In the matter of the Melbourne Metro Rail Project

Planning Panels Victoria

Proponent: Melbourne Metro Rail Authority

Expert Witness Statement of Anthony Bennett

Expert of Melbourne Metro Rail Authority

1 Name and address

Anthony Bennett

C/- Aurecon Australasia Pty Ltd,

Level 8, 850 Collins Street

Docklands, VIC 3008

2 Qualifications and experience

Annexures A and B contain a statement detailing my qualifications and expertise and addressing the matters set out within Planning Panels Victoria's Guide to Expert Evidence.

3 Scope

3.1 Role in Preparation of the EES

My firm Aurecon, as part of the AJM JV was responsible for the preparation of the technical report titled "Ground Movement and Land Stability Impact Assessment" (20 April 2016) which is included as Technical Appendix P to the EES.

My role in the preparation of the Ground Movement and Land Stability Impact Assessment was to assist in preparing the report and reviewing work done by other AJM JV staff in preparing the report.

I also authored the technical report titled "Future Development Loading" (20 April 2016) which is included as Appendix J to Technical Appendix E (Land Use and Planning) to the EES.

I adopt these reports as the basis of my evidence.

A peer review of the Future Development Loading report and the Ground Movement and Land Stability Impact Assessment by Dr A G Bennet was included as Appendix A to the Future Development Loading report.

A peer review of the EES Land Use and Planning Impacts by Robert Milner includes comments on the Future Development Loading report, and is included as Appendix L of the Land Use and Planning Impact Assessment. While principally addressing the planning document, it raises one point related to the Future Development Loading report.

This statement also includes responses to matters raised in the Peer Review reports.

3.2 Instructions

My instructions to prepare this witness statement are set out in Annexure C.

3.3 Process and Methodology

In preparing this expert witness statement I have:

- Reviewed the findings of the reports listed in Annexure A;
- Reviewed Technical Note 001 to Technical Note 018 where potentially affecting the assessment of Ground Movement or Future Development Loadings;
- Prepared a Technical Note in response to the Inquiry and Advisory Committee's 'Preliminary Matters and Further Information' dated 25 July 2016 in relation to requests 71-80;
- Reviewed the peer review of Dr A G Bennet dated 10 May 2016 in relation to the Impact Assessment and Future Development Loading report, and prepared a response;
- Reviewed the peer review of Robert Milner dated April 2016 in relation to the Impact Assessment and Future Development Loading report, and prepared a response insofar as it is relevant to my area of expertise;
- Reviewed an updated version of the Geological Long Section, which is an update to the Geological Long Section which forms part of Appendix A (Geological Long Sections and Reliability Diagrams) to Appendix A (Golder Associates Geological Setting EES Summary Report) to Appendix P (Ground Movement and Land Stability Impact Assessment) of the exhibited version of the Environment Effects Statement for the Project; and bore log data, which form the basis for the updated Geological Long Section and assessed its implications for the EPRs. These updates are part of the further work and investigations identified in the Ground Movement and Land Stability Impact Assessment at s11.1 and are reported in the Interpreted Geological Setting EES Summary Report – July 2016 Update, Golder Report Number 1525532-331-R-Rev0, dated 3 August 2016;
- Critically assessed the Ground Movement EPRs, considering whether they form an appropriate framework to govern the construction of the Project if it differs from the Concept Design, but remains within the Project Boundary; and
- Reviewed the submissions on the EES that included comments on the aspects of the Project addressed under Future Development Loading or Ground Movement and Land Stability.

4 Findings

4.1 Summary of Opinions

I have reviewed the Future Development Loading report, an appendix to the Land Use and Planning Impact Assessment dated 20 April 2016 (AJM JV, 2016a), in preparing this expert witness statement.

I have reviewed the Melbourne Metro Rail Project Ground Movement and Land Stability Impact Assessment dated 20 April 2016 (AJM JV, 2016b), including its appendices prepared by Golder Associates, in preparing this expert witness statement.

Save where otherwise indicated I adopt the Future Development Loading Technical Paper, and the Melbourne Metro Rail Project Ground Movement and Land Stability Impact Assessment dated 20 April 2016, as the basis of my evidence before the Inquiry and Advisory Committee.

4.2 Any Additional Work Undertaken Since Exhibition of EES

Since the preparation of the EES I have:

(a) Responded to matters identified as gaps in Dr A G Bennet's peer review dated 10 May 2016, and comments in Robert Milner's peer review dated April 2016,

published with the EES. The responses are included in Section 4.5 of this statement.

Reviewed the results of the further investigations conducted since the release of the EES documents, to the extent these have been reported to date in the Interpreted Geological Setting EES Summary Report – July 2016 Update, Golder Report Number 1525532-331-R-Rev0, dated 3 August 2016, and the Interpreted Hydrogeological Setting EES Summary Report - July 2016 Update, - Golder Report Number 1525532-332-R-Rev0, dated 29 July 2016. The continuing investigation work was envisaged in the Ground movement and Land Stability Impact Assessment in the EES. The findings of my review are discussed in Section 4.6 of this statement.

(b) Assisted in the preparation of, and reviewed, MMRA Technical Notes, and the findings of my review are discussed in section 4.4 of this statement.

4.3 Response to Submissions

I have reviewed the following submissions which raise issues concerning Future Development Loading: MM013, MM100, MM180, MM207, MM228, MM250, MM257, MM261, MM274, MM287, MM288, MM295, MM299, MM300, MM301, MM308, MM318, MM327, MM362, MM365, MM367, and MM377.

I have reviewed the following submissions which raise issues concerning Ground Movement and Land Stability: MM008, MM010, MM012, MM023, MM024, MM057, MM059, MM095, MM096, MM100, MM101, MM109, MM119, MM134, MM142, MM146, MM155, MM159, MM178, MM180, MM203, MM207, MM216, MM219, MM221, MM222, MM228, MM238, MM250, MM253, MM258, MM266, MM274, MM285, MM290, MM299, MM300, MM301, MM303, MM308, MM310, MM320, MM321, MM324, MM326, MM327, MM350, MM364, MM367, MM368, MM369, MM370, MM371, MM374, and MM377.

My detailed response to the matters raised in these submissions is set out in Annexure D.

I have addressed the technical aspects of the submissions in my responses. I have not addressed commercial, contractual, or planning topics, which are outside my area of expertise.

4.4 Review of MMRA Technical Notes

I have reviewed MMRA Technical Notes 001 – 018.

