Attachment A22

Rail Impact Report - 133-145 Castlereagh Street, Sydney

Stockland

Stockland Piccadilly Complex

Impact of Proposed Development on the Adjacent Rail Tunnels

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Appendices

Appendix A

1 Introduction

This Impact Upon Adjacent Rail Tunnels report has been prepared by Arup on behalf of Stockland. It accompanies a planning proposal seeking to initiate the preparation of a Local Environmental Plan amendment for the land known as 'Stockland Piccadilly Complex' located at 133-145 Castlereagh Street, Sydney (the site) legally described as Lot 10 in DP828419, and shown in Figure 1.

Figure 1: 133-145 Castlereagh Street, Sydney – Stockland Piccadilly Complex

The planning proposal seeks to amend the floor space ratio development standard applicable to the site, under the *Sydney Local Environmental Plan 2012* (the LEP), in accordance with Section 3.33 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In accordance with Clause 7.20 of the LEP, this planning proposal also seeks amendments to the *Sydney Development Control Plan 2012* (the DCP) to establish site specific provisions to guide the future development, including establishing a building envelope for the site as well as other key assessment criteria.

The intended outcome of the proposed amendments to the LEP and DCP is to facilitate the redevelopment of the site for a mixed-use commercial development together with basement car parking and associated facilities. Such a proposal aligns with the draft Central Sydney Planning Strategy to facilitate additional

commercial floor space capacity in Central Sydney while also delivering improved public domain outcomes. Such outcomes will include a northerly aligned direct through-site link between Pitt and Castlereagh Street and enhanced pedestrian amenity and activation at the ground plane.

1.1 Subject site

The site currently comprises three buildings known as the 'Piccadilly Complex' completed in 1991 which has been the subject of progressive improvements to upgrade selected elements within the building. The buildings currently occupying the site are detailed in Table 1.

Table 1: Description of existing buildings and improvements

Building	Description
Piccadilly Court	Comprises a 14-storey office building completed in 1975 and first refurbished in 1991 with frontage to Pitt Street.
Piccadilly Shopping Centre	Comprises a 2-storey retail building and the Wesley Mission facilities including the Wesley Church, Lyceum, Wesley Theatre and supporting office space predominately located at basement level. The Wesley Centre facilities comprise the following patron capacity: • Theatre – 950 • Lyceum – 277 • Chapel – 534 A footbridge over Pitt Street connects the building to 55 Market Street to the west.
Piccadilly Tower	Comprises a 31-storey commercial building comprising office floor space and end of trip facilities and four basement levels of car parking accessed from Castlereagh Street. The building includes two lobby spaces, the main Castlereagh Street entrance and a smaller northern entrance to the through site link. A footbridge over Castlereagh Street connects the building to the Sheraton On the Park located to the east of the site.

1.2 Concept Reference Design

To demonstrate that the proposed building envelope is capable of accommodating a viable scheme, a Concept Reference Design accompanies the planning proposal within the Urban Design Study. The Concept Reference Design is indicative only and the final detailed design will be the subject of a competitive design process and detailed development application (DA) which will ultimately result in further refinement. The ground floor plan is shown in Figure 2.

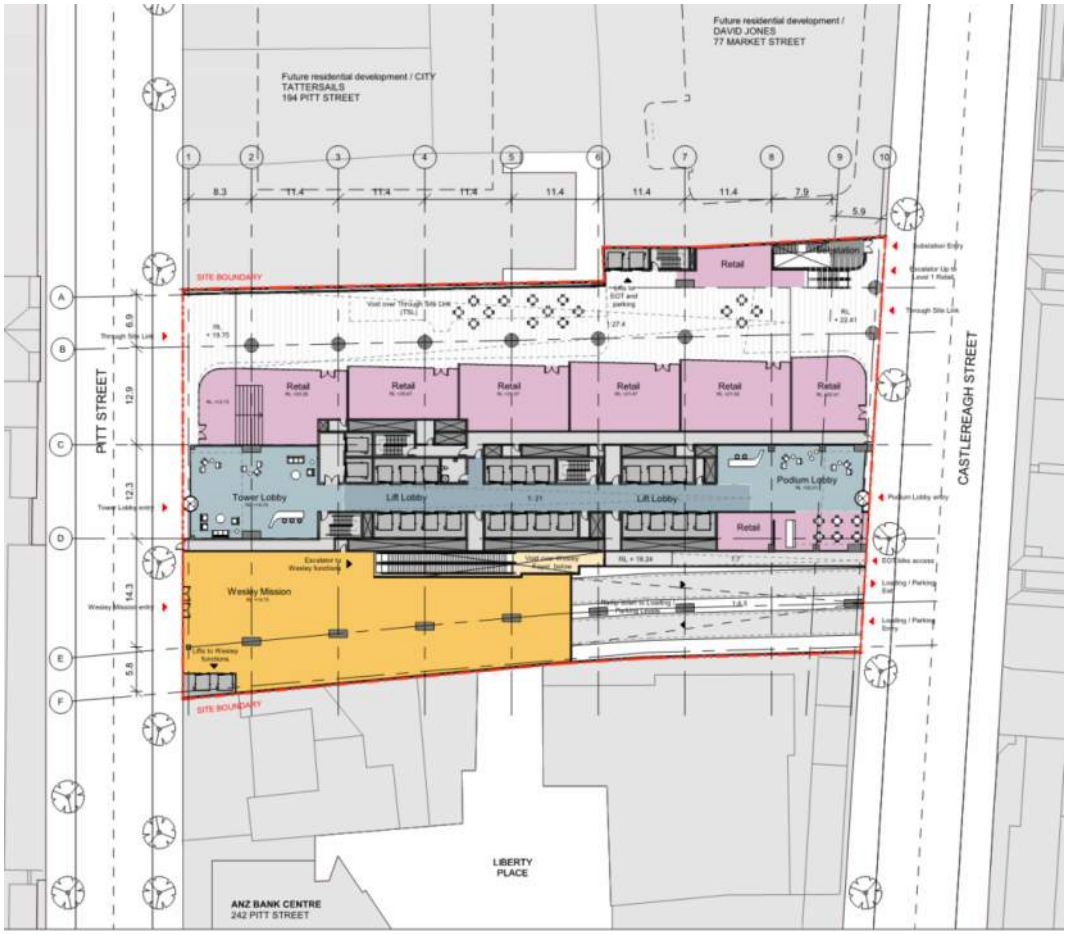

Figure 2: Stockland Piccadilly Complex – Concept Reference Design - Ground plan (3XN, 55001_200805)

The Concept Reference Design includes the following elements:

- Basement car parking and mechanical plant (B05-B03);
- Wesley Mission facilities including the Church, Theatre and Lyceum, and supporting offices (B2-B1);
- End of trip, back of house area and plant (B1);
- A northerly aligned east-west pedestrian through-site link connecting Pitt St and Castlereagh St (L00);
- Podium levels (L00-L09) comprising lobby (L00), retail (L00-L01), commercial (L02-L09) and plant (L09); and
- Tower levels (L10-L34) comprising commercial and plant (L19, L35-L36).

