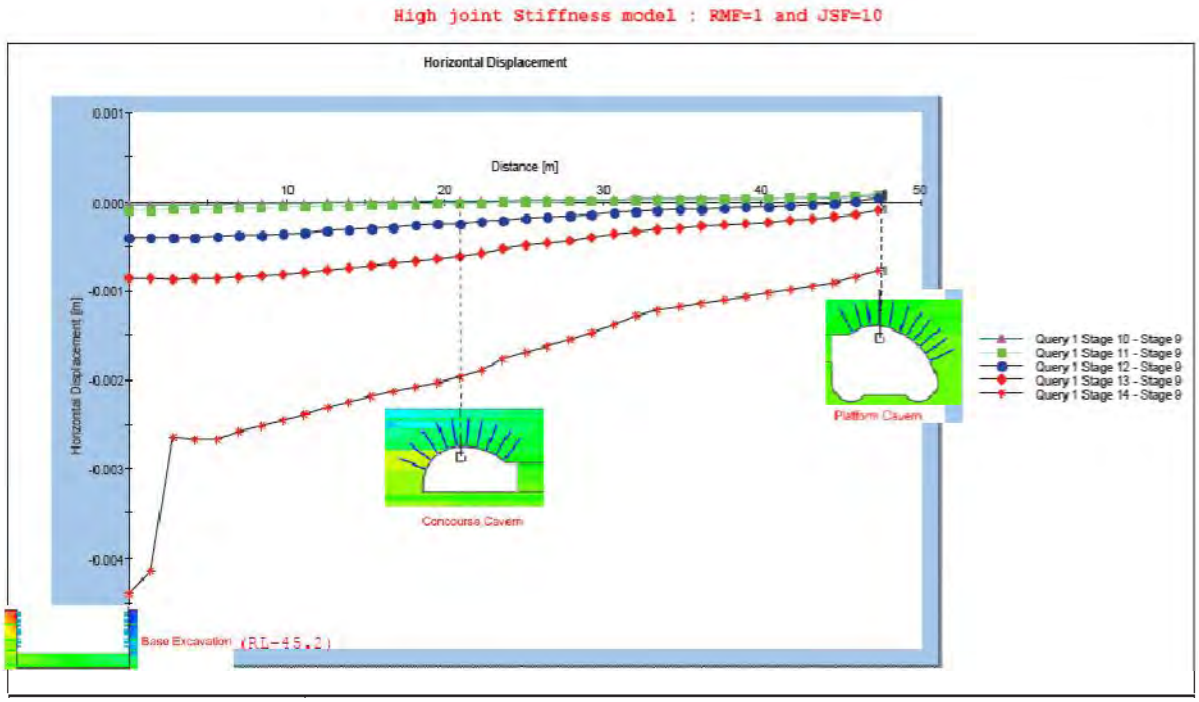

Figure 4-4 Plot of Horizontal Displacement RMF=1 and JSF =2

Based on the preliminary numerical analysis the developer has raised the basement depth to RL 45.2m. It would be reasonable to anticipate that the displacement is predicted to be lower than <5mm within the structural support zone.

Detailed analysis is required during the project design stage following geotechnical investigation to:

- confirm the magnitude and location of ground stress changes which can be expected from the basement excavation
- assess whether these stress concentrations can develop yield conditions for support systems of the existing infrastructure

4.4 Foundations and anchors

Pad foundations and pile foundations will be utilised for the proposed building foundation. Arrangements of the foundation are provided in Appendix B. The basement wall and the edge foundations will be outside the protection zone of the ECRL structures. It noted that the proposed pile foundations for Building A traverses the influence zone, however the piles are sleeved and founded below this zone hence no load is transferred into the zone.

Based on the separation distance of the basement and ECRL infrastructure, it is anticipated that the horizontal load transfer to the proposed tunnels will be low. This will be further investigated in the design stage.

Temporary anchors will be utilised for support works during the excavation and this anchors will be de-stressed on completion. No anchors will encroach the protection zone. Detail assessments will be undertaken during the designs stage to study the impact of transient temporary anchors loads within the influence zones.

There will be no horizontal loads on the anchors on completion of the basement. If permanent rock anchors are utilised, the horizontal load transfers will be limited to acceptable limits.

4.5 Construction impacts

The staging of the basement excavation will be addressed during design stage to minimise ground movements. An excavation sequence plan will be developed using numerical modelling to predict ground movements of each stage.

Basement excavation methods are expected to be limited by local restrictions on ground vibration and noise. It is expected that impact hammering or saw-cutting will likely be employed. These methods are not expected to adversely impact ground conditions in the rock.

Expected peak ground acceleration impacts will be addressed during the designs stage.

4.6 Changes to groundwater regime

Local groundwater levels prior to the construction of Macquarie Park Station indicate that the groundwater level could be approximately 6.4-7.4m deep based on info from adjacent sites. It is likely that the groundwater has been lowered by the construction of the drained station caverns.

It is anticipated that further groundwater variation due to basement excavation could result in the possible settlement of less than 5mm due to consolidation settlement and could also induce the differential stress regime across the station cavern. It is anticipated at this stage the movement of this magnitude would be acceptable and within the limits of the ECRL structures, however detailed numerical modelling will be required to confirm the movement magnitude and stress change levels.

5. Conclusions

The footprint of the proposed development is outside the protection zone as defined by TIDC guidelines and outside the ECRL stratum. While there is minor encroachment on the influence zone, it considered that this encroachment would not likely impact the integrity of the ECRL structural support systems.

The basement excavation work will result in stress relief which can result in unacceptable movement along the horizontal bedding and subsequently undermine the structural integrity of the support systems. A preliminary analysis of this movement based on known geological information and proposed development configuration indicate that these movement will be limited to a value of <5mm within the vicinity of the station caverns. This magnitude of movement would be acceptable but a review of the monitoring data during the construction of ECRL will have to be carried out to confirm the acceptance of this limit.

Detail analyses will have to be carried and a staged excavation system will need to be defined during the design stage to accurately predict the movements. Additionally a monitoring system needs to be defined in the monitoring plan with contingency plans to be taken for breach events of the acceptable limits.

The actual impacts from vibration and consolidation settlement due to lowering of ground water is considered be a low impact but will be studied in the design stage.

6. Recommendations

6.1 General

The geotechnical and structural issues identified in section 4 will have to be studied in detail during the design stage. This section outlines the proposed methodology of the detail design stage.

Based on the information from ECRL investigations and as summarised in section 3.1, it is known that bedding planes / joints are present in the cavern areas and associated tunnels.

We recommend detail numerical modelling to investigate the potential for the adjacent proposed excavation to induce ground movements along these planes due to the stress relaxation of the existing high lateral stress fields, to predict the potential stresses, movements and distortions of the station cavern, shafts and tunnels as a result of the basement excavation and subsequent application of building loads.

6.2 Numerical modelling

Numerical modelling is required to predict any changes in existing stress regime and associated shear displacements along bedding planes/cross-beds and their impact on the permanent caverns /tunnel support system.

The additional loading imposed by the proposed building is not expected to be critical on the ECRL supports systems due the separation distance between the building foundations and the ECRL infrastructure.

However, the proximity of basement excavation to the ECRL support zone may induce some adverse displacements due to the unloading of the overburden. This may impact on the capacity and durability of the permanent support elements such as cable bolts, rockbolts and concrete lining.

As part of the design development we propose to study the impacts by numerical modelling which will generally involve:

- development of the geological model of the proposed site based on the site investigation works and incorporating the geological model into the as built geological model of the ECRL project
- modelling representative sections for the numerical analysis. The representative sections will include the proposed basement excavations, the subsequent application of building loads and considerations of existing displacement impacts on station support systems
- adoption of the same geotechnical design parameters previously used by PB for the design of Macquarie Park station modified to take of account the back-analysis of Macquarie Park Station based on the instrumentation monitoring carried out during construction
- assessment of the impact of the proposed construction sequence on the station caverns and tunnel support system
- checking of bedding plane shears induced by the proposed works
- assessment of the impact of the induced deformations and associated stresses on the cavern and tunnel support system

- review of changes in bolt loads to see whether more detailed modelling is required
- recommend a monitoring regime
- provide conclusions regarding the acceptability of the proposed development

6.3 Monitoring Plan

A detailed monitoring plan will have to be done during the design stage to address the required monitoring programme of the works. The primary objective of the monitoring is to confirm the predictive results of the numerical modelling. Additionally it will provide a response action plan if the set triggers are breeched.

7. Limitations

This report has been prepared on behalf of Winten Property Group and Australand to address specific project requirements. By necessity, this report has been limited to a conceptual assessment of the geotechnical and structural constraints associated with development in close proximity to the ECRL infrastructure. At the outline in the report detail assessment of these issues would be required at design development stage.

Additional to providing the Geotechnical and Structural Assessment report, Winten Property Group and Australand will provide an undertaking to study the noise and vibration impacts and the electrolysis impacts as per the Interim Guidelines in the project application stage of the development.

The proposed ECRL infrastructure details have been sourced from PB in-house records. At the time of writing this report no further information was provided by RailCorp, hence the details are limited in its accuracy and will be subject to further review during the design stage.