The following Technical Notes are related to the Ground Movement and Land Stability Impact Assessment, and Future Development Loading reports:

- Technical Note 007 - Ground movement and protection measures. This is a Technical Note that provides further information on structures at which protective measures may be required. This clarified or expanded on the Ground Movement and Land Stability report, and did not require any changes to the report or the EPRs.
- Technical Note 008 - Soil and rock bore logs and CBD South update. This Technical Note includes additional geotechnical information and a revised interpretation of the geology. It also identifies a potential variation in the alignment that would lower CBD South by 4 m. The revised geotechnical data are interpretation are discussed in Section 4.6 of this statement. My assessment of the implications of lowering the alignment on ground movement and land stability is discussed in Section 4.8.

- Technical Note 011 - Franklin Street Adit. This technical note introduces a new tunnelled link for high voltage electrical cables from the Franklin Street shaft to the CBD North Station cavern passing beneath the City Baths at a depth of approximately 25 m. My assessment of the implication of this is discussed in Section 4.7 of this statement.
- Technical Note 024 – Revised station construction methodology (CBD North and CBD South Stations). This technical note details the changes that would be made to the design of the ground support in the cavern stations after considering the new interpretation of the ground conditions described in Technical Note 8, which is consistent with the information provided in the Interpreted Geological Setting EES Summary Report – July 2016 Update, Golder Report Number 1525532-331-R-Rev0, dated 3 August 2016. The assessment of the effects of this technical note are discussed in Section 4.6.
- I assisted MMRA to prepare a Technical Note in response to IAC RFIs question numbers 71-80, in relation to matters concerning ground movement.

4.5 Response to Peer Reviews

(a) Future Development Loading and Design and Development Overlay

Dr A G Bennet's peer review dated May 2016, with regard to the Future Development Loading report and the derivation of the extent of the DDO, states that "*the only matter where possible clarification should be given is in relation to the parameters adopted for settlement analysis as assigned in Table 2-2 of the FDL Report. The Elastic Modulus value for Rock (column 3 of the table) adopted implies a small strain condition. The case of future development loading is treated differently to the case of excavation induced stress changes and deformation of the rock mass during construction of the Project.*"

The following response expands upon the last sentence of Section 2.4 of the Future Development Loading report which states "*The Melbourne Formation has been modelled using parameters, adopted from recommendations by Golder Associates, appropriate for the small strains that would be expected away from the Melbourne Metro construction where the ground movements would be minor.*". The parameters for the Melbourne Formation are shown in Table 2-2 of the Future Development Loading report. These particular values are not shown in the reports prepared by Golder Associates for the EES, because these are focussed on ground movement in the immediate surrounds of the excavations for the tunnels, caverns and cut and cover structures, associated with moderate strain levels (and hence list lower modulus values). While the dispersion of the future development loads might be affected marginally around the Melbourne Metro structures by the changes in the rock mass induced by the excavations, the majority of the load distribution will be through rock for which the small strain modulus values are appropriate because it is away from the zone of disturbance caused by the excavation. In addition, further sensitivity modelling, conducted for the preparation of this statement, demonstrated that, as the dispersion of the loading is sensitive to relative rather than absolute values, the difference between the moduli values derived from small and moderate strains has almost no effect on the results used to determine the width of the DDO.

The peer review by Mr Milner in relation to the planning aspects of the Future Development Loading report suggests that the "*EES would be enhanced by an identification of if and where the depth of tunnels and soil conditions may constrain the manner of site development and the delivery of planning outcomes*."

Mr Milner identifies two of the important factors that would influence the constraints on a development, but the third is the proposed development configuration itself. The Future Development Loading report notes in its introduction (Section 1) that "*the presence of Melbourne Metro is unlikely to prevent future new developments, or future re-developments. However, in some cases, engineering measures would be required to*

stay clear of the Melbourne Metro assets or to keep the change of loading on Melbourne Metro assets to acceptable levels". The nature and extent of the engineering measures would depend upon what the development was proposing to achieve, in terms of structural form and layout. In section 3.2, the report notes that "*it is anticipated that a technical guide would be developed by the referral authority to assist developers in identifying and addressing potential issues under the Design and Development Overlay, and to assist the referral authority in considering permit applications, referred under the Design and Development Overlay*." This guide would include more definitive information on how the potential risks posed by proposed developments on Melbourne Metro would be assessed. An interim technical guide could be produced to assist developers and the referral authority prior to application of the Design and Development Overlay, and the explanation of the assessment required in the technical guideline would be revised, based upon the as-constructed details of the Melbourne Metro.

(b) Ground Movement and Land Stability

Dr Bennet did not identify any gaps or matters in his peer review where he disagrees with the assessment or which in his view should be addressed in the Ground Movement and Land Stability Impact Assessment. Dr Bennet stated that in order to address the EES Scoping Requirements, there is a need for further engagement with stakeholders, particularly those with responsibility for major infrastructures assets. The EES Ground Movement and Land Stability Assessment recognises this and includes an EPR, GM3, which requires consultation with stakeholders as part of developing the ground movement plan. This would appropriately be conducted during the detailed design phase.

4.6 Response to updated geological information

Section 11 of the Ground Movement and Land Stability Impact Assessment notes that the Concept Design is preliminary in nature, and while being suitable for the purposes of the EES and for assessing the likely impact of the project, further work will be required as additional information becomes available and the design is developed through to the detailed design stage.

Consistent with this process, the results of additional geotechnical field investigations have become available since publication of the EES. I have reviewed an updated version of the Geological Long Section, and the associated bore log data, and assessed its implications. I have been supplied with Technical Note Number 008, and the revised Geological Setting EES Summary Report (Golder 2016c).

As part of my review of this material I have taken additional numerical modelling to inform myself as to the potential differences from the effects of these revisions on the magnitudes of the predicted ground movement and whether this required changes in the EPRs, the Impact Assessment or the Future Development Loading report.

Through the CBD section, there are two main differences from the ground model developed for the Concept Design that potentially affect the assessment of ground movement:

- The more weathered rock has been found to extend to greater depths than previously modelled. There is also more information on the extent of likely structures, mainly faults through the rock. In combination, these mean that the strength and stiffness of the rock over the cavern stations is less.
- The investigations have encountered a deeper channel filled with clay, between Flinders Lane and Flinders Street, where previously weather rock was modelled.

In order to maintain ground stability in these weaker ground conditions, it is expected that ground support systems that are stronger (and stiffer) than those assumed in the Concept

Design will need to be installed within the caverns and other underground structures as they are excavated. Potential changes to the ground support that could also be used to satisfy the EPR requirements for ground movement are described in Technical Note Number 024.

In order to assess the counterbalancing effects of weaker ground and stiffer support, additional numerical modelling was carried out for comparison with the results used earlier for the assessment of the Concept Design. The modelling indicates that the net effect of these changes are minor in terms of ground movement at buildings, and thus by inference, the impacts on adjacent buildings at the surface are also not changed significantly from the EES assessments.