1.3 Purpose of report

The purpose of this report is to provide a review of relevant aspects of the proposed planning amendments and Concept Reference Design, to evaluate their likely suitability, and requirements for future assessment and detailed design. As the planning submission does not seek consent for the specific development, a

detailed quantitative assessment of the Concept Reference Design is not considered to be warranted at this stage.

This report presents a review of the proposed development and potential impacts on the adjacent rail tunnels, given their proximity to the site under both Castlereagh Street and Pitt Street.

2 Site and interface description

2.1 Site geology

A geotechnical desktop assessment report has been prepared by Douglas and Partners (D&P), ref: 86990.00.R001 rev 1, dated August 2020. The D&P report is based on D&P investigations on sites in close proximity including neighbouring sites 194-204 Pitt St*reet* and 65-77 Market Street which are located immediately to the north of the project site. Limited shallow bore hole information from these sites is available.

A geological feature known as the Martin Place Joint Swarm passes through the site. The joint swarm zone comprises closely spaced steeply dipping joints in otherwise medium to high strength rock. Excavating vertical faces in this material may require a retention system or rock bolting to secure any potentially unstable rock wedges.

At the 65-77 Market St*reet* site, a clay seam in the bedrock was present in all bore holes. At the bore hole location nearest to the 133 Castlereagh site, the clay seam is 80mm thick and located at a depth of 5.55 m (RL3.9 m). The new foundations found below this level, however this seam may dip lower within the site potentially affecting foundation bearing.

Founding for the tower columns and cores is expected to be otherwise located in medium to high strength sandstone.

2.2 Site topology

The site slopes, rising approximately 2.7 m from Pitt Street to Castlereagh Street. The majority of the site is currently excavated to RL 3.6 accommodating *five* basement levels. The Piccadilly Court area of the site is currently excavated to approximately RL16.8 accommodating a single basement level.

2.3 Interface with rail tunnels

The CBD Rail Link tunnel is located under Pitt Street and the CBD Metro tunnel is located under Castlereagh Street. The Pitt St Metro rail corridor encroaches slightly across the north west corner of the site.

The new basement excavation proposed does not encroach into the rail first reserve protection zones.

The proposed basement extent is generally within the existing basement volume except for additional excavation required to the Piccadilly Court area to bring this down from approximately RL 16.8 to the same level (approx' RL3.6) as the rest of the site. Other excavation required for the development includes the detailed excavation required to for lift pits and the building foundations.

The existing basement shoring walls are proposed to be kept and integrated into the new construction. The existing upper level basement floors currently prop the

shoring walls. The upper basement level shoring walls were temporarily anchored during their construction. Temporary anchors are proposed to be reinstated to maintain the retention function of the existing shoring walls during the demolition and re-construction of the basement floors.

To the southern half of the Pitt Street boundary the proposed basement excavation will cut a new face against the rail first reserve. Our preliminary assumptions (to be confirmed from geotechnical site testing during the detailed design phase) are that the upper soil / fill and weak rock layer is currently excavated and shored away from the road boundary. New shoring is to be constructed and temporarily re-anchored into the road reserve above the rail first reserve. The Pitt Street site boundary is expected to be outside the highly jointed region of the Martin Place rock swarm. Excavation below in the medium strength sandstone is proposed without additional shoring retention other than rock bolting above the rail first reserve if required. No anchoring or rock bolting is permitted into the rail first reserve protection zone. If any adverse rock jointing is encountered during excavation against the rail first reserve, structural steel temporary shoring props will be installed to retain any potentially unstable rock wedges.