8. References

1. Hewitt, Burkitt & Baskaran, *Design and Construction of Retaining Structures for Lane Cove Tunnels.*
2. Glastonbury & Fell (2002). *Report on the analysis of the deformation behaviour of excavated rock slopes*. UNICIV Report R403, UNSW.
3. Chan & Stone (2005), Back-analysis of monitoring results at Macquarie Park Station, Epping to Chatswood Rail Line.
4. Rozek (2004) – *Parramatta Rail Link – Design and Construction.*

Appendix A

Site Plan and Cross -section

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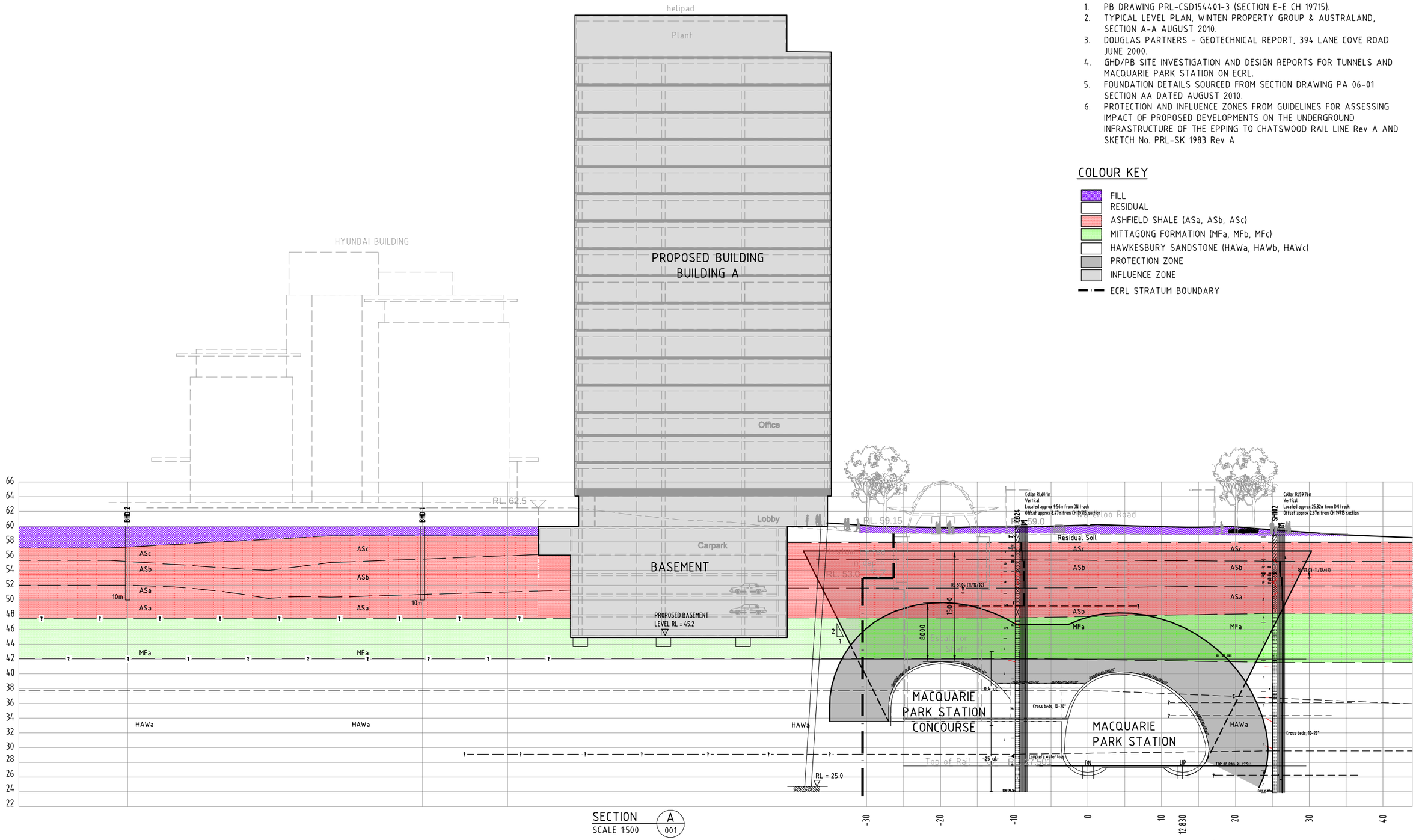

SECTION A
SCALE 1:500
001

SOURCE:

1. PB DRAWING PRL-CSD154401-3 (SECTION E-E CH 19715).
2. TYPICAL LEVEL PLAN, WINTEN PROPERTY GROUP & AUSTRALAND, SECTION A-A AUGUST 2010.
3. DOUGLAS PARTNERS - GEOTECHNICAL REPORT, 394 LANE COVE ROAD JUNE 2000.
4. GHD/PB SITE INVESTIGATION AND DESIGN REPORTS FOR TUNNELS AND MACQUARIE PARK STATION ON ECRL.
5. FOUNDATION DETAILS SOURCED FROM SECTION DRAWING PA 06-01 SECTION AA DATED AUGUST 2010.
6. PROTECTION AND INFLUENCE ZONES FROM GUIDELINES FOR ASSESSING IMPACT OF PROPOSED DEVELOPMENTS ON THE UNDERGROUND INFRASTRUCTURE OF THE EPPING TO CHATSWOOD RAIL LINE Rev A AND SKETCH No. PRL-SK 1983 Rev A

COLOUR KEY

- FILL
- RESIDUAL
- ASHFIELD SHALE (ASa, ASb, ASc)
- MITTAGONG FORMATION (MFa, MFb, MFc)
- HAWKESBURY SANDSTONE (HAWa, HAWb, HAWc)
- PROTECTION ZONE
- INFLUENCE ZONE
- ECRL STRATUM BOUNDARY

INFORMATION ONLY

50mm AT FULL SIZE

REV	DATE	DESCRIPTION	DRAWN	CHECK	DESIGN	VERIFY
A	27.08.10	REPORT	PX	RL	JM	PH

SCALES
0 5 10 15
Full Size 1:500 A3;
SCALE (m)

A3 ORIGINAL
DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY
VERIFY ALL DIMENSIONS ON SITE

APPROVED FOR AND ON BEHALF OF
PARSONS BRINCKERHOFF AUSTRALIA PTY LIMITED

SIGNED

DATE

PARSONS BRINCKERHOFF
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Sydney NSW 2000
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Australia
ABN 80 078 004 798
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Email: sydney@pb.com.au

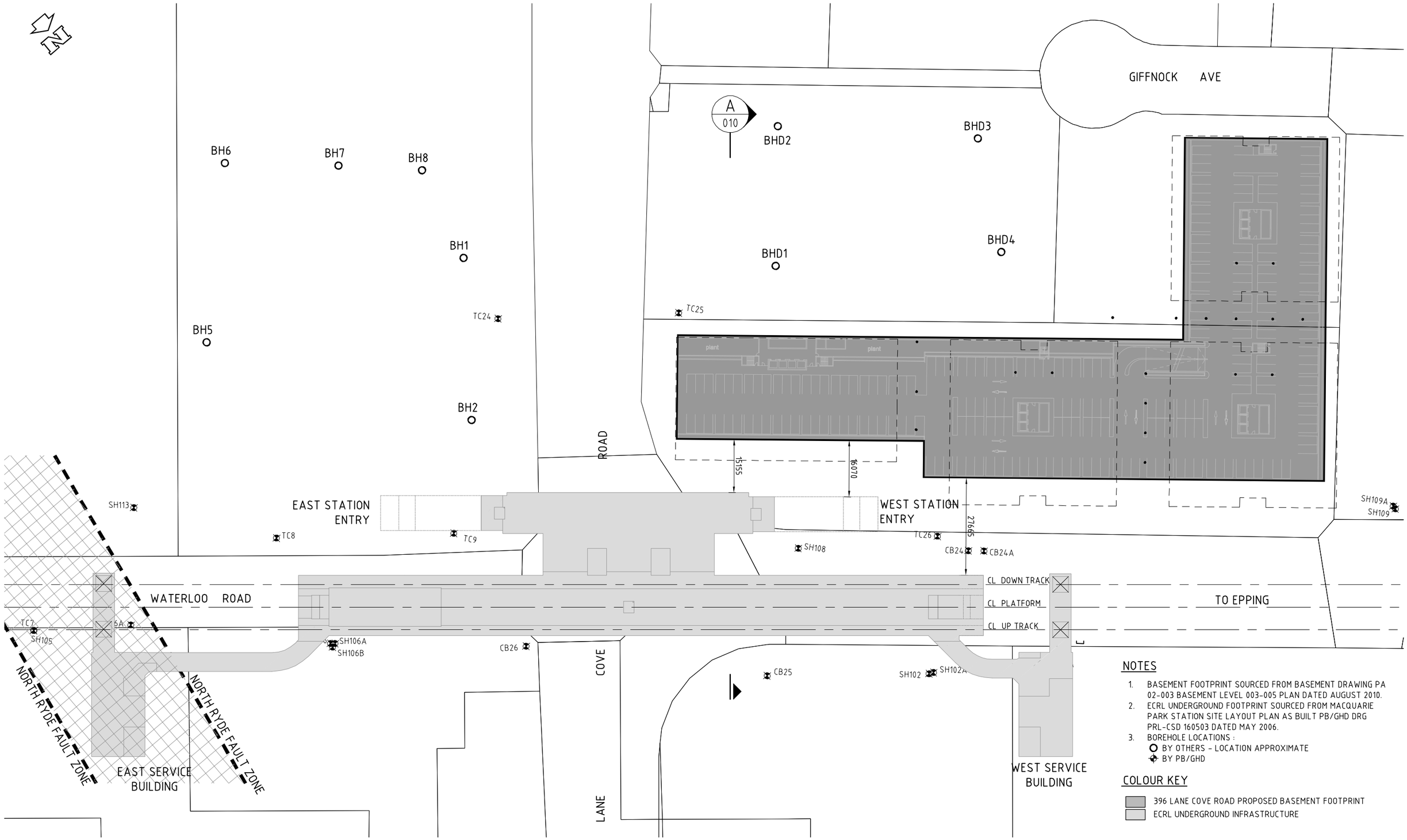
CLIENT
WINTEN PROPERTY GROUP
AUSTRALAND

PROJECT
396 LANE COVE ROAD MACQUARIE PARK
GEOTECHNICAL SECTION

PROJECT No.	DISCIPLINE	NUMBER	REV.
2108235A	- GEO -	010	A

Plotted By: xup Plot Date: 27/08/10 - 10:42 Cad File: \\APSYDFIL01\proj\W\Winten_Property_Group\2108235A_396_LANE_COVE_ROAD\09_CADD\Drawings\2108235A-GEO-010.dwg