The Interpreted Hydrogeological Setting EES Summary Report - July 2016 Update (Golder 2016d) incorporates the results of additional field testing, which are considered in conjunction with revisions of the ground model. The results have not yet been analysed to revise the ground movements, but the indications are that the proposed mitigation measures proposed to manage the groundwater drawdown would be equally effective under the current conditions as anticipated under the EES assessment. Therefore the assessments of the effects of ground movement remain appropriate. The EPRs require that the ground water model is maintained to reflect new data (EPR GM1), such as that expected from the St Paul's 30 day pump test that was being conducted at the time that the Interpreted Hydrogeological Setting EES Summary Report was issued.

My review of the potential design changes that would result in the Concept Design would not change my general assessment that the types of impacts from ground movements would remain similar to those described in the EES report, and that the EPRs still form an appropriate framework for governing the construction of the Project.

4.7 Response to the Franklin Street adit

Technical Note 011 introduces a new tunnelled link for high voltage electrical cables from the Franklin Street shaft to the CBD North Station cavern passing beneath the City Baths at a depth of approximately 25 m. This is a new underground element that is within the Project boundary but is outside the envelope of the Concept Design works. I have reviewed the construction of the adit to assess the potential differences on the magnitudes of the predicted ground movement and whether this required changes in the EPRs, the Impact Assessment or the Future Development Loading report.

If considered in isolation, the Franklin Street adit, because of its depth and the fact that it will be in Melbourne Formation rock, would lead to ground movements at the surface that would not be of concern, with maximum settlement expected to be less than 4 mm. Even when considered together with the settlement from the Concept Design, the outcomes are expected to be no more severe than currently predicted. The Potential Zone of Influence for ground movement would change but not extend into buildings that were outside the zone before the adit was introduced. The re-assessment of the Potential Zone of Influence is addressed in the EPR GM3, which requires that a ground movement plan is developed. The plan is required to address the location of structures which may be susceptible to ground movement, effectively defining the Potential Zone of Influence for the design that would be constructed.

The extent of the DDO might change to reflect the protection required by this new section of underground structure. This highlights the need to review the extent of the DDO at the completion of construction, to accommodate any further changes made during construction.

4.8 Environmental Performance Requirements

I have reviewed the EPRs relevant to Ground Movement and Land Stability.

The review has considered whether the EPRs establish an appropriate frame work for the project. In undertaking this review I have had regard to:

- The Concept Design;
- The Concept Design as potentially modified by the matters raised in the Technical Notes, and in response to the revised geotechnical interpretation of the ground conditions; and
- The construction of the Project if it differs from the Concept Design, but remains within the Project Boundary.

The Ground Movement EPRs GM1-GM6 establish a framework to regulate the control of ground movement and limiting of the effects on buildings. As set out in the EES, the EPRs have been developed by reference to the potential impacts identified through the EES assessment of the Concept Design, setting out a regime to manage such impacts including potential changes being contemplated in the detailed design.

Technical Note 008 provides additional bore hole data and a revised interpretation of the ground conditions. There are a number of implications for ground movement that have been reviewed against the EPRs. These are firstly the changes that would result in the structures of the Concept Design in response to the revised ground conditions. As discussed in Section 4.6 of this statement, the outcomes with respect to ground movement and its effects on structures are similar in nature to those described in the EES, particularly Section 8 of the Ground Movement and Land Stability Impact Assessment.

Technical Note 008 also notes the potential to lower the cavern station at CBD South by 4 m. It is envisaged that the design of the structures of the Melbourne Metro would again be modified to suit the changed depth and different ground conditions that would be encountered. While the effects of this option have not been assessed numerically, it is expected that the effects on ground movement would be that the ground movements at a building already affected by the higher alignment would be of a smaller magnitude. However, the greater depth would also mean that the width of the settlement trough increases. Again, analysis is required to determine which way these two effects in combination move the Potential Zone of Influence as defined by a settlement of 5 mm.

It should be noted that the derivation of the Potential Zone of Influence is not a specific requirement for the project but is a commonly used tool for addressing various matters related to ground movement, such as identifying which structures are potentially vulnerable (EPR GM3) and which structures will be the subject of pre-construction condition surveys (EPR GM4). The definition of the zone would be determined by the contractor and ultimately approved by MMRA on the basis of the assessed risk, and might be based on different criteria depending upon the particular purpose for which it is being used. Typically, zones based on settlements of 1 mm to 10 mm would be appropriate depending upon the context. For the purposes of the EES assessment, a relatively conservative value (for typical buildings) has been selected, and has been used to compare the alternative designs noted in this Technical Note.

I have also been instructed to consider whether the EPRs establish an appropriate framework to govern the construction and operation of the Project if it ultimately differs from the Concept Design (but is still situated primarily within the Project Boundary as shown in the EES Map Book). In complying with the EPRs, a modified design would still meet the EES Evaluation Objective of avoiding or minimising adverse effects on land stability that might arise directly or indirectly from project works. With regard to the impact assessments, in a similar way as would occur if the Concept Design was simply lowered, it would be expected that the ground movement effects would remain similar to those predicted for the Concept Design, but could potentially affect some additional structures, and have a reduced effect on others currently affected, depending upon the changes that occur.

For the Concept Design and the three alternatives discussed above, the controls that would be imposed by complying with the EPRs would remain an appropriate framework within which to govern the construction of the Project. The EPRs describe good practice for the management of ground movement in a way that is not limited by particular geology or construction type. In summary, the approach can be described as:

- Manage the following processes through a ground movement plan
    - Determine the geology and the hydrogeology
    - Develop the appropriate design (and review against the following)
    - Assess groundwater effects (against criteria from drawdown effects)
    - Assess ground movement (against criteria agreed with stakeholders)
    - Construct in a manner which limits ground movement and confirm by monitoring
    - Repair any damage caused by ground movement created by the construction

Therefore, I have no changes to make to the reviewed EPRs relevant to Ground Movement and Land Stability.

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Signed …….……

Dated 11 August 2016

Annexure A – Response to PPV Guide to Expert Evidence

Expert's Qualifications

B.E (Civil) (Hons), University of Melbourne, and

M. Eng. Sc., University of Melbourne

Professional Associations

Fellow of the Institution of Engineers, Australia

Chartered Professional Engineer

Chartered Engineer (UK)

Fellow of the Institution of Civil Engineers, London

Registered Building Practitioner

Member - Australasian Tunnelling Society

Employment History and Achievements

CV included as Annexure B

Expertise to Make Report

I hold a Bachelor of Civil Engineering from the University of Melbourne and a Master of Engineering Science from the University of Melbourne.