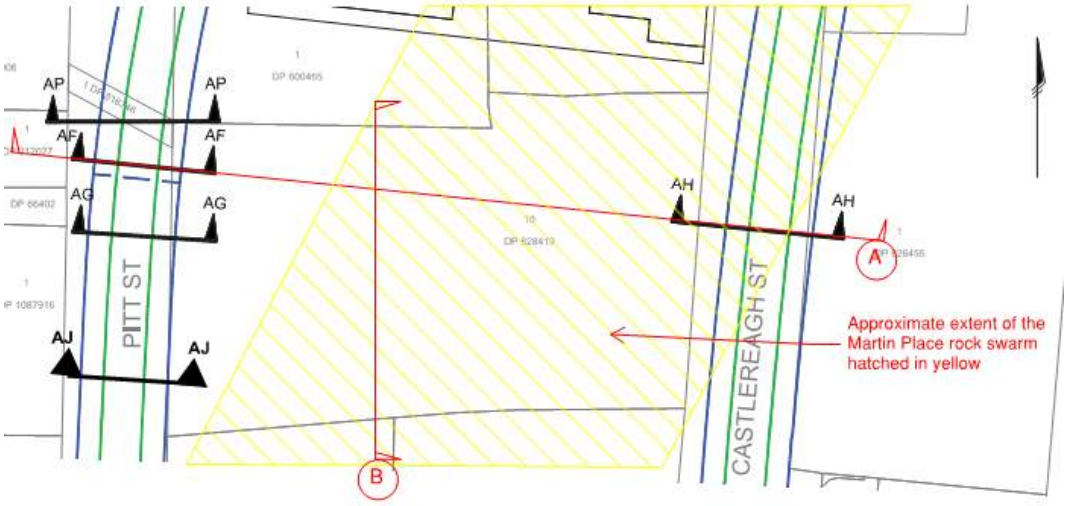

Figure 3: Plan reference of sections through site

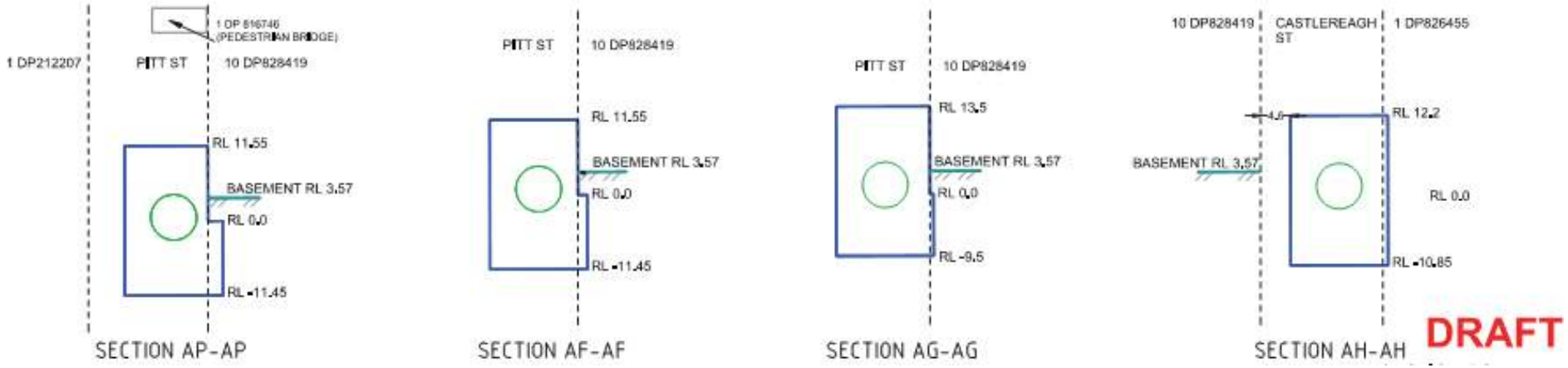

Figure 4: Rail first reserve protection zone sections

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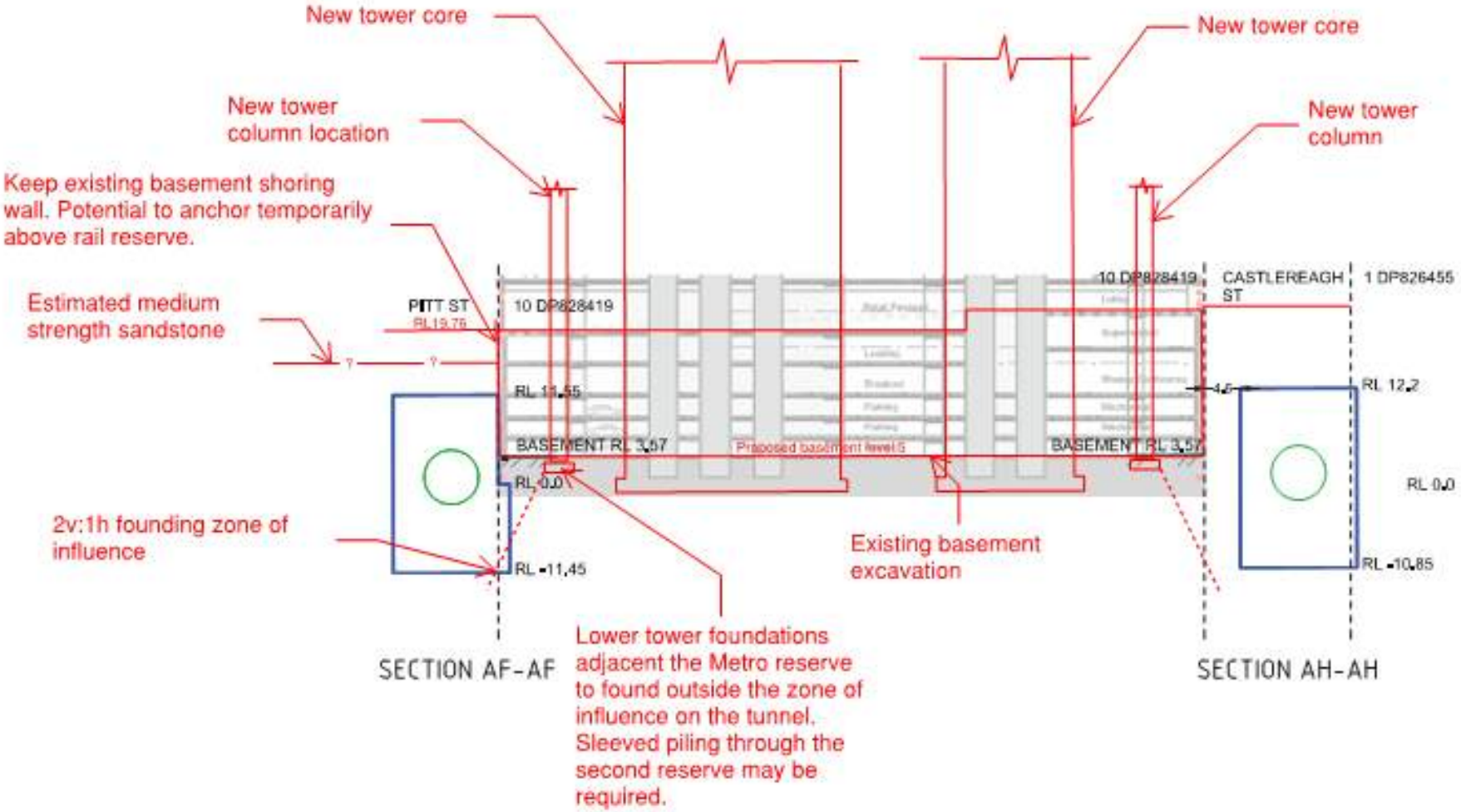

Figure 5: Section A through site illustrating the interface with the Metro Rail tunnels