2108235A-GEO-001



SITE LAYOUT PLAN

SCALE: 1:1000

NOTES

1. BASEMENT FOOTPRINT SOURCED FROM BASEMENT DRAWING PA 02-003 BASEMENT LEVEL 003-005 PLAN DATED AUGUST 2010.
2. ECRL UNDERGROUND FOOTPRINT SOURCED FROM MACQUARIE PARK STATION SITE LAYOUT PLAN AS BUILT PB/GHD DRG PRL-CSD 160503 DATED MAY 2006.
3. BOREHOLE LOCATIONS :
   - ○ BY OTHERS - LOCATION APPROXIMATE
   - ⌖ BY PB/GHD

COLOUR KEY

- 396 LANE COVE ROAD PROPOSED BASEMENT FOOTPRINT
- ECRL UNDERGROUND INFRASTRUCTURE

INFORMATION ONLY

50mm AT FULL SIZE

REV	DATE	DESCRIPTION	DRAWN	CHECK	DESIGN	VERIFY
A	27.08.10	REPORT	PX	RL	JM	PH

SCALES
0 10 20 30
Full Size 1:1000 A3
SCALE (m)

A3 ORIGINAL
DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY
VERIFY ALL DIMENSIONS ON SITE

APPROVED FOR AND ON BEHALF OF
PARSONS BRINCKERHOFF AUSTRALIA PTY LIMITED

SIGNED

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CLIENT
WINTEN PROPERTY GROUP
AUSTRALAND

PROJECT
396 LANE COVE ROAD MACQUARIE PARK
PROPOSED BASEMENT FOOTPRINT PLAN
SHOWING BOREHOLE LOCATIONS

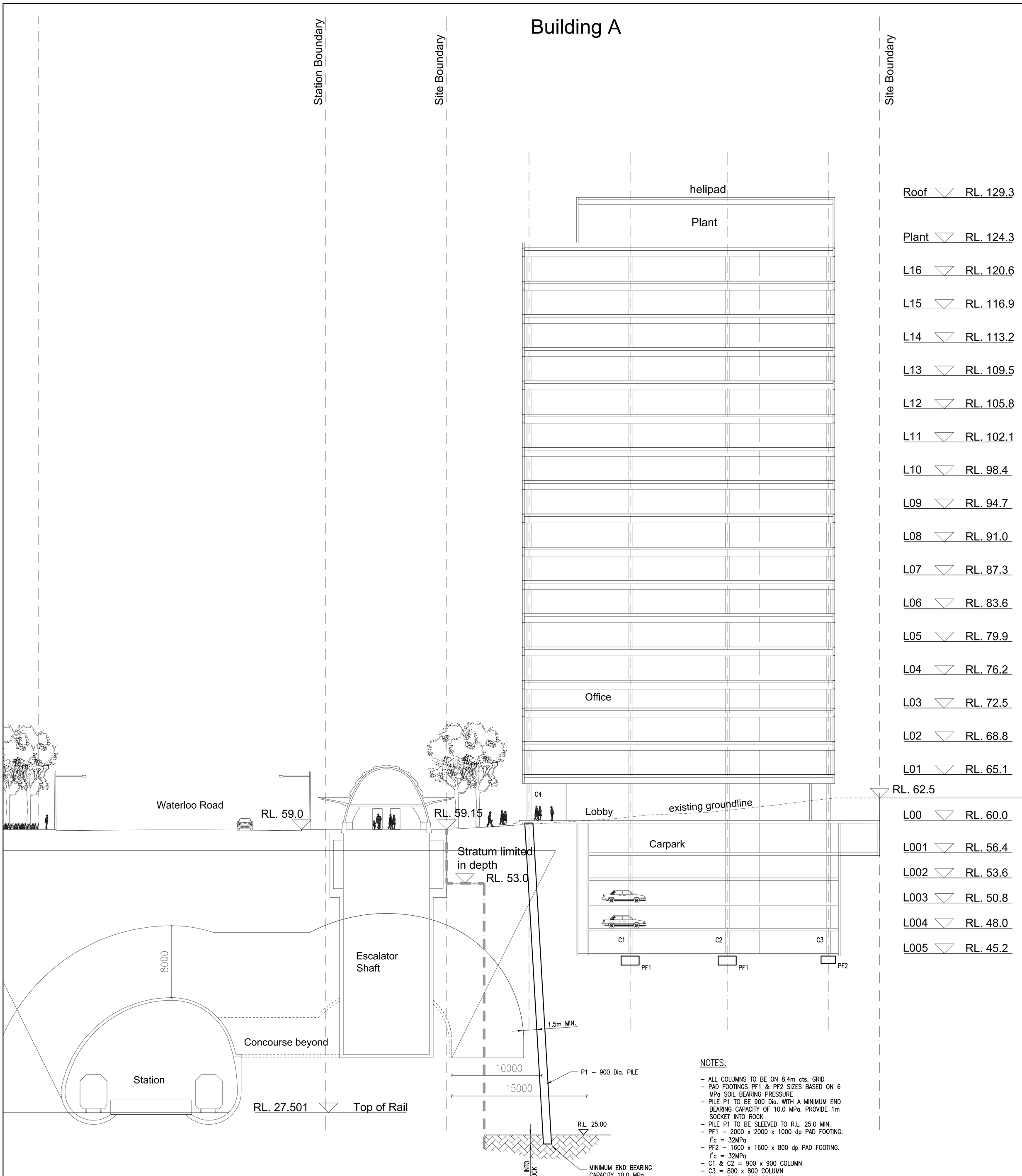
PROJECT No.	DISCIPLINE	NUMBER	REV.
2108235A	GEO	001	A

Plotted By: xup Plot Date: 27/08/10 - 10:44 Cad File: \\APSYDFIL01\proj\W\Winten_Property_Group\2108235A_396_LANE_COVE_ROAD\09_CADD\Drawings\2108235A-GEO-001.dwg

Appendix B

Enstruct – Engineer Drawings

Building A



NOTES:

- ALL COLUMNS TO BE ON 8.4m cts. GRID
- PAD FOOTINGS PF1 & PF2 SIZES BASED ON 6 MPa SOIL BEARING PRESSURE
- PILE P1 TO BE 900 Dia. WITH A MINIMUM END BEARING CAPACITY OF 10.0 MPa. PROVIDE 1m SOCKET INTO ROCK
- PILE P1 TO BE SLEEVED TO R.L. 25.0 MIN.
- PF1 – 2000 x 2000 x 1000 dp PAD FOOTING. f'c = 32MPa
- PF2 – 1600 x 1600 x 800 dp PAD FOOTING. f'c = 32MPa
- C1 & C2 = 900 x 900 COLUMN
- C3 = 800 x 800 COLUMN
- C4 = 700 x 700 COLUMN

rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

drawing title
BUILDING A
SECTION

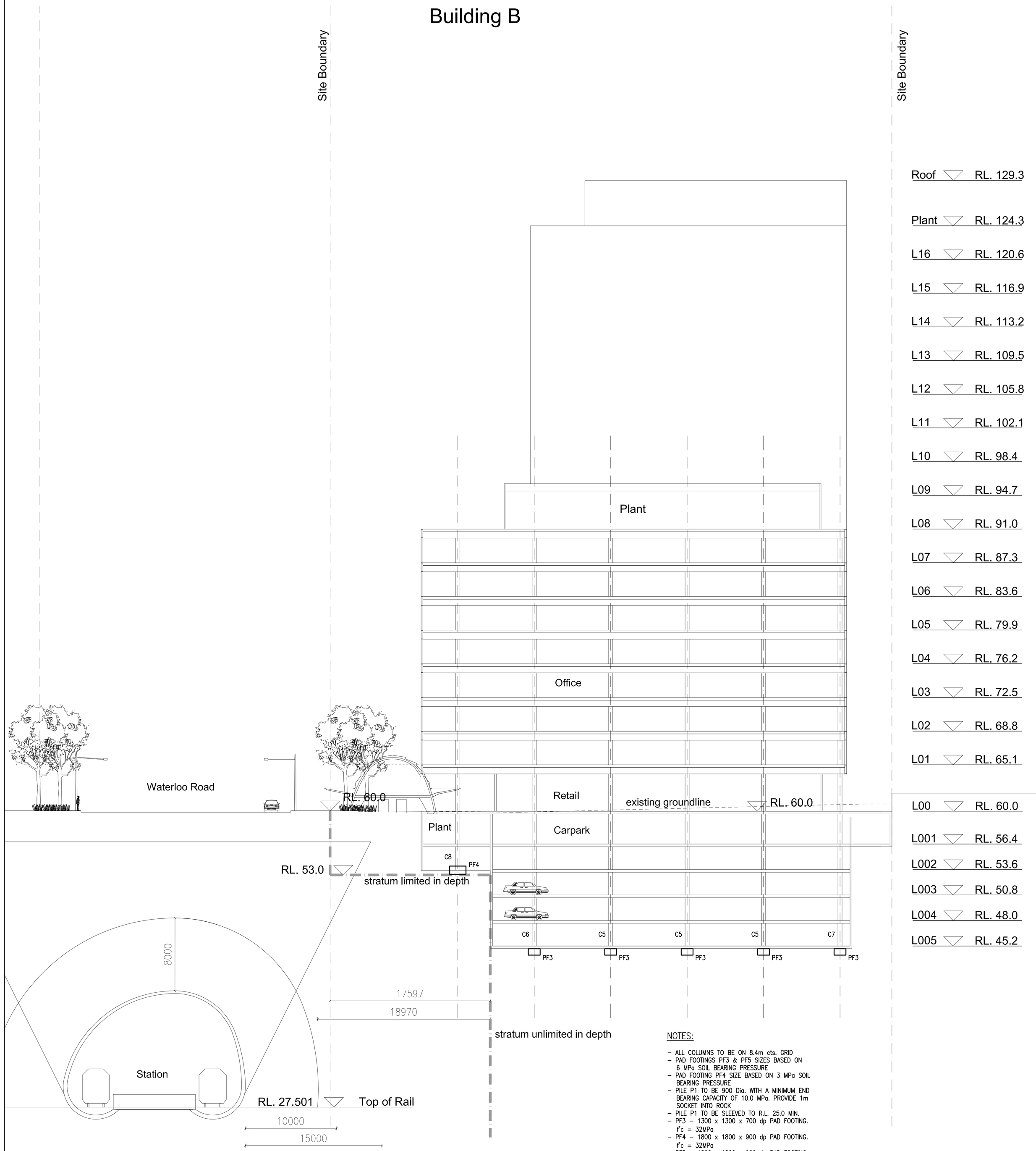
status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-A	02