I am a Technical Director at Aurecon Australasia Pty Ltd. Over the past thirty six years I have worked on civil engineering projects including underground structures and geotechnical analyses. My experience includes design and review of tunnels in rock and soft ground, and analysis of civil structures with geotechnical interfaces

My most recent tunnelling design or reviews include:

- Melbourne Metro Rail Project – tunnels and shafts
- Melbourne Underground Rail Loop – reviews of proposed developments in the vicinity of the Loop and advice to VicTrack
- Melbourne Metro Stage One – tunnel area leader
- NWRL (NSW) Reviewer of tender designs

Other Significant Contributors to the Report (if any)

I am the sole author of this report.

Instructions to Prepare Report

Included as Annexure C

Identity of Persons who have Carried out Tests or Experiments upon which Reliance has been Placed (if any)

Roque Alea – Numerical modelling to assess the implications of the revised geotechnical models

Reports Relied Upon to Prepare Expert Witness Statement

AJM JV (2016a), Melbourne Metro Rail Project, - Future Development Loading, AJM JV Report Number: MMR-AJM-PWAA-RP-NN-001548, Revision C1, dated 20 April 2016

AJM JV (2016b), Melbourne Metro Rail Project, Ground Movement and Land Stability Impact Assessment, AJM JV Report Number: MMR-AJM-PWAA-RP-NN-000827, Revision C1, dated 20 April 2016.

Golder (2016a), Melbourne Metro Rail Project – Interpreted Geological Setting EES Summary Report, Golder Report Number 1525532-218-R-Rev2 dated 20 April 2016.

Golder (2016b), Melbourne Metro Rail Project – Ground Movement Assessment EES Summary Report, Golder Report Number 1525532-219-R-Rev1 dated 14 April 2016.

Golder (2016c), Melbourne Metro Rail Project - Interpreted Geological Setting EES Summary Report – July 2016 Update, Golder Report Number 1525532-331-R-Rev0, dated 3 August 2016.

Golder (2016d), Melbourne Metro Rail Project - Interpreted Hydrogeological Setting EES Summary Report - July 2016 Update, - Golder Report Number 1525532-332-R-Rev0, dated 29 July 2016.

Technical Note 7 - Ground movement and protection measures

Technical Note 8 - Soil and rock bore logs and CBD South update

Technical Note 11 - Franklin Street Adit

Technical Note 039 – Revised station construction methodology

Annexure B – Curriculum Vitae

Anthony Bennett

Technical Director

Anthony Bennett is an Executive in Aurecon's Melbourne Office with over thirty years design experience in civil engineering projects including underground structures and geotechnical analyses. His experience encompasses rock and soft ground tunnels, and analysis of civil structures with geotechnical interfaces. He was Area Leader for the Concept Development of the proposed rail tunnels in Melbourne Metro and continued with tunnelling advice for the Melbourne Rail Link. Recent work includes assessing the impacts of proposed developments on the MURL tunnels, and co-ordination of the reviews for the client on the Doha Expressway Programme.

Qualifications

B.E (Civil) (Hons), University of Melbourne

M. Eng. Sc., University of Melbourne

Fellow of the Institution of Engineers, Australia

Chartered Professional Engineer

Chartered Engineer (UK)

Fellow of the Institution of Civil Engineers, London

Registered Building Practitioner

Member - Australasian Tunnelling Society

Specialisation

Tunnel Analysis & Design, Geotechnical Analysis, Civil Structures

Years in industry

36

Experience

1985 to present
Aurecon Australasia Pty Ltd
1986 to present

Leading design teams or contributing to:

- Melbourne Metro, various technical roles across tunnelling including review of tunnel and cavern design, review of interfaces with existing infrastructure, review of geotechnical and hydro-geotechnical information with respect to tunnelling and other underground works, and leading the development of a strategy for allowances and framework for reviews of future developments around the Metro.
- Melbourne Rail Link option studies for the tunnelled sections, particularly at the Yarra crossing, and at the South Yarra junction with the existing rail system.
- Co-ordinating reviews of the tunnel sections of the Doha Expressway programme for the client
- Site based overview of the selected ground support for the rock walls of the Wyndhamvale cutting in Basalt, Regional Rail Project, Package E
- Tunnel Area Leader for the Concept Development of Melbourne Metro Stage 1 & Melbourne Metro (combined)
- Melbourne Underground Rail Loop, Advice to VicTrack regarding the concrete lined tunnels and stations for the loading effects from adjacent building developments. Design checking and site inspection of tunnel protection work
- Site based overview of the selected ground support for the rock walls of the Wyndhamvale cutting in Basalt, Regional Rail Project, Package E
- Review of tender design for NWRL (NSW)

- Tunnelling components of the pre-feasibility study for the Doncaster Rail Link, Package C
- DOT Concept Development for Melbourne Metro Stage 2
- DOT studies for feasibility of reconfiguring the Melbourne Underground Rail Loop, the extension of the Melbourne Metro east of Caulfield and the initial section of an extension to Rowville, from Huntingdale to Springvale Road.
- Project Leader for the functional designs of the Epping Craigieburn Sewer Project Stages 1 & 2 including alignment selection, and construction planning
- Design representative on site for the excavation and primary support in the EastLink tunnels.
- Design Portal Works for the tunnels of the EastLink Project and overall responsibility for the supplementary geotechnical investigations.
- Providing technical advice to the PTA (WA) on the tunnel linings of the New CityRail Tunnels, Perth.
- Review of Northern Diversion Sewer and Northern Interceptor Sewers for advantages of combining aspects of the construction.
- Scoping Studies and Phase 1 Investigations for the tunnels of the Northern Diversion Sewer for Melbourne Water including concept design and alignment selection.
- Verification of the tunnel design for the Cross City Tunnel, Sydney and the Mitcham Frankston Freeway, Melbourne
- Tender design for the tunnels of the Eastern Freeway Extension and Cross City Tunnel, Sydney.
- Tender design for S1 Sewer, Brisbane and M5 East Motorway, Sydney.
- Roadworks, tunnels, storm water and sanitary drainage, including:
- New Riverside Park Melbourne involving design of 8 m high embankments on Coode Island Silt. Design of structures to cope with long term subsidence.
- Port Hedland Harbour Tunnel.
- West Ryde Storm water Tunnel - Primary lining.
- North Yarra Main - Lloyd Street Refurbishment.
- Freeway and Interchange works on the Calder Freeway.
- Perth Main Sewer lining design.
- Commercial developments at South Gate and Riverside Quay, Melbourne.
- Optus GSM Network - design of monopole foundation.

Project Engineer for:

- Assessment of geotechnical design parameters for retaining wall and slope stability analysis including Boronia Rail Crossing design and Westgate Bridge Pier 12 bund review.
- Review of preliminary lining costings for alternative routes for PURD, Perth.
- Assessment and selection of alignment and structural options for Western Harbour Crossing, Hong Kong and preliminary design of roadworks and bridge structures.
- Assessment of Esso Long Island Point Liquids Pier for loading from Tadano Mobile Crane, using 3D Finite Element modelling.