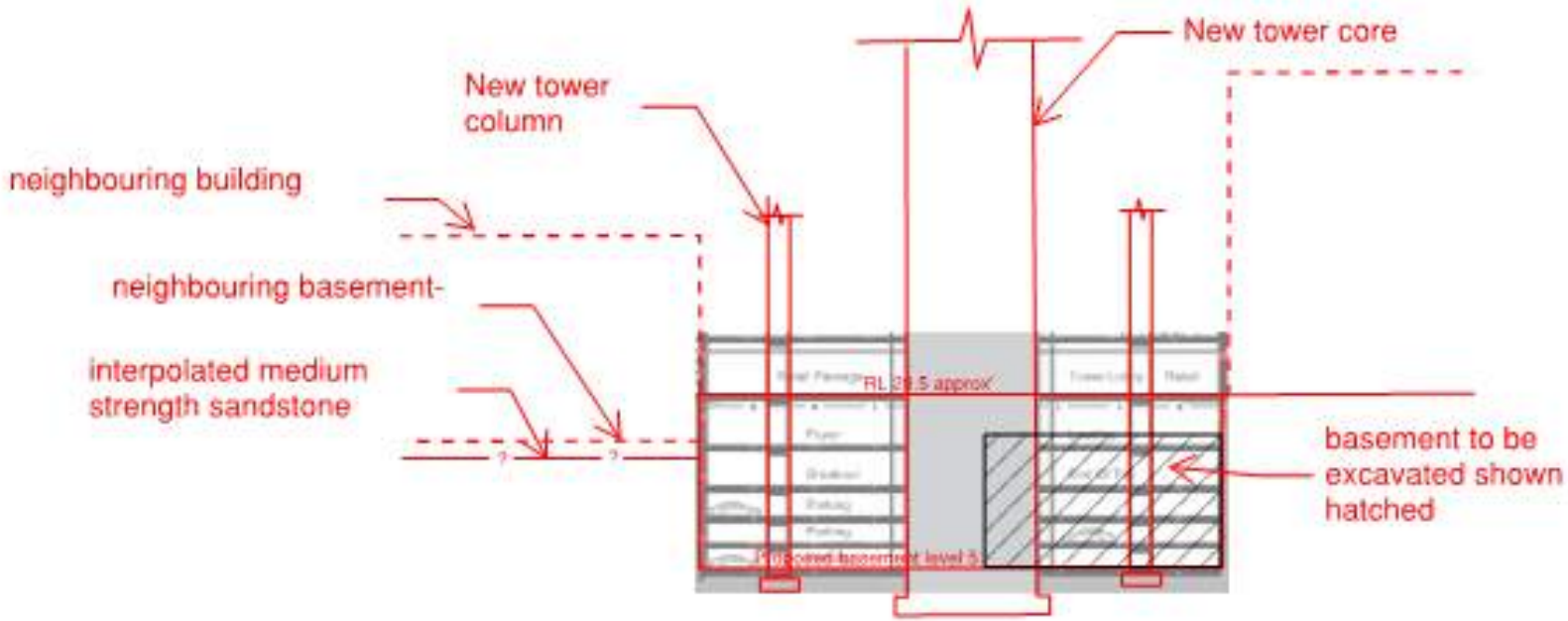

Figure 6: Section B through site

2.4 Interface with underground services

Temporary anchoring of the basement shoring walls and rock relief movement due to excavation may impact on the underground services under Pitt Street and Castlereagh Street.

The existing shoring is typically confined to the top 4.0 m of the basement. Temporary anchoring of existing and new shoring will be located to avoid the existing services under the roads. There is a historic Telstra tunnel adjacent the Pitt Street boundary. Soil and rock relief movement due to the additional basement excavation may induce lateral movement which could affect movement sensitive underground services such as the Telstra tunnel. The backfill over underground services is often uncontrolled and generally un-suitable for anchoring in, thus any shoring anchors will be located below any services present and above the rail first reserve protection zone.

All underground services will need to be accurately located before the basement works can commence.

3 Shoring

3.1 Existing basement shoring

The proposed basement is generally limited to the volume of the existing basement. Additional basement excavation is required to the Piccadilly Court area and the detailed excavation required for the building foundations. The basement to the Piccadilly Court area is currently of variable depths but typically approximately 4.0 m deep (approx' RL 16.8).

Interpolated from shallow bore holes on the neighbouring site we estimate that medium strength sandstone is present at a depth of approximately 3.5 m below ground level at the north end of the Pitt Street boundary.

At least the upper level of the basement has a retaining function where soil or fill is expected along the Castlereagh and Pitt Street boundaries. Soil or fill material will require shoring retention to be maintained during demolition and replacement of the basement floors.

Below level B1, although the rock substratum may be highly jointed it is suspected that the basement faces were excavated with no shoring retention although rock bolting may have been employed.

The existing basement construction at the excavated faces comprise concrete columns built in front of but not generally in contact with the cut face.

Figure 7: Level B5 Pitt Street boundary excavation

The cut sandstone face is visible between the columns on both road boundaries of level B5 only.

Blockwork infill between the columns is present along the north and south excavation faces of level B5 and to all excavation faces of levels B4, B3 and B2.

Much of the level B1 shoring construction is concealed, however there is indication around the loading dock and an adjacent corridor of the concrete encased structural steel framed shoring. The available drawings describe the existing shoring comprising paired 200 x 75 steel channel soldiers at up to 3.0m centres. 200UB walers at 900-1200 centres span between the paired 200 x 75 soldiers. The structural steel shoring grid is encased in concrete. The structural steel shoring grid was temporarily anchored into the rock until the concrete floors were constructed that now replace the function of the anchors.

The concrete shoring wall is typically propped by the level ground floor and the level B1 floor. Along the Castlereagh Street boundary, the vehicle entry ramp partially extends beyond the site boundary. The ramp is on fill and the wall stem supporting Castlereagh Street cantilevers from the ramp base.

Drawings of the boundary construction to the neighbouring buildings have been investigated and the information from this research collated in Appendix A.

3.2 Proposed basement shoring

The function of any existing shoring systems on the site that support vertical excavated faces are recommended to be preserved and potentially incorporated into the new construction. The existing level ground and B1 floors are serving a propping function that is an integral part of the shoring system. Below level B1 the blockwork infill panels that are present enclose a drainage cavity and are not expected to be a structural element of the shoring system. This assumption needs to be verified before demolishing the basement floors. The removal of a portion of the blockwork infill walls is envisaged to ascertain the extent of the shoring retention.

To allow the demolition of the existing basement floors and the construction of new basement floors, temporary propping to the existing shoring is required. The simplest method to achieve this is to re-introduce temporary anchors and rock bolts through the existing shoring walls. Where this may not be feasible, retaining either temporarily or permanently portions of the existing floors to act as walers or props is an option or alternatively the introduction of new temporary internal structural steel propping systems.

There are substantial underground services particularly under Pitt Street adjacent the site boundary which place restrictions on the location of temporary anchors proposed for the new development. The underground services are required to be accurately located to determine where temporary anchoring of the shoring can be located.

Below is a summary of the shoring concept proposals for the site boundaries

- **Castlereagh Street:** Temporarily re-anchor the existing shoring wall into the road reserve from the loading dock level to allow the removal of the existing basement floors. The temporary anchors are to be positioned to avoid clashes with underground services and the rail first reserve protection zone. Refer to the section in Appendix A.

- **South boundary, eastern side:** Temporarily re-anchor the shoring and under-pinning of the neighbouring building to allow the removal of the existing basement floors and ramps.
- **South boundary, western side:** The basement is to be excavated from a current level of approximately RL16.8 down to RL3.4. Any existing shoring and under-pinning present may require temporary re-anchoring. Additional shoring to retain soil or weak rock may be required. Typical construction for new shoring comprises reinforced concrete bored soldier piles, 600 mm diameter at nominal 2.8 m centres with 150 mm reinforced shotcrete between. Below this in the medium strength sandstone rock bolting may be required as excavation proceeds due to the presence of the Martin Place rock swarm jointing.
- **Pitt Street, southern end**: The basement is to be excavated from a current level of approximately RL16.8 down to RL3.4. New shoring is to be constructed and temporarily re-anchored into the road reserve, typically below the underground services and above the rail first reserve. Typical construction for new shoring comprises reinforced concrete bored soldier piles, 600-750 mm diameter at 2.8 m centres with 150 mm reinforced shotcrete between. Below this in the medium strength sandstone rock bolting may be required as excavation proceeds down to the top of the rail first reserve. No anchoring is permitted into the rail first reserve. If any adverse rock jointing is encountered during excavation against the rail first reserve, structural steel temporary shoring props are proposed to retain any potentially unstable rock wedges.
- **Pitt Street, northern end:** Temporarily re-anchor the existing shoring into the road reserve. The temporary anchors are to be positioned to avoid clashes with underground services and the rail first reserve protection zone. Refer to the section in the mark-up: 191115 Existing basement shoring.pdf

4 Impact on the rail tunnels

The bulk excavation proposed is limited in extent to the Piccadilly Court region, thus rock stress relief movement effects on the tunnels are expected to be confined to the Pitt Street tunnel only. The Piccadilly Court region of the site is currently excavated to approximately RL 16.8 and is proposed to be excavated to RL 3.6. 1 mm to 1.5 mm of lateral rock stress relief displacement per metre of excavation depth is typical guidance on movement expected for excavation in Sydney sandstone. Based on this guidance, the proposed excavation could result in up to 20 mm of lateral displacement at ground level midway along the Pitt Street site boundary reducing to near zero lateral displacement at the base of the excavation RL 3.6. Geotechnical modelling of the rock mass to more accurately predict the rock stress relief deformation influence on the tunnels is required.