A1

Building B



NOTES:

- ALL COLUMNS TO BE ON 8.4m cts. GRID
- PAD FOOTINGS PF3 & PF5 SIZES BASED ON 6 MPa SOIL BEARING PRESSURE
- PAD FOOTING PF4 SIZE BASED ON 3 MPa SOIL BEARING PRESSURE
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- PILE P1 TO BE SLEEVED TO R.L. 25.0 MIN.
- PF3 – 1300 x 1300 x 700 dp PAD FOOTING. f'c = 32MPa
- PF4 – 1800 x 1800 x 900 dp PAD FOOTING. f'c = 32MPa
- PF5 – 1800 x 1800 x 900 dp PAD FOOTING. f'c = 32MPa
- C5, C6 & C7 = 700 x 700 COLUMN
- C8 = 600 x 600 COLUMN

rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

drawing title
BUILDING B
SECTION
PAD OPTION

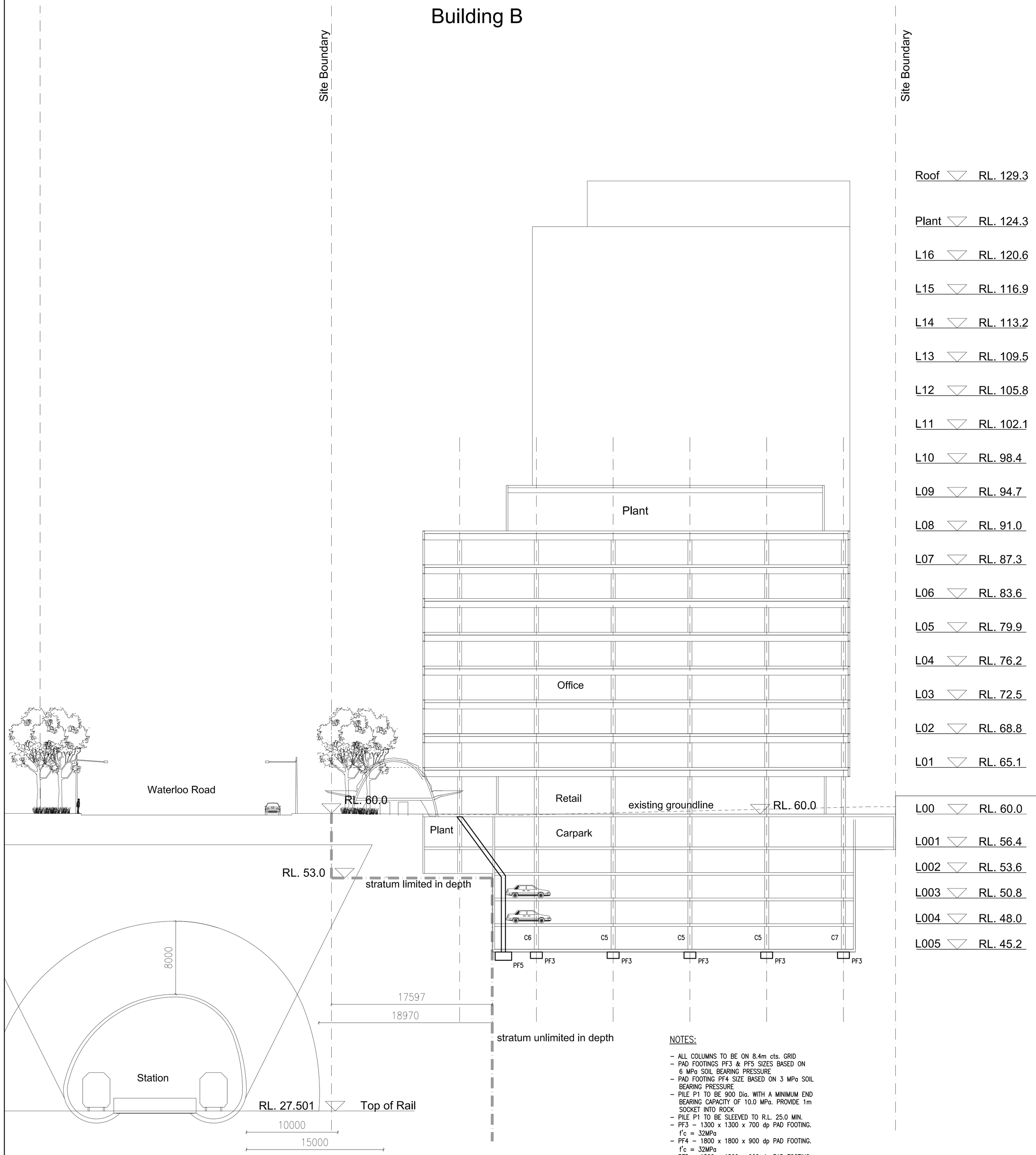
status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-B-2	02

A1

Building B



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- C8 = 600 x 600 COLUMN

rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

drawing title
BUILDING B
SECTION
COLUMN OPTION

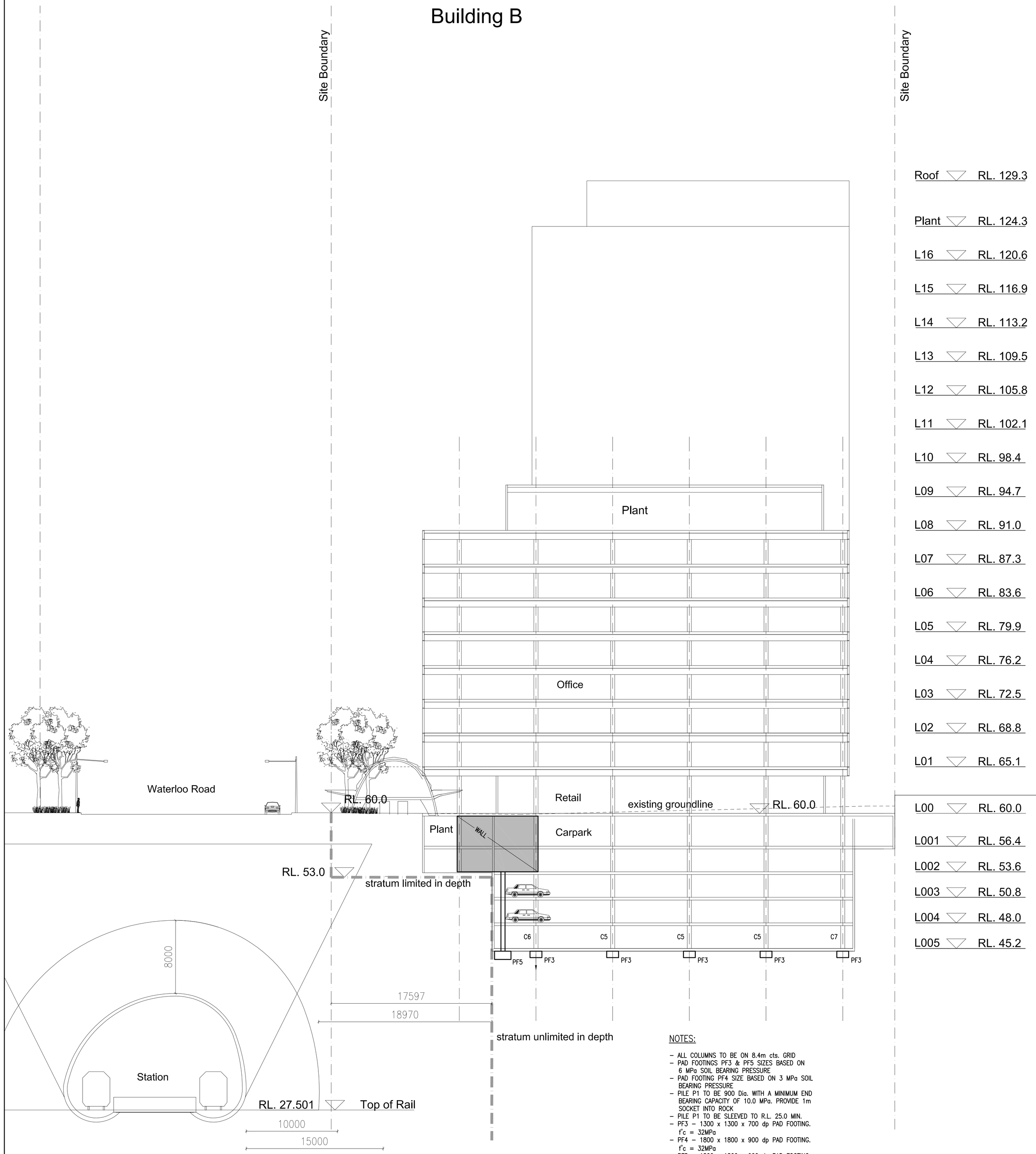
status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-B-3	02