Design Engineer on the following projects:

- Tender design, Melbourne City Link Tunnels for Chart Roads
- Sydney Airport Third Runway, Preliminary design of pavement and storm water drainage.
- Cityrail Bridge Study for SRA of NSW, Site assessment of 300 rail and road bridges.
- N W Sewer, Design checking of lining for tunnel for Streamline Australia (Melbourne Water).
- Site investigation and analysis of 100 year old brick-lined railway tunnel at Geelong including use of ground penetration radar in conjunction with CSIRO.
- Riverside Quay Development, Design of riverside works on the Yarra for construction of the, including optimizing the entrance shape to ensure flushing of the water feature by river flow using hydraulic model testing at Monash University.
- Trauma Centre, Alfred Hospital, Design of Helipad spanning roadway using precast prestressed concrete beams.
- Feasibility studies for quarry railway sidings, and VFT routes.
- Use of finite element analysis to predict settlement at railway tracks, due to tunnelling operations.
- Assessment of existing underground railway station structures and bridge structures for effects of heavy mobile crane loadings.
- Geotechnical analysis and reporting of site investigations for railway and roadway cuttings, and cement silos adjacent to river banks, including calculation of slope stability and settlement at: ETRB Belgrave, Austin Hospital, ACL Port Melbourne and Goliath, Devonport.

1985

Civil Design Engineer, Darwin Office responsible for design and documentation of civil engineering aspects of various projects including various commercial/tourism complexes, contract packages for the Tindal air base plus the complete project for providing a new

access road to the Darwin Ferry Terminal which involved major earthworks and drainage works.

1980 to 1984

Freeman Fox and Partners, UK

1983 to 1984

Hull, UK

Assistant Engineer

Involved in construction of 3 km of Trunk Road and 2 km of slip roads and interchanges on the A63 South Docks Road Project including reinforced and prestressed concrete structures including bridges and subways, earthworks and pavement construction; construction of surface water drainage including an outfall into the Humber Estuary, and diversions and provision for development for telephone, power, water and gas.

1980 to 1983

Design Office, London

Assistant Engineer

Designed reinforced and prestressed concrete bridges for motorway systems in Kuwait. Worked on design of 260 m reinforced concrete tower and 460 m, 22 span access bridge (prestressed, precast) for Abu Dhabi and prestressed viaduct structures and transfer slab above station for the Hong Kong Mass Transit Railway.

1975 to 1977

R M Parsons - Student Engineer

Annexure C – Instructions to Prepare Report

HERBERT SMITH FREEHILLS

Anthony Bennett
Technical, Planning and Engagement Advisor
AJM
121 Exhibition Street
Melbourne Vic 3000
Anthony.bennett@aurecongroup.com

14 June 2016
Matter 82449055
By Email

Dear Mr Bennett

Confidential and Privileged

Melbourne Metro Rail Project
Engagement of Expert Witness - Ground Movement / Future Development Loading

We are acting as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**). Your impact assessment report has been exhibited as part of the Environment Effects Statements (**EES**) for the Project.

1 Background

The EES is on public exhibition for six weeks from 25 May to 6 July 2016. At the completion of the public exhibition period, a panel of inquiry (**Panel**) appointed by the Minister for Planning under the *Environment Effects Act 1978* will consider and report on the EES. There are three key steps in this process that affect you:

(a) The Panel will convene a directions hearing on 26 July 2016;

(b) At the directions hearing, the Panel will direct the Authority to file and serve expert witness statements, probably 5 or 10 business days before the Panel hearing starts. For planning purposes, you are asked to assume this date will be on or about Monday 8 August 2016. We will advise you of the exact date for filing and serving statements after the directions hearing; and

(c) At this stage, you are asked to assume the Panel will commence the inquiry on or about Monday 22 August 2016. We anticipate the hearing could last up to six weeks.

During the hearing, Panel members will hear submissions and evidence on the merits and impacts of the Project from the Authority, government agencies, supporters and opponents of the Project.

We are unlikely to have all of the public and government agency submissions on the EES until the end of the public exhibition period about mid-July 2016. So that the Authority's case is fully prepared, Herbert Smith Freehills has been asked to begin preparing for the Panel now.

2 Scope

2.1 Expert Witness statement

We would like you to prepare a witness statement in accordance with Planning Panel Victoria's *Guide to Expert Evidence* which prescribes the content and form of expert witness statements. We enclose a copy of the Guide for your reference. You are required to review and understand the Guide and to ensure your witness statement addresses all matters set out in the Guide in particular those matters listed under the heading content and form of expert's

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report. Please contact us if there is anything in this Guide which you do not understand, or if you have any questions in relation to it.

You should commence preparing your witness statement with the preliminary matters required as set out in the Guide such as:

(a) An unambiguous reference to the technical report or reports that you rely upon. In this regard your witness statement should refer to both future development loading work and ground movement assessment;

(b) A statement to the effect that you adopt the findings in the exhibited report and identifying any departure from the findings and opinions you express in your report exhibited with the EES;

(c) Any key assumptions made in preparing the report; and

(d) Whether the exhibited report is incomplete or inaccurate in any respect.

Once we receive submissions relevant to your area of expertise we will also request you consider those submission and respond to relevant matters in your witness statement.

2.2 Presentation

We also encourage you to prepare a PowerPoint presentation for you to present in the Panel. This will be a presentation of your evidence, and as a 'rule of thumb' we suggest you work on the basis that your evidence could take about 45 minutes.

2.3 Availability

You will need to be available to give evidence to the Panel at some time during the course of the Panel proceedings. Your evidence is likely to be in the first two weeks of the Panel hearing, although we will advise you of the times and dates when they become available. We may also ask that you be available at other times when evidence is being called by other Authority experts whose evidence is relevant to yours, or by experts retained by other parties.

3 Fee estimate and invoicing

It is important to note that you will continue to be contractually engaged by the Authority. The Authority will continue to be responsible for the payment of your fees and your accounts should be sent directly to the appropriate person nominated by the Authority.

4 Confidentiality

Your expert report prepared in accordance with this retainer is confidential and is not to be copied or used for any purpose unrelated to the Panel hearing without our permission.

Material supplied by Herbert Smith Freehills is, unless it is already in the public domain, confidential and is not to be copied or used for any purpose unrelated to your retainer without our permission.

5 Conflict of interest

As an expert, it is important that you are free from any possible conflict of interest in providing your advice. While we assume you have no conflict of interest given your role in preparing the EES, you should again ensure that you have no connection with any potential party to the panel hearing which could preclude you from providing your opinion in an objective and independent manner.

6 Communications

Unless advised otherwise, all communications, whether verbal or written, should be directed to our office so that we can coordinate, manage and integrate work activities with legal requirements and ensure legal professional privilege is maintained as appropriate. It is however quite appropriate for your communication to be copied into the Authority.