Vertical movement of the rock substratum will be induced from unloading of the site due to demolition of the existing buildings and re-loading of the site due to the construction of the new tower and basement. The tower foundations will be designed to limit their impact on the tunnels. This is typically achieved by founding below the zone of influence on the tunnels and sleeving to any piles required to achieve this by extending through the second reserve.

The majority of the additional loading from the proposed building will found outside the zone of influence on the rail tunnels. Where tower foundations are located in close proximity to the rail first reserves these will be located at a depth to minimise movement influence on the tunnels.

The shoring systems for retention of the upper soil and weak rock layers and stabilization of any potential rock wedges are to be designed without any structure or excavation encroaching into the rail first reserve protection zone, including temporary anchors.

Noise, vibration and stray currents will be assessed as part of the detailed design process.

5 Conclusion

Underground rail easements are located along Pitt Street and Castlereagh Street that bound the site. The first reserve of the CBD Rail Link (CBDRL) tunnel under Pitt Street encroaches across the northwest corner of the site. The CBD Metro tunnel is located under Castlereagh Street.

The proposed excavation to enlarge the existing basement is confined to the southwest corner potentially influencing only the Pitt Street tunnel. Negligible excavation is proposed near the Castlereagh Street tunnel thus the impact from rock stress relief movement is not expected to be significant. The Pitt Street tunnel is located near the base of the proposed excavation thus limiting the effects of the rock stress relief movement on this tunnel but will require geotechnical modelling to quantify any impact.

The new building foundations are to be found below the zone of influence on the tunnels. Sleeved pile or similar foundations may be employed in situations where founding is located within the rail second reserve protection zone.

A geotechnical desktop study for the proposed development is available. Further investigation including site testing will be required to assess the impact on the rail tunnels from rock movement occurring due to the proposed development. It is envisaged that the study will include a non-linear staged modelling of the rock mass representing the demolition unloading, excavation rock relief and loading of the site due to the new building.

Noise, vibration and stray currents will also be assessed as part of the detailed design process.

Appendix A

Existing Basement Shoring

65-77 Market Street,
Basement RL 9.5 approx'

196-204 Pitt Street,
Basement RL 15.0 approx'

No temporary shoring
required due to presence
of neighbouring basement

B

No temporary shoring
required due to presence
of neighbouring basement

C

A

Temporary shoring
retention support required

206-214 Pitt Street,
Basement RL 3.6 approx'

E

Temporary shoring
retention support required

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PITT STREET

D

CASTLEREAGH STREET

Construction and basement
depth of this area have not
been determined

?

Piccadilly Court
216-224 Pitt Street,
Basement RL varies -
generally RL16.8 approx'

No additional shoring is likely to be required due to
neighbouring single storey basement. However the
stability of underpinning to the neighbours foundations
may require temporary anchoring

New shoring wall required

New shoring wall may be
required soldier piles??

151 Castlereagh Street,
Single storey basement

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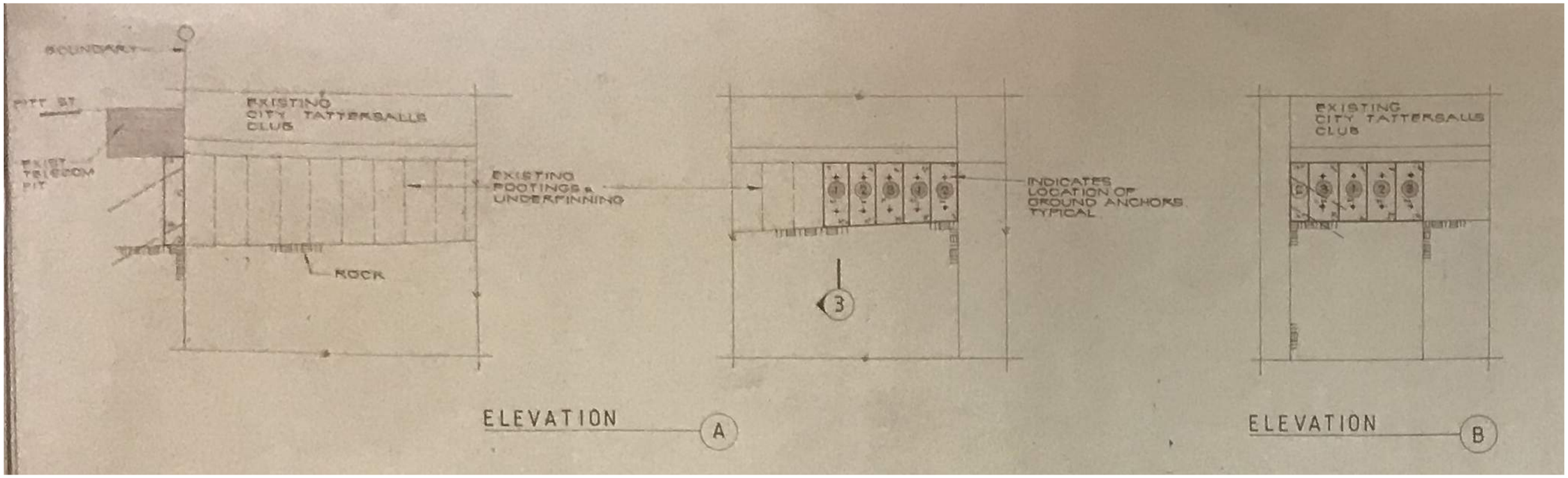
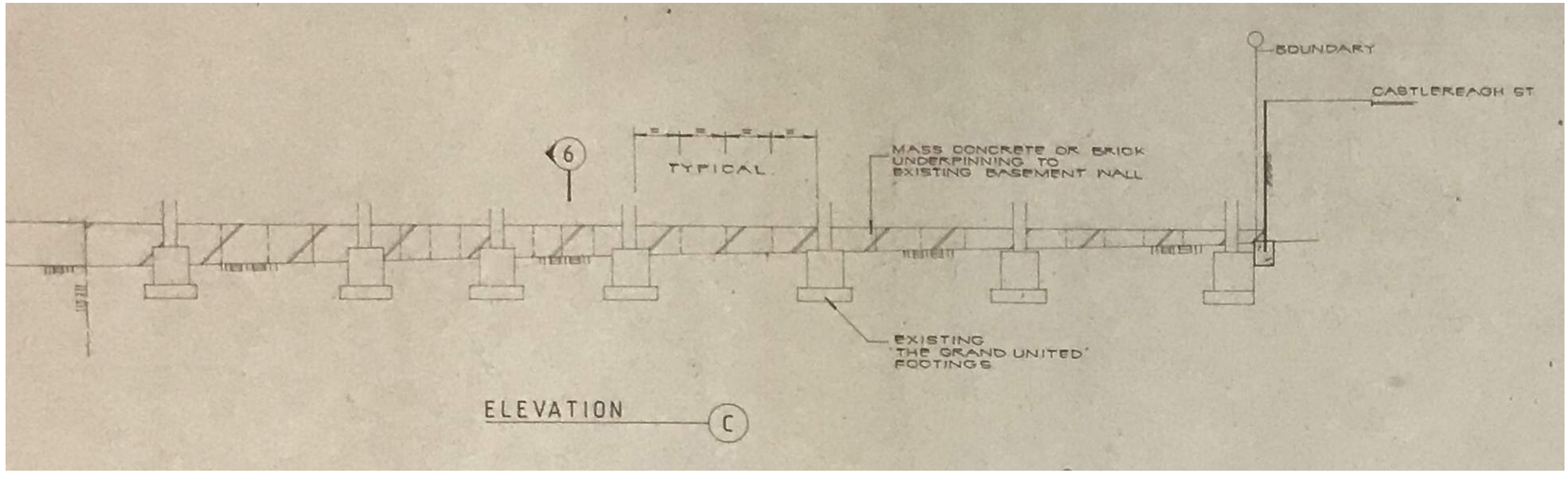