A1

Building B



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- PF5 – 1800 x 1800 x 900 dp PAD FOOTING. f'c = 32MPa
- C5, C6 & C7 = 700 x 700 COLUMN
- C8 = 600 x 600 COLUMN

rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

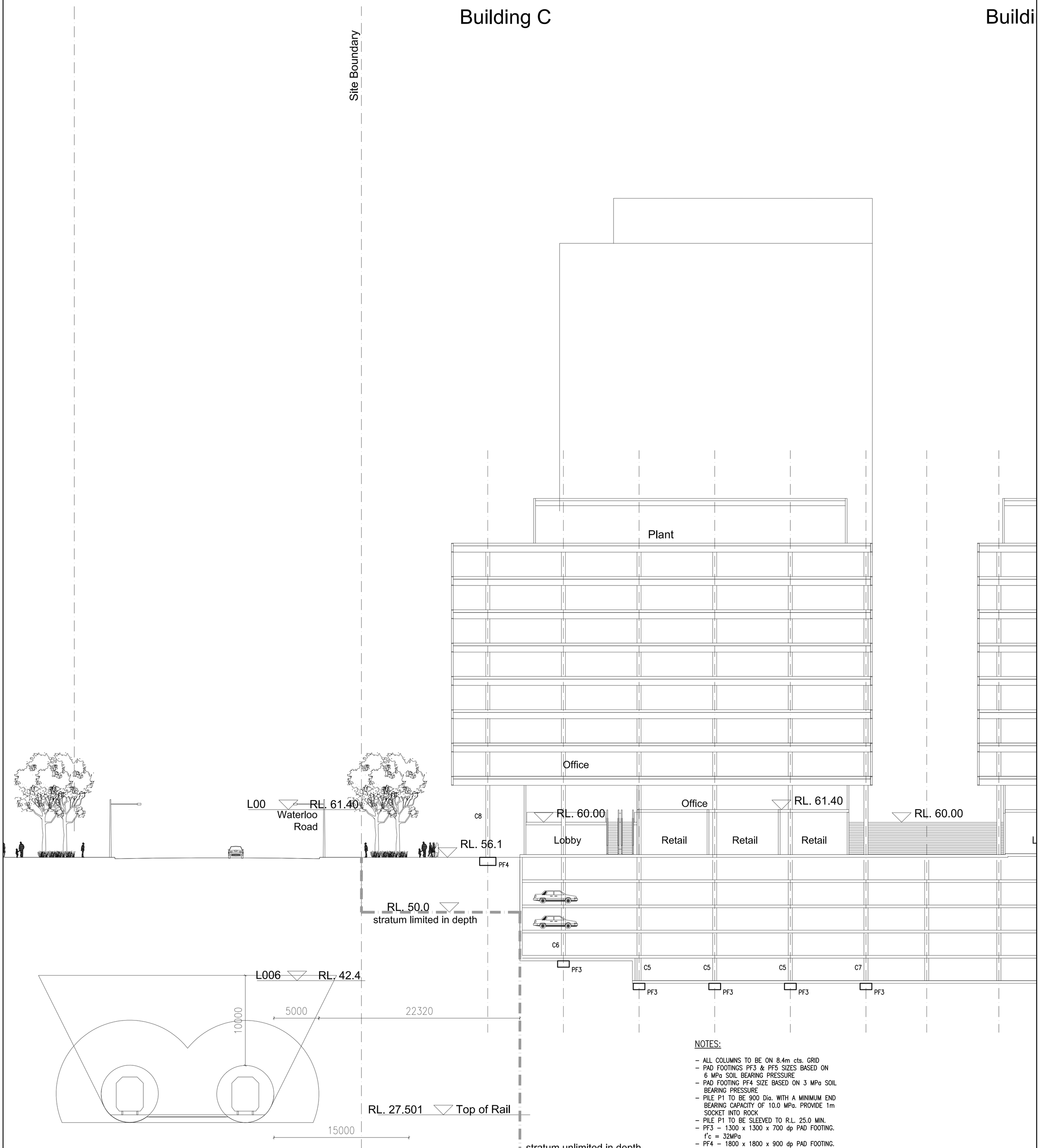
drawing title
BUILDING B
SECTION
BLADE WALL OPTION

status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-B-4	02

A1



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- PF5 – 1800 x 1800 x 900 dp PAD FOOTING. f'c = 32MPa
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- C8 = 600 x 600 COLUMN

rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

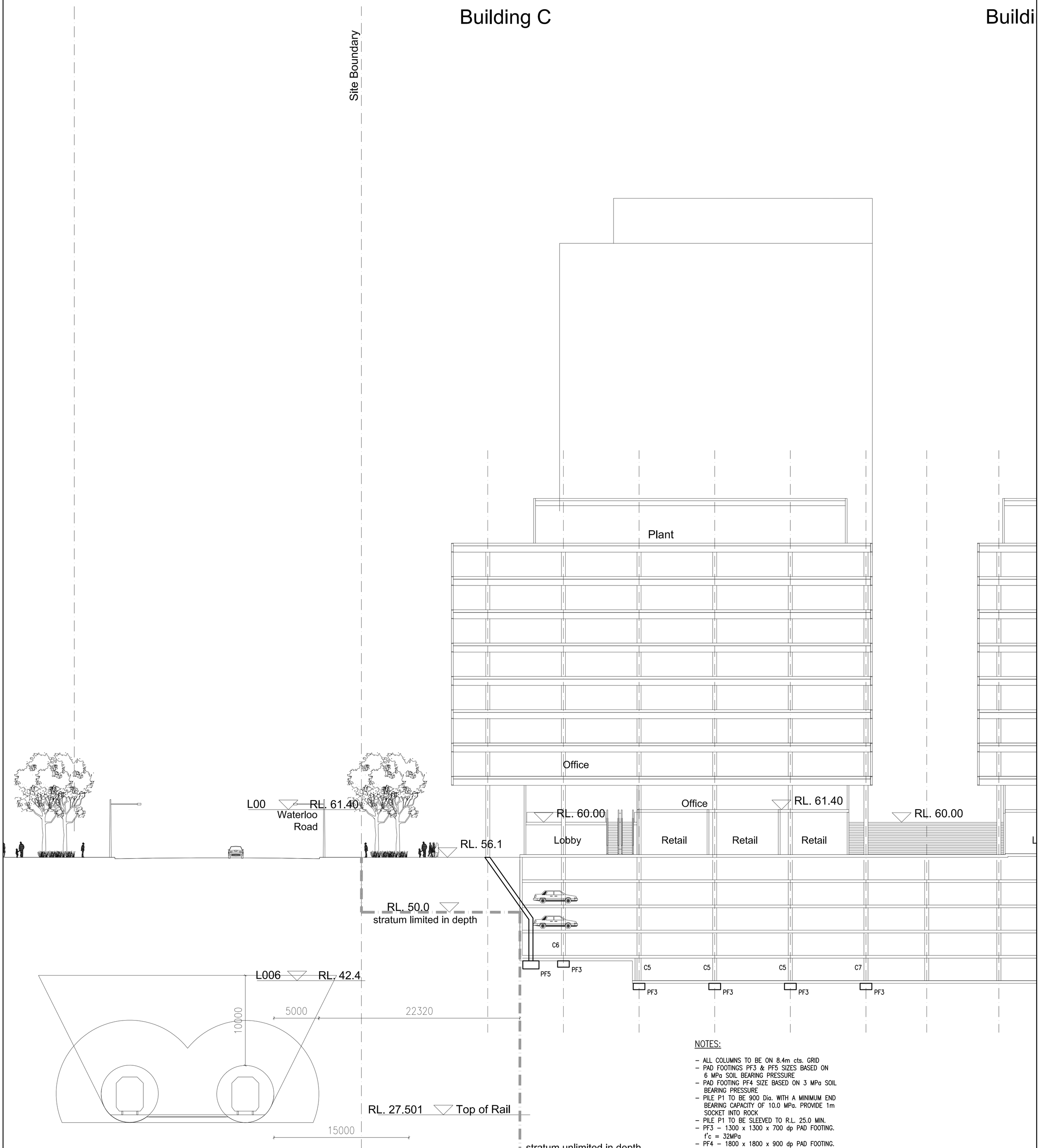
drawing title
BUILDING C
SECTION
PAD OPTION

status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-C-2	02

A1



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rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

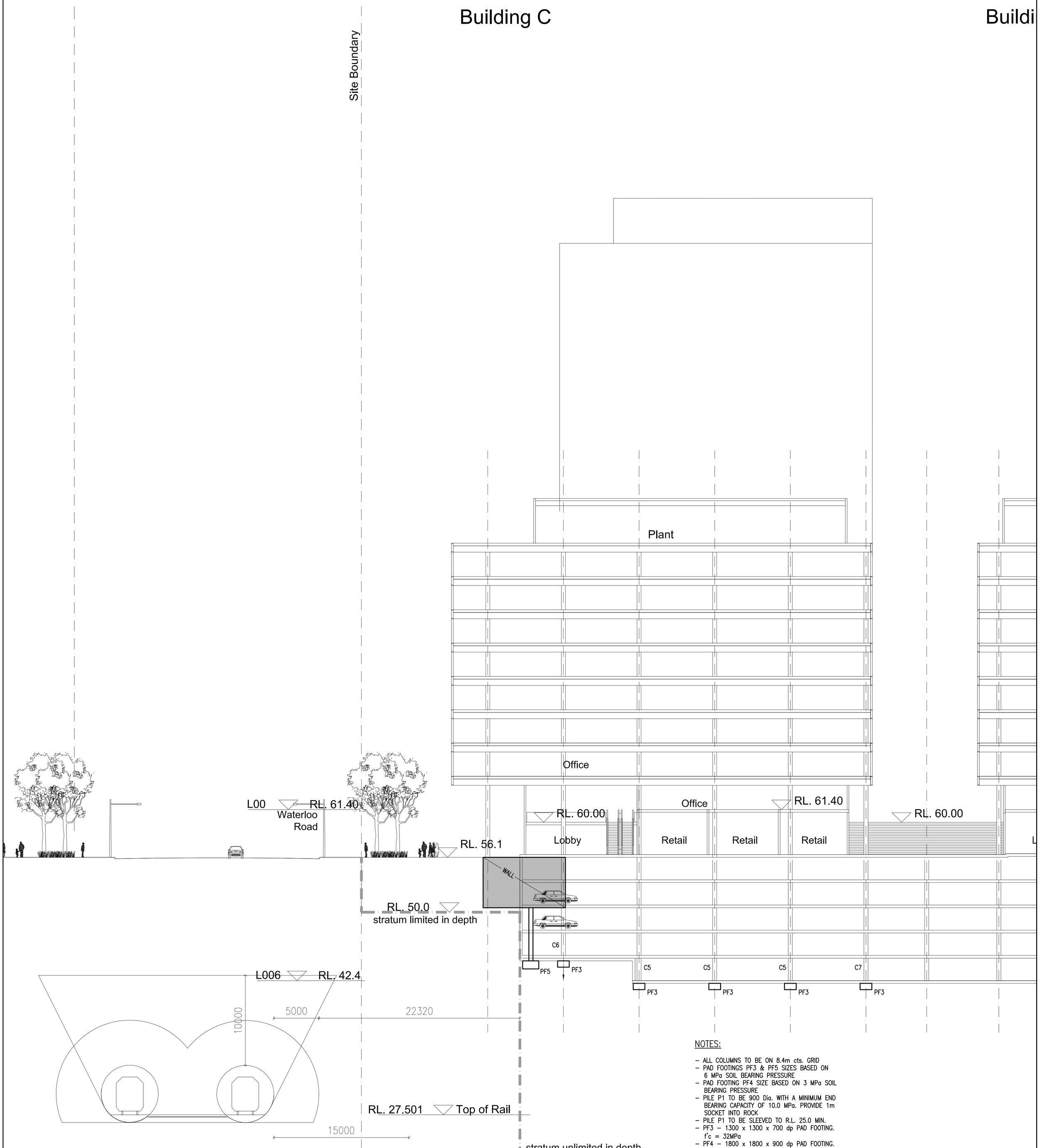
drawing title
BUILDING C
SECTION
COLUMN OPTION