HERBERT SMITH FREEHILLS

7 Your duties and responsibilities as an expert witness

As set out in the Guide, an expert witness has a duty to the Panel and not to the person engaging the expert. You are not an advocate for any party. Consequently, though you are retained by the Authority, you are retained as an expert to assist the Panel, and have an overriding duty to it. The Panel will expect you to be objective, professional and form an independent view as to the matters in respect to which your opinion is sought.

Until your statement is in final form it should not be signed. You should, however, be aware that unsigned documents may need to be disclosed to other parties.

8 Important dates

It is important that you be available for the following dates, which assume a Panel commencement date of around 22 August 2016:

(a) Witness statement, addressing preliminary matters, due **6 July 2016**;

(b) Witness statement, including addressing all submissions, due **22 July 2016**;

(c) Final witness statements due to Herbert Smith Freehills on **3 August 2016** (including addressing any matters we ask you to address which may include issues raised by the Panel during the directions hearing);

(d) A PowerPoint presentation of your evidence for presentation at the Hearing due **17 August 2016**;

(e) Panel Hearing (indicative): Monday **22 August to 30 September 2016**.

It will be particularly important that you are available during July and early August when your statement and presentation is finalised, as there may be last minute issues and questions that we have in respect of those matters.

It will also be important for you to be available for the hearing dates, though you are likely to give evidence during the first two weeks of the hearing. If you give evidence, you will be expected to answer questions of the Panel and other parties, and you may be cross-examined by Counsel. We will contact you with the exact time or date of your evidence before the hearing commences, as soon as it is scheduled.

If you have any questions about this letter, your role in the hearing, or the approval process, and would like to discuss your availability or the content of your report, please contact us.

Yours sincerely

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Attached

1 Guide to Expert Evidence

HERBERT SMITH FREEHILLS

Mr Anthony Bennett
Technical, Planning and Engagement Advisor
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Level 8, 850 Collins Street
Docklands VIC 3008
anthony.bennett@aurecongroup.com

29 July 2016
Matter 82449055
By Email

Dear Mr Bennett

Confidential and Privileged

Melbourne Metro Rail Project
Further Instructions Concerning Preparation of Expert Witness Statement

We continue to act as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**).

1 Directions Hearing

A directions hearing was conducted by the Inquiry and Advisory Committee (**IAC**) appointed in respect of the Project on 26 July 2016.

The IAC made the following directions relevant to the preparation and circulation of your expert witness statement and your participation in the upcoming hearing:

(a) The hearing will commence on 22 August 2016 and conclude on or around 5 October 2016;

(b) The hearing will be conducted at the Mercure Hotel at 13 Spring Street, Melbourne;

(c) MMRA will likely be allocated ten days to complete its principal case, between 22 August 2016 and 5 September 2016;

(d) Expert witness statements must be prepared in accordance with Planning Panel Victoria's Guide to Expert Evidence and must be submitted to the IAC in electronic and hard copy formats by 10 am 12 August;

(e) Expert conclaves in respect of the following disciplines are to be conducted in the week commencing 15 August 2016. The experts participating in these conclaves are to prepare a statement which sets out matters upon which they agree and matters upon which they disagree relevant to their area of expertise. These statements will be provided to the IAC at the commencement of the hearing on 22 August 2016. The IAC has directed that the following disciplines be the subject of an expert conclave:

(1) Traffic;

(2) Heritage;

(3) Acoustics and vibration;

(4) Arboriculture;

(5) Land Contamination;

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(6) Groundwater; and

(7) Air Quality.

It is anticipated that the IAC will prepare a timetable in respect of the upcoming hearing which will identify the date and time that you will be required to present your evidence. We will advise you of these details when they are made available to us.

The purpose of this letter is to provide you with further instructions concerning the preparation of your expert witness statement, and to identify additional matters that you will need to address in preparing for your appearance before the IAC.

2 MMRA Technical Notes

Throughout the course of the hearing MMRA will prepare technical notes in response to requests for information made by the IAC or in respect of matters arising out of submissions made to the IAC or following consultation with relevant stakeholders (**MMRA Technical Notes**). The purpose of the MMRA Technical Notes is to set out MMRA's position in respect of particular issues or matters that arise throughout the course of the hearing.

The first group of MMRA Technical Notes – numbered 1 - 18 – was provided to the IAC at the Directions Hearing. Copies of those MMRA Technical Notes are enclosed.

MMRA Technical Notes 1 – 8 were prepared in response to a request for information made by the IAC on 13 July 2016 (a copy of which is attached). MMRA Technical Notes 9 – 18 document modifications to the Concept Design supported by MMRA.

You are instructed to review the enclosed MMRA Technical Notes and, insofar as they are relevant to your area of expertise, consider whether they give rise to a need to modify any of the proposed EPRs relevant to your area of expertise.

It is anticipated that MMRA will prepare further technical notes both in advance of, and during, the hearing. You may be instructed to review further technical notes prior to the completion of your witness statement or prior to giving evidence before the IAC.

3 Updated geological long section and borelog data

Golder Associates have provided:

- an updated version of the Geological Long Section, which is an update to the Geological Long Section which forms part of Appendix A (Geological Long Sections and Reliability Diagrams) to Appendix A (Golder Associates Geological Setting EES Summary Report) to Appendix P (Ground Movement and Land Stability Impact Assessment) of the exhibited version of the Environment Effects Statement for the Project; and
- borelog data, which forms the basis for the updated Geological Long Section.

You are instructed to review the enclosed Geological Long Section and borelog data and, insofar as they are relevant to your area of expertise, consider whether they give rise to a need to modify any of the proposed EPRs relevant to your area of expertise.

4 Environmental Performance Requirements

In preparing your expert witness statement you are instructed to critically evaluate the proposed EPRs that are relevant to your area of expertise. In doing so you should consider whether the EPRs establish an appropriate framework to govern the construction and operation of the Project if it ultimately differs from the Concept Design (but is still situated primarily within the Project Boundary as shown in the EES Map Book).

Your report should identify any modifications to the EPRs that you consider necessary.

5 Consolidated Instructions

For the purposes of assisting you to respond to the matters identified in Planning Panel Victoria's Guide to Expert Evidence (**Guide**) we have included a consolidated list of the instructions provided to you by Herbert Smith Freehills in respect of the preparation of your expert witness statement.