NORTH BOUNDARY ELEVATIONS -
Underpinning to neighbouring building at 196-204 Pitt Street



NORTH BOUNDARY ELEVATION -
Underpinning to neighbouring building at 65-77 Market Street

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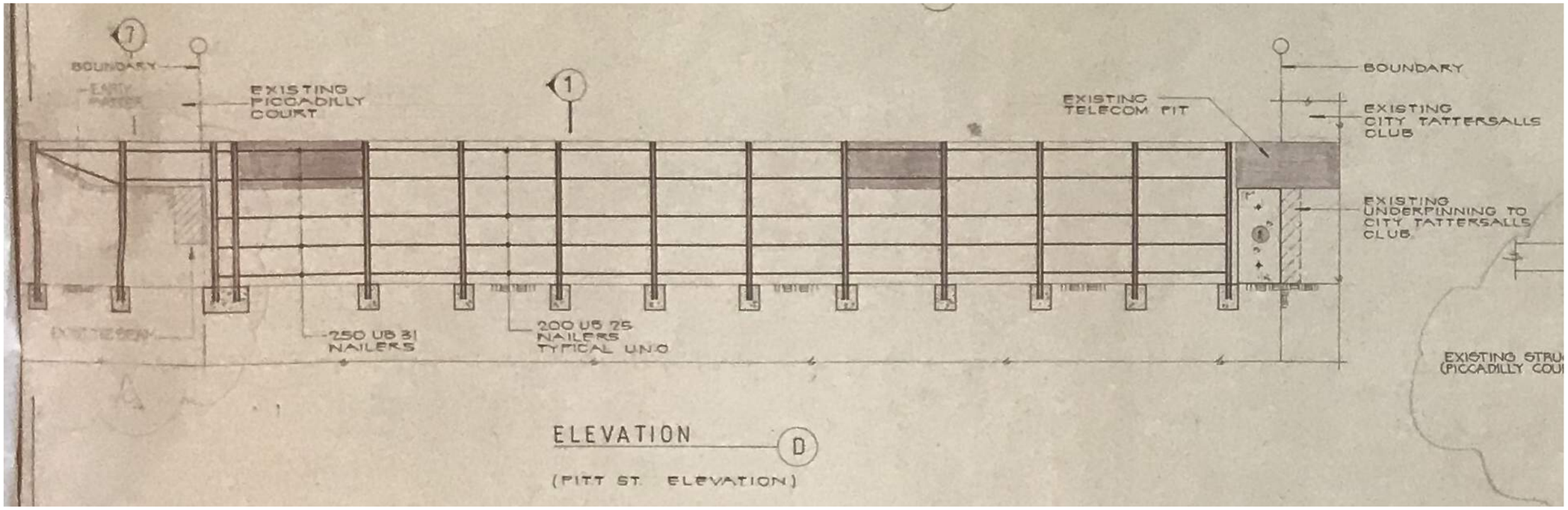
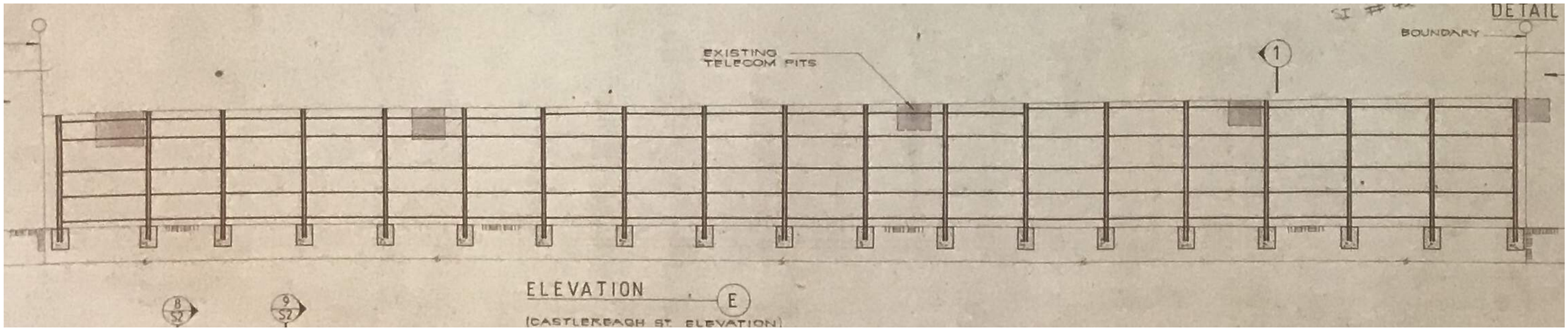