status
PRELIMINARY

scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-C-3	02

A1



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rev	date	description	drn	ch'k
02	25.08.10	PRELIMINARY	ML	CM
01	23.07.10	PRELIMINARY	ML	CM

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project
Macquarie Park Commerce Centre
Waterloo Road
Macquarie Park

drawing title
BUILDING C
SECTION
WALL OPTION

status
PRELIMINARY

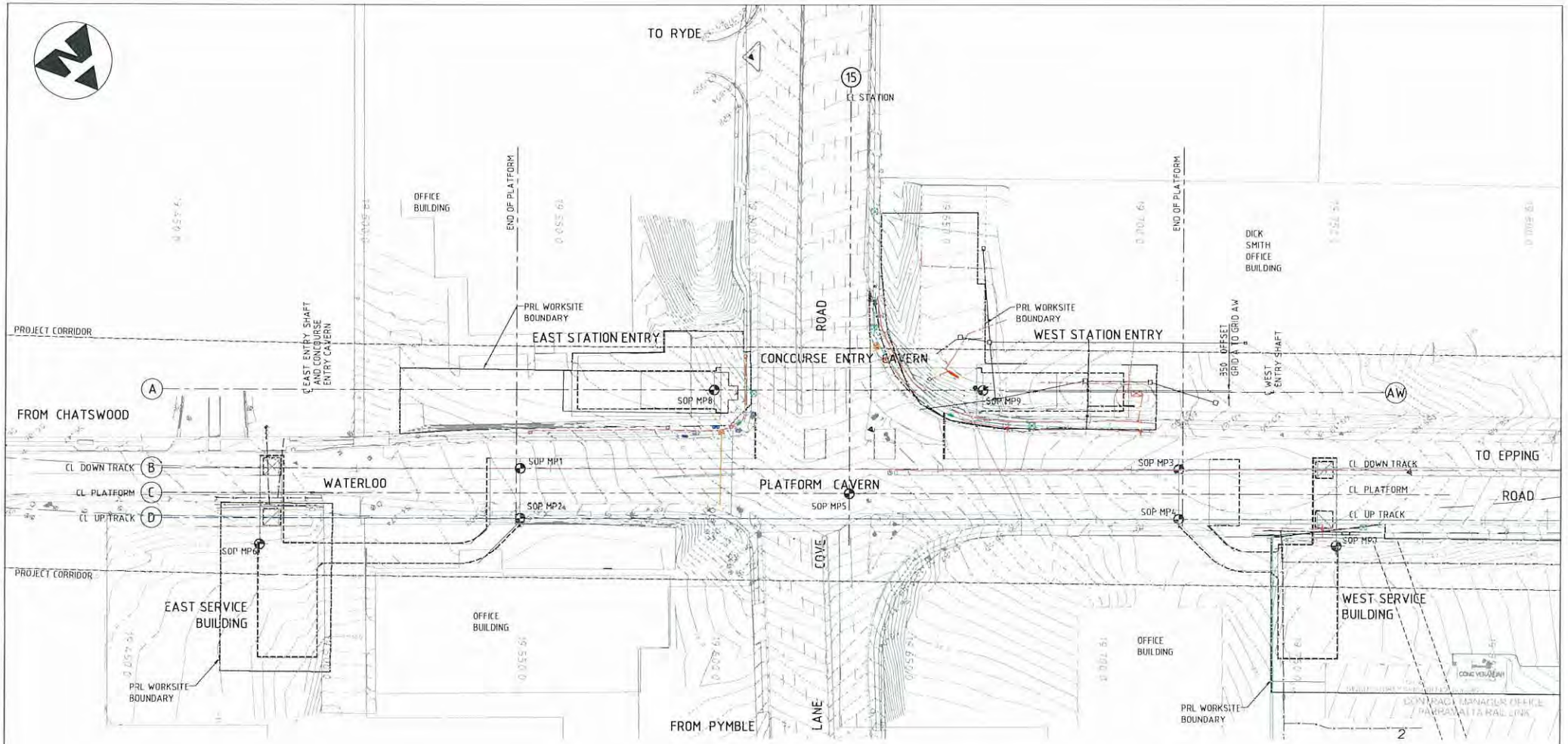
scale at A1	drawn by	checked	date
1:200	ML	BK	JULY 2010

project no.	drawing no.	rev.
4072	SK-C-4	02

A1

Appendix C

Epping to Chatswood Rail Link – As built drawings



MACQUARIE PARK STATION

NOTE

1 FOR LOCATION OF SERVICES REFER DRG No PRL-CSD164804

ALL COORDINATES TO MGA

AS BUILT

A1 1:500
A3 1:1000

0 10 20 30m
10 5

REV	BY	DATE	DESCRIPTION	APPD
4	GS	040805	AS BUILT	GE
3	SPG	080404	WEST ENTRY SHAFT MOVED, GRID ADDED	DW
2	EMJ	161003	NOTE ADDED	DW
1	EMJ	180603	ISSUED FOR CONSTRUCTION	DW

GHD
PARSONS BRINCKERHOFF
AB

	PREPARED	CHECKED	DESIGN CONSULTANT APPROVED
DESIGN	JMcN		D WUNDER
DRAWN	MPR	GCS	DATE 180603
CAD FILE			C12 A

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Macquarie Park - NSW 2113
Tel 02 9878 6544
Fax 02 9878 6565