1 Prepare a witness statement that:

- addresses all matters set out in the Guide in particular those matters listed under the heading 'content and form of expert's report';
- describes any technical report that you reviewed or relied on in the preparation of your witness statement;
- states whether you adopt the findings in the exhibited report, identifying any departure from the findings and opinions you express in your report exhibited with the EES;
- includes any key assumptions made in preparing your report;
- states whether the exhibited report is incomplete or inaccurate in any respect

2 Address or respond to each of the public submissions we forwarded to you in your witness statement;

3 Review the enclosed MMRA Technical Notes and consider whether they give rise to a need to modify proposed EPRs relevant to your area of expertise; and

4 Consider whether the EPRs relevant to your area of expertise establish an appropriate framework to govern the construction and operation of the Project if it ultimately differs from the Concept Design

6 Template

We have prepared a template to assist you prepare and order your expert witness statement. You should treat the template as an aid and should not consider yourself constrained by it if you would prefer to structure your statement differently.

7 PowerPoint Presentation

We had previously instructed that you that you should prepare a PowerPoint presentation of your evidence to the Panel. Given the serious time constraints for the IAC hearing, a PowerPoint presentation may not be required by all witnesses. We will advise you closer to the hearing date whether a PowerPoint presentation will be required and, if so, the length of such presentation.

8. Important dates

We confirm the following dates in respect of the upcoming hearing:

(a) Final witness statements due to Herbert Smith Freehills on **10 August 2016**;

(b) Potential participation in expert conclave in the week commencing **15 August 2016.**

(c) A PowerPoint presentation of your evidence for presentation at the Hearing due **17 August 2016**;

(d) Panel Hearing: Monday **22 August to 5 October 2016**.

As noted above we will provide you with further details concerning your participation in the hearing upon receipt of the timetable from the IAC.

HERBERT SMITH FREEHILLS

0 8. Important dates

If you have any questions about this letter, your role in the hearing, or the approval process, and would like to discuss your availability or the content of your report, please contact us.

Yours sincerely

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Attached

1 Pro forma Expert Witness Statement

HERBERT SMITH FREEHILLS

Mr Anthony Bennett
Level 8, 850 Collins Street
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Anthony.Bennett@aurecongroup.com

1 August 2016
Matter 82449055
By Email

Dear Mr Bennett

Confidential and Privileged

Melbourne Metro Rail Project
Interpreted Hydrogeological Setting EES Summary Report

We continue to act as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**).

We refer to our letter of instruction dated 29 July 2016.

1 Updated Interpreted Hydrogeological Setting Summary Report

Golder Associates has provided us with an updated version of the Interpreted Hydrogeological Setting EES Summary Report (**Updated Interpreted Hydrogeological Setting Summary Report**) dated 29 July 2016, which we enclose in this letter.

2 Further instructions

We ask that you consider the Updated Interpreted Hydrogeological Setting Summary Report and insofar as it is relevant to your area of expertise

1 consider whether it gives rise to a need to modify any of the proposed EPRs relevant to your area of expertise; and

2 consider whether it causes you to depart from the findings and opinions that you express in the Ground Movement and Land Stability Impact Assessment exhibited with the Environment Effects Statement (EES).

Yours sincerely

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Attached

1 Interpreted Hydrogeological Setting EES Summary Report (July 2016)

HERBERT SMITH FREEHILLS

Mr Anthony Bennett
Level 8, 850 Collins Street
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Anthony.Bennett@aurecongroup.com

4 August 2016
Matter 82449055
By Email

Dear Mr Bennett

Confidential and Privileged

Melbourne Metro Rail Project
Interpreted Geological Setting EES Summary Report

We continue to act as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**).

We refer to our letter of instruction dated 29 July 2016, and our letter of further instruction dated 1 August 2016.

1 Updated Interpreted Geological Setting EES Summary Report

Golder Associates has provided us with an updated version of the Interpreted Geological Setting EES Summary Report (**Updated Interpreted Geological Setting Report**) dated 3 August 2016, which we enclose in this letter.

2 Further instructions

We ask that you consider the Updated Interpreted Geological Setting Report and, insofar as it is relevant to your area of expertise:

1 consider whether it gives rise to a need to modify any of the proposed EPRs relevant to your area of expertise; and

2 consider whether it causes you to depart from the findings and opinions that you express in the Ground Movement and Land Stability Impact Assessment exhibited with the Environment Effects Statement (**EES**).

Yours sincerely

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Attached

1 Interpreted Geological Setting EES Summary Report (August 2016)

HERBERT SMITH FREEHILLS

Mr Anthony Bennett
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10 August 2016
Matter 82449055
By Email

Dear Mr Bennett

Confidential and Privileged

Melbourne Metro Rail Project
Construction Methodology Technical Note

We continue to act as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**).

We refer to our letter 14 June 2016 engaging you as an expert witness on behalf of the Authority.

1 Construction Methodology Technical Note

As you are aware, throughout the course of the hearing, the Authority will prepare technical notes in response to requests for information made by the IAC or in respect of matters arising out of submissions made to the IAC or following consultation with relevant stakeholders (**MMRA Technical Notes**). The purpose of the MMRA Technical Notes is to set out the Authority's position in respect of particular issues or matters that arise throughout the course of the hearing.

One of the MMRA Technical Notes has been drafted in respect of the construction methodology to be used for the Project (**Construction Methodology Technical Note**). We have enclosed it in this letter.

2 Further instructions

We ask that you consider the Construction Methodology Technical Note in the course of preparing your expert witness statement.