WEST BOUNDARY ELEVATION -
Existing shoring to Pitt Street boundary



EAST BOUNDARY ELEVATION -
Existing shoring to Castlereagh Street boundary

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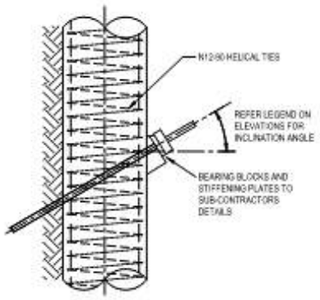
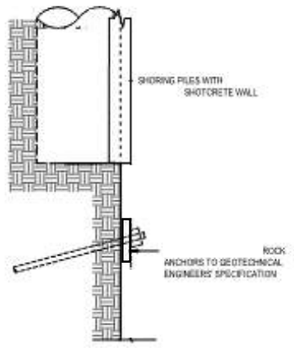


TYPICAL PILE & ANCHOR DETAIL



TYPICAL MID-LEVEL PILE BASE

EXAMPLE OF TYPICAL NEW SOLDIER PILE SHORING POTENTIALLY REQUIRED TO THE PICCADILLY COURT SITE BOUNDARIES

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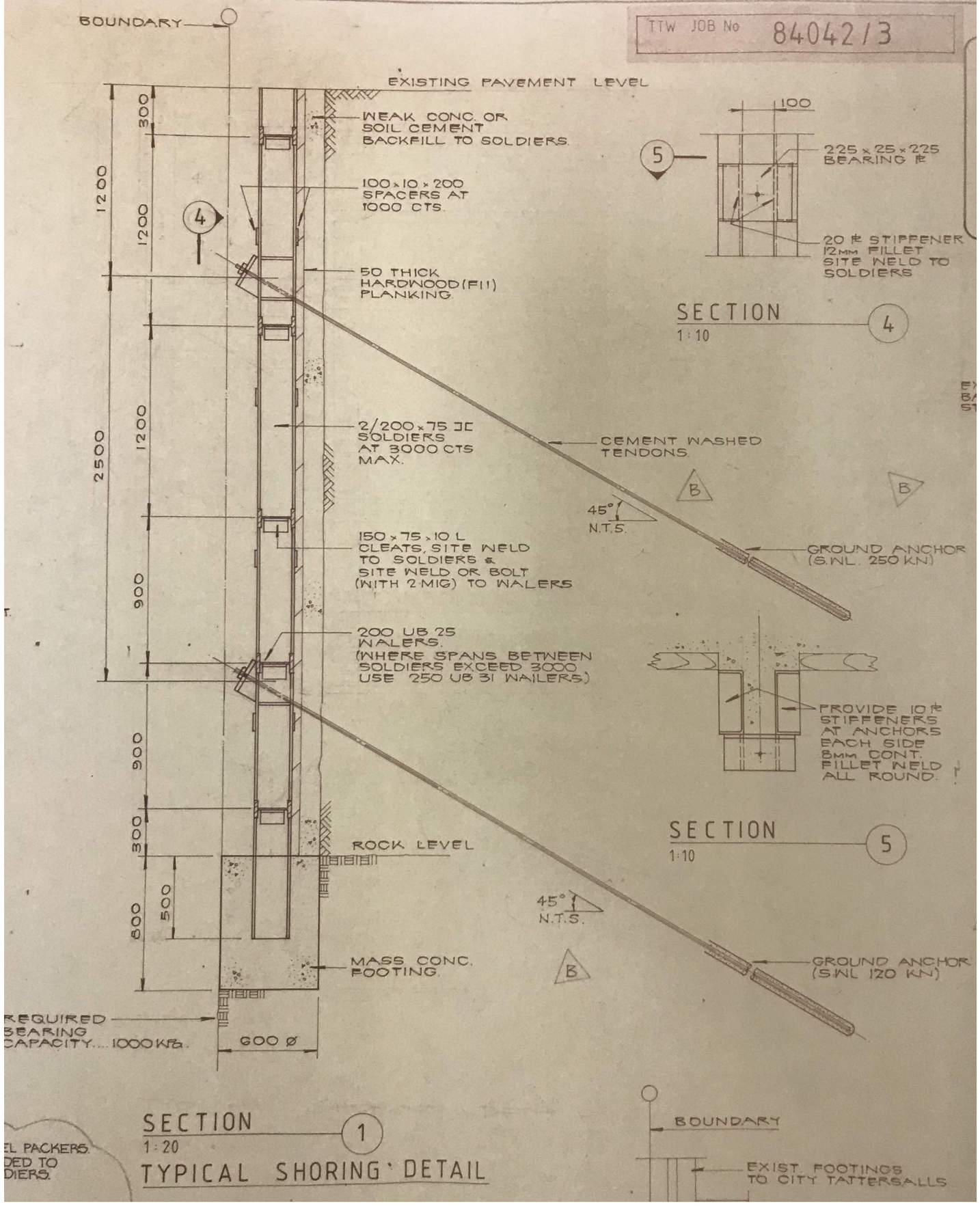
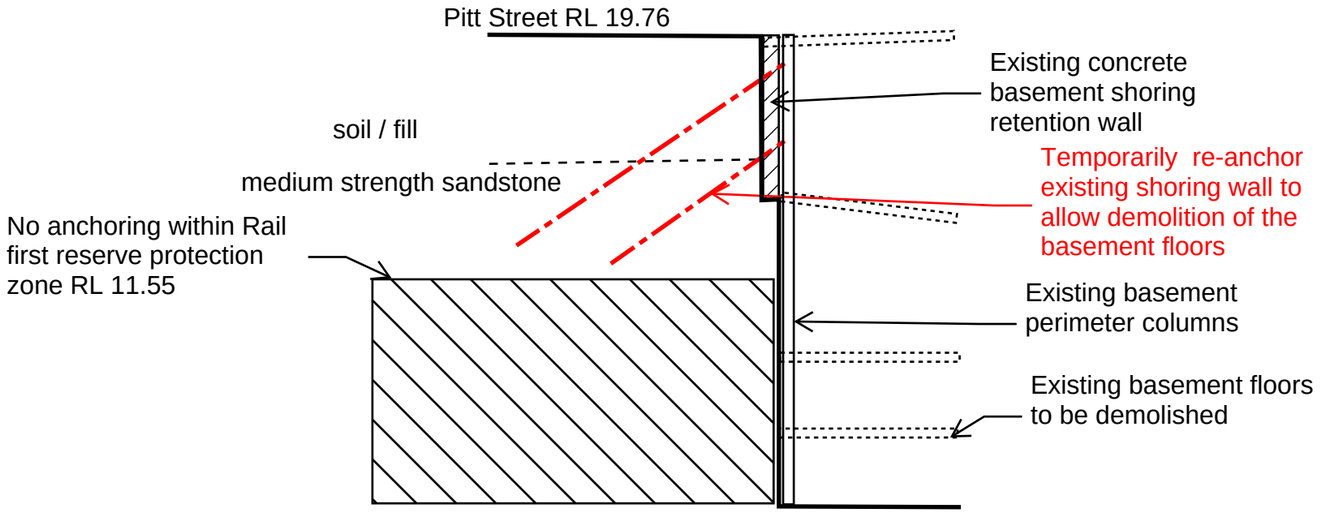
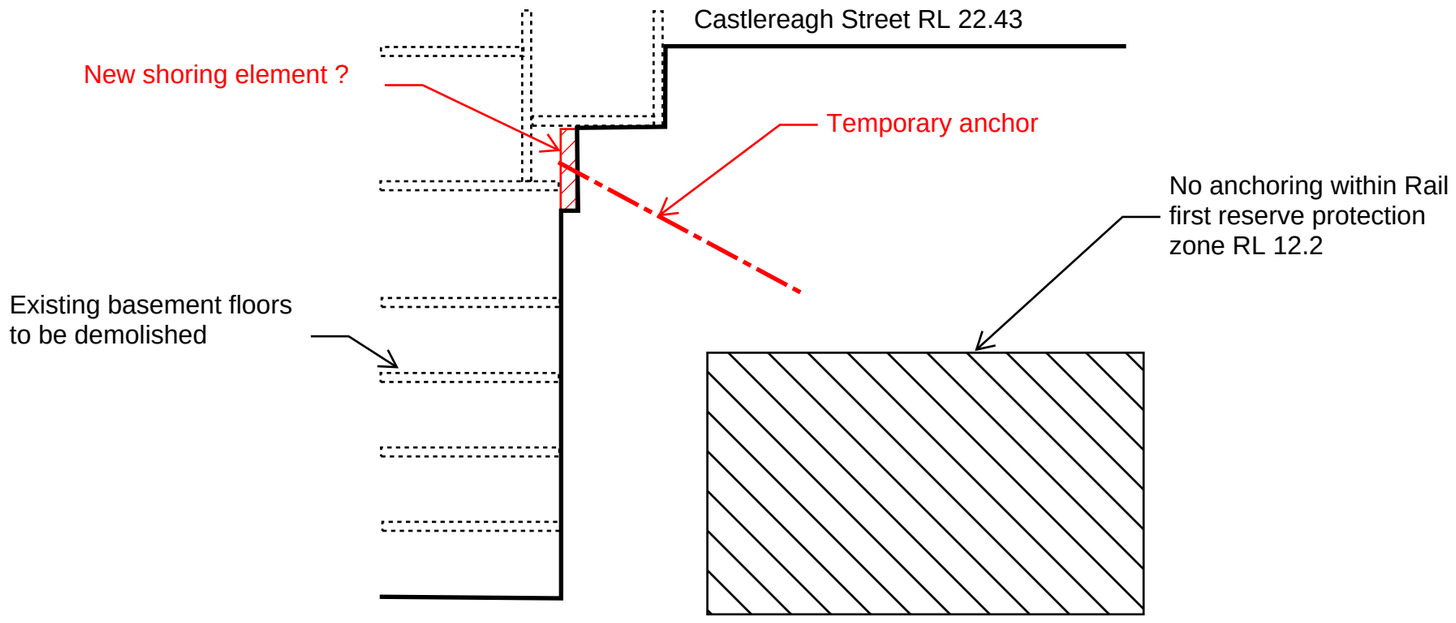