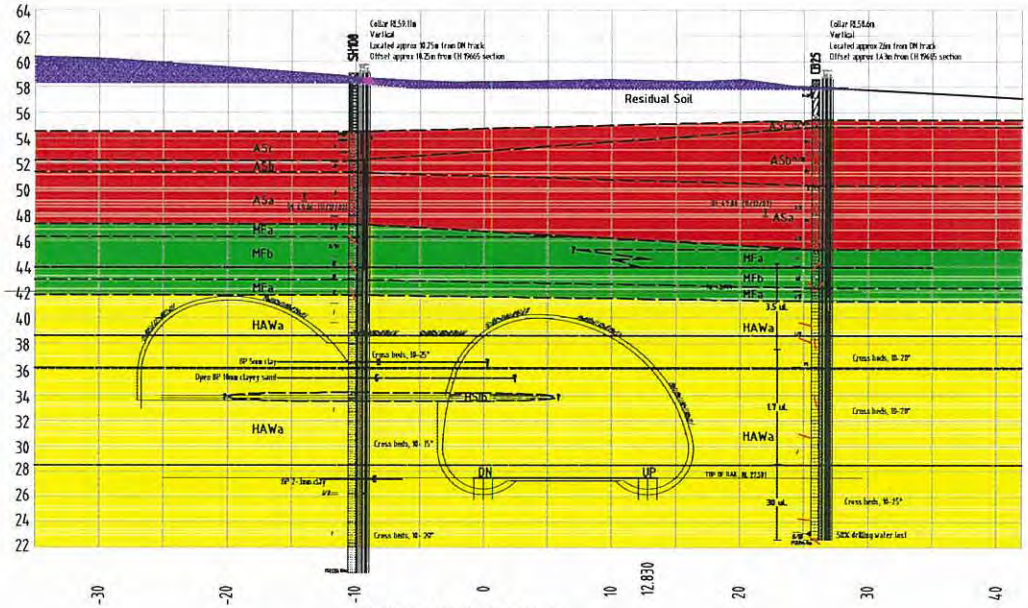
THIESS HOCHTIEF

Parramatta Rail Link
A NSW GOVERNMENT INITIATIVE

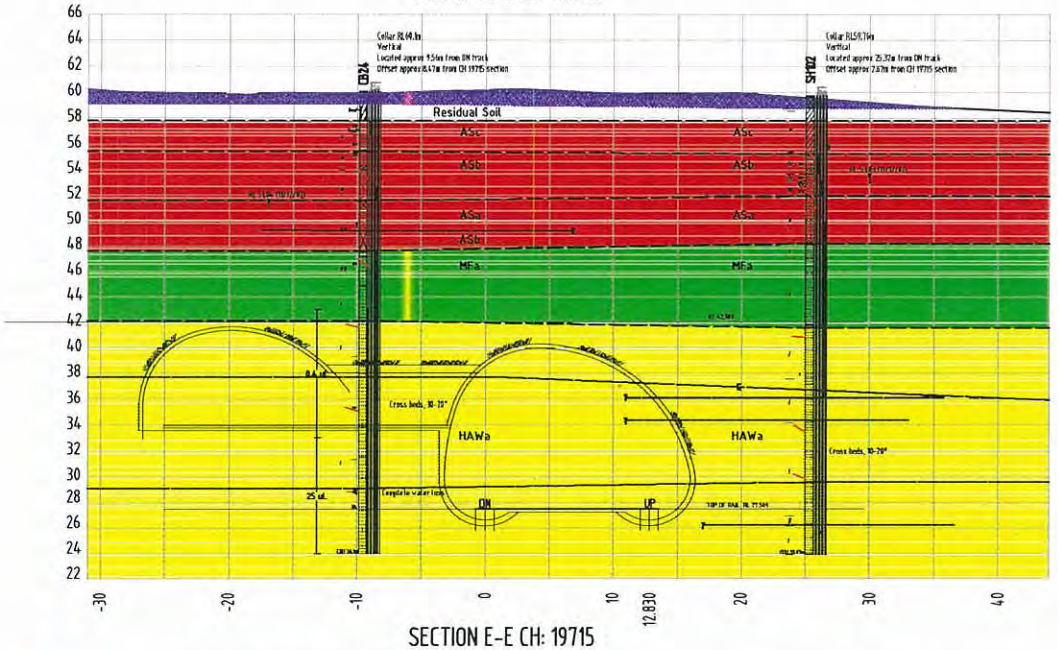
PARRAMATTA RAIL LINK

DRAWING TITLE
MACQUARIE PARK STATION
SITE LAYOUT
PLAN

SCALE	DRG NO.	REV
A1 1:500	PRL-CSD160503	4



SECTION D-D CH: 19665



SECTION E-E CH: 19715

NOTES

1. REFER TO DRAWING PRL-CSD104401 FOR SYMBOL NOTES AND EXPLANATIONS.
2. FOR SECTION LOCATIONS REFER TO DRAWING PRL-CSD164400.
3. THESE SECTIONS ARE INTERPRETIVE REPRESENTATIONS AND HAVE BEEN USED AS A BASIS FOR GEOTECHNICAL MODELLING IN CONJUNCTION WITH A FACILITY OVERLAY. PROMINANT STRUCTURAL UNITS AND FEATURES ARE SHOWN CONCEPTUALLY. FOR FURTHER DETAILS REFER TO INDIVIDUAL BOREHOLE LOGS AND GEOTECHNICAL REPORTS ON THIS FACILITY.

COLOUR KEY

- FILL
- ASHFIELD SHALE
- MITTAGONG FORMATION
- HAWKESBURY SANDSTONE

(1:200 for A1 Size Plot)

AS BUILT

REV	BY	DATE	DESCRIPTION	APPD
4	GS	04/08/05	AS BUILT	GE
3	DMS	21/04/05	AMENDED AS CLOUDED	DW
2	DMS	28.04.05	AMENDED AS CLOUDED	DW
1	JH	14/07/04	APPROVED FOR CONSTRUCTION	DW

GHD
PARSONS BRINCKERHOFF
AB

	PREPARED	CHECKED	DESIGN CONSULTANT APPROVED
DESIGN	DW	GPK	D.WUNDER
DRAWN	JH	GPK	DATE 14/07/04

CAD FILE C12 A

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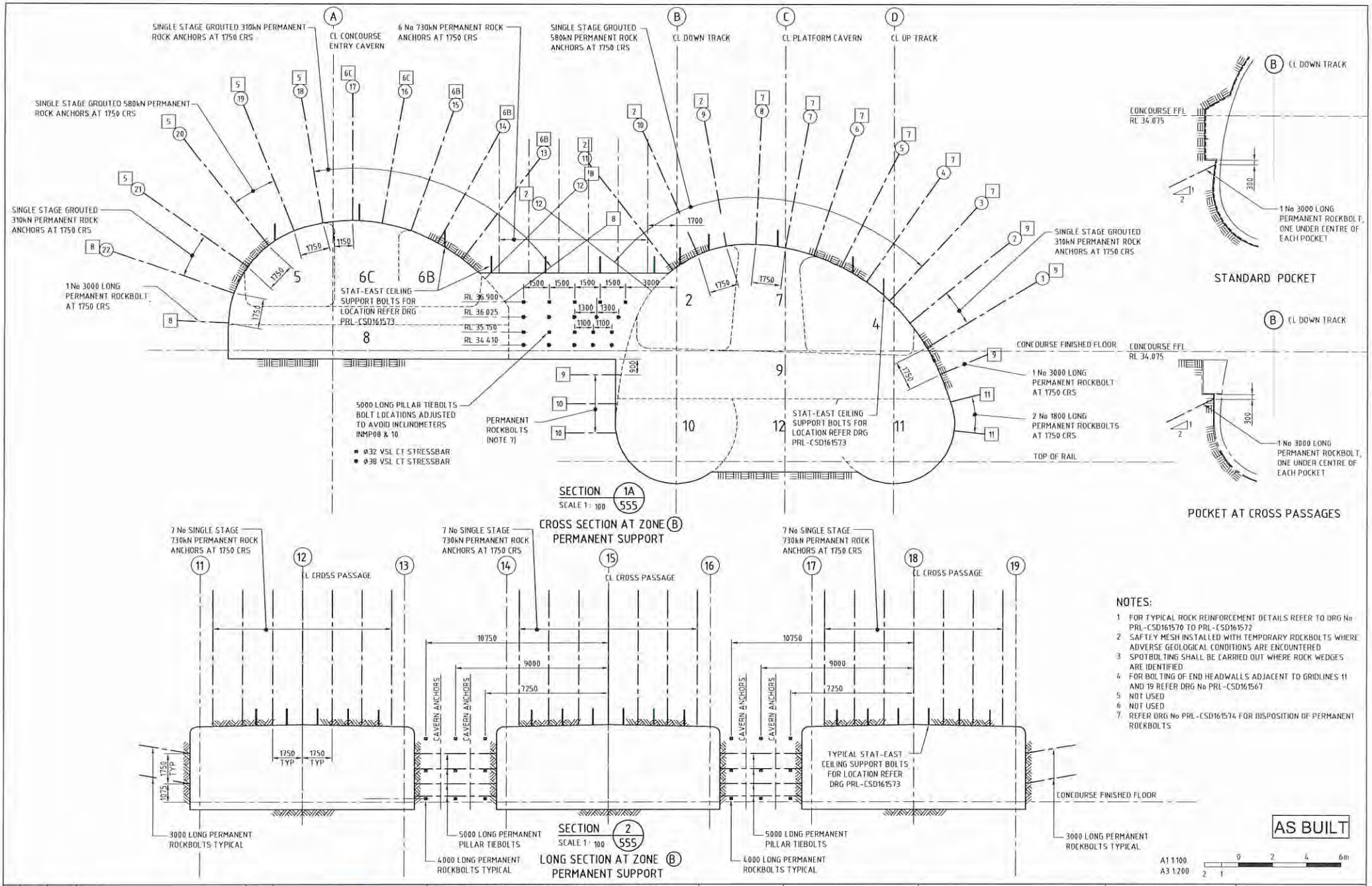
THIESS HOCHTIEF

Parramatta Rail Link
A NSW GOVERNMENT INITIATIVE

PARRAMATTA RAIL LINK

DRAWING TITLE
MACQUARIE PARK STATION
CROSS SECTIONS D-D AND E-E

SCALE	DRG NO.	REV
A1 1:200	PRL-CSD164403	4



REV	BY	DATE	DESCRIPTION	APPD
6	GS	040815	AS BUILT	CE
5	EMJ	271103	MINOR AMENDMENTS, PERMANENT ROCKBOLTS REVISED (RFI 002365)	DW
4	GCS	270803	STAT-EAST BOLTING REVISED	DW
3	SPG	200703	STAT-EAST & BOLTING REVISIONS	DW
2	PRW	270603	PILLAR DIMS. CLARIFIED	DW
1	EMJ	180603	ISSUED FOR CONSTRUCTION	DW

GHD
PARSONS BRINCKERHOFF
AB

THE INFORMATION SHOWN ON THIS DRAWING IS FOR THE PURPOSES OF THE PARRAMATTA RAIL LINK PROJECT ONLY. NO WARRANTY IS GIVEN OR IMPLIED AS TO ITS SUITABILITY FOR ANY OTHER PURPOSE.

	PREPARED	CHECKED	DESIGN CONSULTANT APPROVED
DESIGN	ES	JMcN	D WUNDER
DRAWN	LKO	GCS	DATE 180603
CAD FILE			C12 A

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THIESS HOCHTIEF

Parramatta Rail Link
A NEW GOVERNMENT INITIATIVE

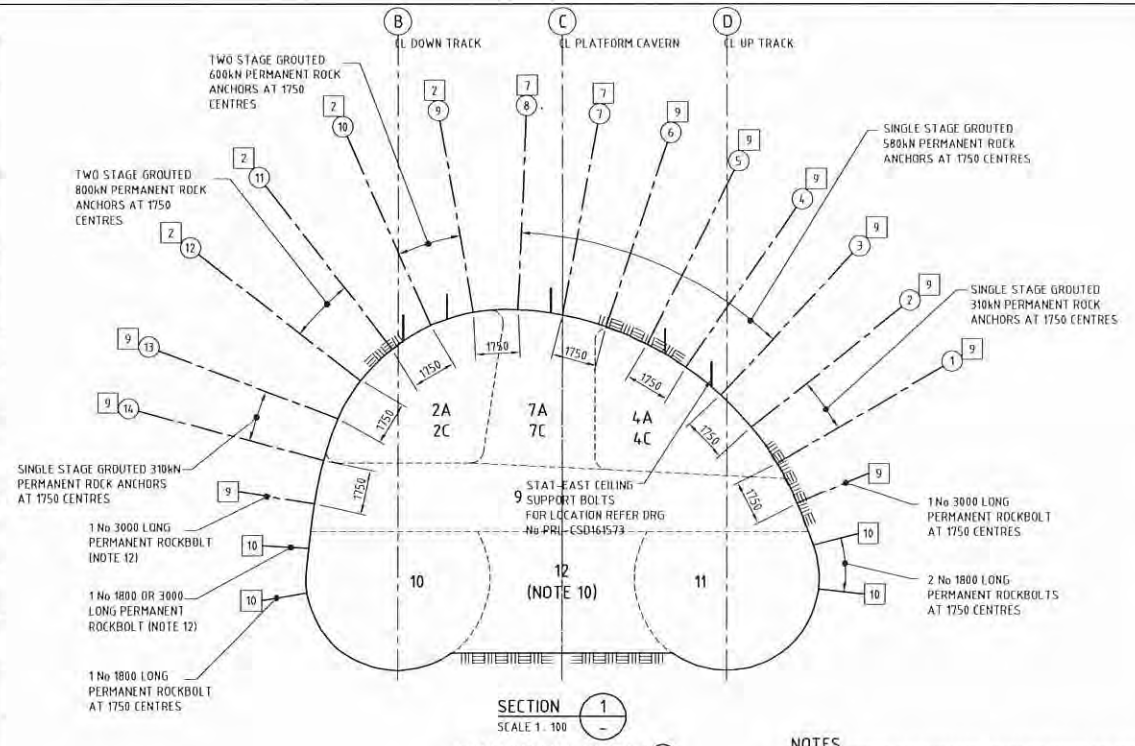
PARRAMATTA RAIL LINK

DRAWING TITLE
MACQUARIE PARK STATION
TYPICAL CAVERN AND CONCOURSE CROSS PASSAGE
PERMANENT ROCK REINFORCEMENT

SCALE	DRG No.	REV
A1 1:100	PRL-CSD161556	6

ROCK SUPPORT SCHEDULE

ROCK REINFORCEMENT	TENDON/BAR DESCRIPTION	EMBEDDED LENGTH	TENDON/BAR DIAMETER	HOLE DIAMETER	MIN ULTIMATE TENSILE CAPACITY (kN)	INITIAL PRE-TENSION LOAD (kN)	GROUTING REQUIREMENTS
SINGLE STAGE GROUTED ANCHOR	SHEATHED BLACK STEEL MULTIPLE STRAND TENDON WITH POLYPROPYLENE SLEEVE GREASED TO FREE LENGTH	7000	TENDON		310	100	MECHANICAL ANCHOR CEMENT GROUT INJECTION TO EMBEDDED LENGTH
SINGLE STAGE GROUTED ANCHOR	SHEATHED BLACK STEEL MULTIPLE STRAND TENDON WITH POLYPROPYLENE SLEEVE GREASED TO FREE LENGTH	7000	TENDON		580	175	MECHANICAL ANCHOR CEMENT GROUT INJECTION TO EMBEDDED LENGTH
SINGLE STAGE GROUTED ANCHOR	SHEATHED BLACK STEEL MULTIPLE STRAND TENDON WITH POLYPROPYLENE SLEEVE GREASED TO FREE LENGTH	7500	TENDON		730	220	MECHANICAL ANCHOR CEMENT GROUT INJECTION TO EMBEDDED LENGTH
TWO STAGE GROUTED ANCHOR	GREASE FILLED SHEATH TO FREE LENGTH BLACK STEEL MULTIPLE STRAND TENDON	7500	TENDON	TO ACCOMMODATE 40 ROCK SHEAR	600	175	MECHANICAL ANCHOR CEMENT GROUT INJECTION TO ANCHORAGE LENGTH, FREE LENGTH GROUTED LATER
TWO STAGE GROUTED ANCHOR	GREASE FILLED SHEATH TO FREE LENGTH BLACK STEEL MULTIPLE STRAND TENDON	8000	TENDON	TO ACCOMMODATE 40 ROCK SHEAR	800	240	MECHANICAL ANCHOR CEMENT GROUT INJECTION TO ANCHORAGE LENGTH, FREE LENGTH GROUTED LATER
PERMANENT ROCKBOLT	SHEATHED THREADBAR	VARIES	24	45	300	60	RESIN END-ANCHORAGE /MECHANICAL ANCHOR CEMENT GROUT INJECTION TO EMBEDDED LENGTH
TEMPORARY ROCKBOLT	SINGLE BLACK DEFORMED BAR	2700/3000	24	28	310	60	TWO SPEED RESIN ENCAPSULATION
TEMPORARY SPILING BAR (DOWEL)	SINGLE BLACK DEFORMED BAR	2400	24	36	310	–	FULL COLUMN CEMENTITIOUS GROUT INJECTION
PILLAR TIEBOLTS	EPOXY COATED STRESSBAR	5000	32	75	870	250	FULL COLUMN CEMENTITIOUS GROUT INJECTION
STAT-EAST CEILING SUPPORT	STAINLESS STEEL THREADED BAR	1000	20	28	100	–	FULL COLUMN CEMENTITIOUS GROUT
OHW HANGER	STAINLESS STEEL THREADED BAR	1000	20	28	100	–	FULL COLUMN CEMENTITIOUS GROUT

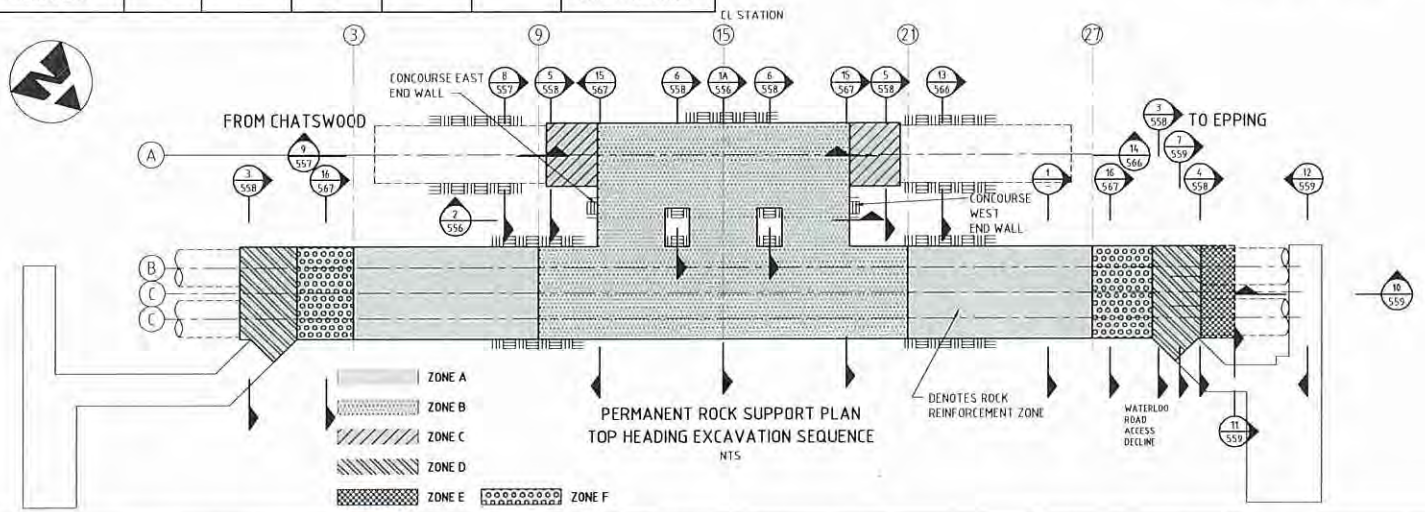


SECTION 1 – SCALE 1 : 100

CROSS SECTION AT ZONE (A)
PERMANENT SUPPORT

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED
NOT USED
2 SPOTBOLTING SHALL BE CARRIED OUT WHERE POTENTIALLY
3 UNSTABLE ROCK WEDGES ARE IDENTIFIED
FOR TYPICAL CAVERN ROCK REINFORCEMENT DETAILS REFER
4 DRG No PRL-CSD161570
ROCKBOLT/ANCHOR DIMENSIONS AND CAPACITIES AS SHOWN ARE
5 MINIMUM
NOT USED
6 SAFETY MESH INSTALLED WITH TEMPORARY ROCKBOLTS WHERE
7 ADVERSE GEOLOGICAL CONDITIONS ARE ENCOUNTERED
NOT USED
8 FOR EACH TRANSFER PASSAGE PILLAR REFER DRG No
9 PRL-CSD161558
SUPPORT OF CENTRE PILLAR, 12, REFER RUNNING TUNNEL
10 DRAWINGS DESIGN PACKAGE C11A
ALL BOLTING ARRAYS AT 1750 CENTRES LONGITUDINALLY. UNO
11 REFER DRG No PRL-CSD161574 FOR SPACING AND DISPOSITION OF
12 PERMANENT ROCKBOLTS IN THIS ROW



PERMANENT ROCK SUPPORT PLAN
TOP HEADING EXCAVATION SEQUENCE
NTS

AS BUILT

A1 1:100
A3 1:200
0 2 1 4 6m

REV	BY	DATE	DESCRIPTION	APPD
6	LMT	11.12.03	AS BUILT	GE
5	AB	150605	NOTE NOT USED	DW
4	CZ	070103	MINOR AMENDMENTS, PERMANENT ROCKBOLTS REVISED (EEI 040365)	DW
3	GCS	270803	STAT-EAST & OHW REVISIONS	DW
2	SPG	280703	STAT-EAST & MINOR BOLTING REVISIONS	DW
1	EMJ	160603	ISSUED FOR CONSTRUCTION	DW

GHD
PARSONS BRINCKERHOFF
AB

	PREPARED	CHECKED	DESIGN CONSULTANT APPROVED
DESIGN	TS	JMcN	D WUNDER
DRAWN	EMJ	GCS	DATE 160603

CAD FILE * ORIGINAL SHEET SIZE ON PLOTTED TITLE
C12 A

Thiess Hochtief Joint Venture
43 Waterloo Road
Macquarie Park - NSW 2113
Tel 02 9878 6544
Fax 02 9878 6585

THIESS HOCHTIEF

Parramatta Rail Link
A NEW GOVERNMENT INITIATIVE

PARRAMATTA RAIL LINK

DRAWING TITLE
MACQUARIE PARK STATION
TYPICAL CAVERN AND CONCOURSE
PERMANENT ROCK REINFORCEMENT

SCALE	DRG NO.	REV
A1 1:100	PRL-CSD161555	6