TYPICAL EXISTING SHORING DETAIL TO STREET FRONTAGE BOUNDARIES



SECTION THROUGH PITT STREET BOUNDARY



SECTION THROUGH CASTLEREAGH STREET BOUNDARY

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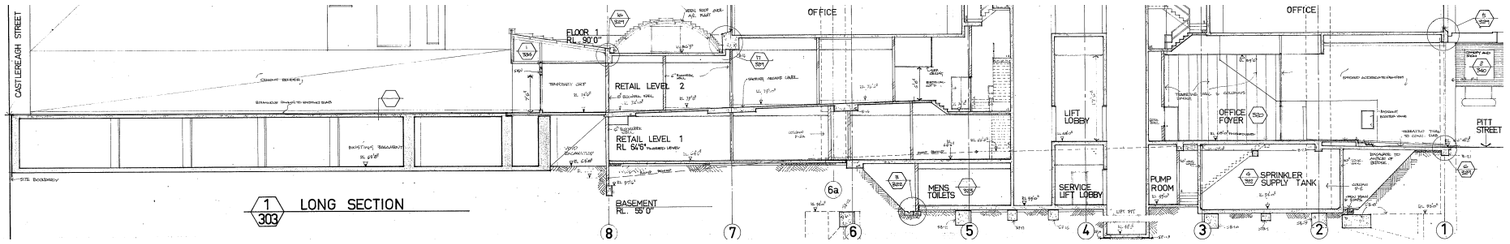
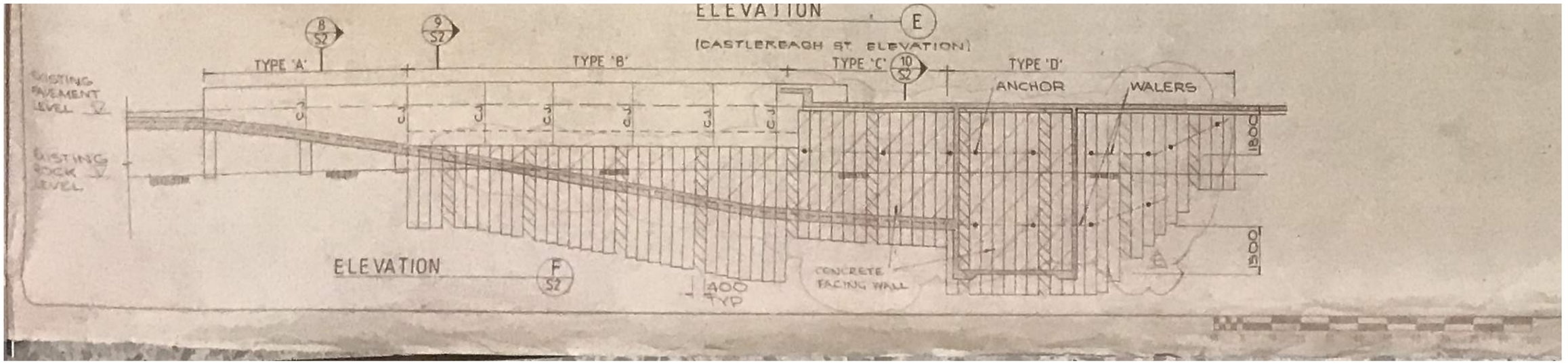


SECTION THROUGH PICCADILLY COURT



SHORING / UNDERPINNING - LOCATION UNDEFINED

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Dwg Title	Existing basement shoring - Basement elevation and section					