Yours sincerely

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Attached

1 Construction Methodology Technical Note (August 2016)

Annexure D – Detailed Response to Submissions

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
A number of submissions raised concern about the potential impact of the DDO on future development of the affected properties. This was raised in relation to limiting future development and a resulting reduction in the value of the property. There were also questions about how the owners of the affected properties would be informed.	MM013 MM207 MM250 MM257 MM299 MM300 MM301 MM308 MM327 MM362 MM367	The primary intent of the Design and Development Overlay (DDO) would be to instigate review of proposed developments that have the potential to affect the Melbourne Metro adversely and to control any inconsistent elements. A summary of the general intent of the DDO is included in Section 1.1 of the EES report Appendix J of the Future Development Loading report (which is an appendix of Technical Appendix E Land Use and Planning Impact Assessment). The Future Development Loading report notes that the presence of the Melbourne Metro would be unlikely to preclude future developments, but that engineering measures might be required in some cases to modify the effects on the development. In areas of shallow cover, there might a limitation on the number of basements that could be constructed. The type and extent of any measures within a future development required to protect the Melbourne Metro would depend upon the proposed development and its spatial relationship to the underground structures. Melbourne Metro would incorporate design measures to allow for a portion of potential development effects by including allowance for future developments as described in Section 3 of the Future Development Loading report. Section 3.2 also notes that it is anticipated that a technical guide would be developed by the referral authority to assist developers in identifying and	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
		addressing potential issues under the DDO. It should be noted that Melbourne Underground Rail Loop (MURL) currently imposes constraints on developments that are built over or in the vicinity of its assets. Although the controls are dealt with through a legislative scheme, Section 54 of the Transport (Compliance and Miscellaneous) Act 1983, the technical assessments are similar to what would occur to protect Melbourne Metro. The presence of MURL has not prevented developments in its vicinity, as can be seen along Spring Street and La Trobe Street, although some of these developments have included specific measures such as deepened piles or construction staging.	
Submissions noted that the Design and Development Overlay adds an additional planning application process, which would be more onerous than for properties outside the Design and Development Overlay.	MM180 MM207 MM228 MM250 MM362	The DDO would properly impose additional requirements on development proposals that have the capacity to impact adversely on the structural integrity and operation of the underground structures. The proposed Schedule to Clause 43.02 (Design and Development Overlay), identifies information that must accompany planning permit applications made under the DDO. The list is based on documents that would be readily available in some form for major developments. For all developments, but particularly for smaller developments, the information must be provided as appropriate. It is anticipated that a technical guide would be developed by the referral authority to assist in identifying and addressing potential issues under the DDO.	No
This submission suggested that the exemptions should be extended to exempt any internal works with	MM318	The change proposed in the submission is not supported. While at face value, it would appear that the proposed change would be consistent with the proposed exemptions for a new building listed	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
structural changes down to 2 m below the ground surface, and for the exemptions to be reviewed after construction.		in the draft Schedule to the DDO, the latter case is also limited with respect to the overall height of the proposed development, and therefore by inference, the overall change in loading that would be imposed on Melbourne Metro. The intention of the exemptions being limited to above ground work is to avoid a complicated set of requirements for assessment around changes to structures that already exist. The proposed requirements would capture any works to strengthen foundations, and would thus mean that the changes of a building with no works below ground level are unlikely to change its loading into the ground. I believe that if we tried to take a more flexible approach, the number of permutations would become unwieldy. As an example, the requirements for referral would need to be expanded to include the loadings from the existing structures and the size of the changes. It is expected, however, that the plan extent of the DDO would be reviewed at the completion of construction to account for any changes in the Project that occur during the detailed design and the construction phases and refined as required.	
A number of submission suggested that they should be excluded from the DDO by changing the boundary changes, particularly if there were no planned developments, or concerns about its constraints.	MM274 MM367	In developing the DDO, the fact that the tunnel has a design life of 100 years, and potentially will be an asset operating for longer, has meant that current development plans and planning controls would potentially be not applicable later in the Melbourne Metro's operational life. The rationale behind the extent of the proposed DDO in plan is explained in Section 2 of the Future Development Loading report. It adopts appropriately conservative assumptions that would adequately safeguard against potential impacts in the future. Any measures required to protect the Melbourne Metro	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
		from the effects of future development are engineering considerations, and would exist irrespective of the extent of the DDO. As already noted, it is expected that the proposed extent of the DDO would be reviewed at the completion of construction to account for any changes in the Project that occur during the detailed design and the construction phases.	
A number of submissions noted that their properties have planning approval already granted for development or master plans for new works in the vicinity of the tunnels. Some noted that the MM should avoid clashes or adverse effects on the proposed works.	MM100 MM287 MM288 MM295	Section 3.3 of the Future Development Loading report notes that additional loadings from approved future developments which are immediately above or adjacent to Melbourne Metro (i.e., within the DDO area), and for which there is a valid planning approval at the date that the DDO is applied to the land, would be assessed and the underground structures designed to minimise any impacts on the future developments. In effect, they would be regarded similarly to existing buildings. For approved developments where the construction period might overlap that of the Melbourne Metro, there would be a need for co-ordination and consultation as the analyses of the interactions will depend upon which is constructed first.	No
A number of submissions raised a general concern about damage to properties that might arise from being in the vicinity of the tunnels or stations.	MM008 MM012 MM059 MM096 MM101 MM216	The ground movement EPRs are drafted to achieve the broad EES Objective of avoiding or minimising adverse effects on land stability that might arise directly or indirectly from project works. The EPRs establish the framework within which the Project will be designed and built, and sets more detail around the processes that will be used to limit any damage on buildings among other structures. The Ground Movement and Land Stability Impact Assessment identified the likely sources of	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM219 MM222 MM238 MM258 MM266 MM285 MM290 MM324 MM327 MM377	ground movements, and the EPRs include requirements to assess and manage these effects. While phrased in broad terms, they appropriately cover the processes that would be expected to be conducted during the detailed design and the construction phases. To confirm the feasibility of achieving the objectives and to assess whether there are any unusual aspects requiring further consideration, the EES has used the Concept Design to make preliminary predictions of ground movements and the resulting damage to buildings at representative sections. The results are reported in Section 8 of the Ground Movement and Land Stability Impact Assessment. The predicted outcomes are typically between negligible and minor. The predicted outcomes, following industry practice (modified to be consistent with other Melbourne Metro terminology) are described in terms of ease of repair.	
A number of submissions raised questions about the potential for damage from consolidation settlement caused by drawdown of the ground water table. Some asked for information on the parameters used for the predictions of these effects.	MM023 MM109 MM207 MM228 MM274 MM299 MM300 MM301	The predictions for the settlements that result from potential drawdown of the ground water are described in the Ground Movement Assessment - EES Summary Report by Golder Associates (2016b), an appendix of Ground Movement and Land Stability Impact Assessment. The predictions come from combining the predictions of the groundwater modelling (Technical Appendix O) with the ground conditions described in the Interpreted Geological Setting EES Summary Report (2016a). Over most of the alignment, the existing levels of ground water table are at a depth which places it below the softer near surface soils. In these cases, the changes in ground loading that occurs if the water table level is lowered occurs in	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM321 MM367	rock or stiff soils, where the resulting movements are negligible. The predicted surface movement are shown in drawings in the appendix of the Ground Movement Assessment - EES Summary Report (by Golder Associates 2016b). These indicate four potential areas where the draw down will occur in softer ground conditions. Of these, only two are predicted to exceed 10 mm, which is the value adopted as significant for building assessments for consolidation settlement. One area extends under J J Holland Park and southwards into the industrial or railway land. The adjacent areas of Kensington are protected by the basaltic rock on which it is founded. The second area is in the former railway yards in North Melbourne affected by the construction of Arden station. There is no settlement from groundwater drawdown predicted for the areas of North Melbourne east of Laurens Street, where the geological conditions become more favourable. Two specific areas of concern were raised in the submissions. At St Paul's Cathedral, the groundwater levels are at or near the top of the Melbourne Formation rock, and therefore any draw down effects will be in the stiffer ground material. At the Arts Centre, where the surrounding surface is on the softer ground, the groundwater draw down is limited, and therefore the predicted settlements are less than 10 mm. The Ground Movement Assessment - EES Summary Report by Golder Associates (2016b) includes summaries of parameters used to date for Coode Island Silt, for Pleistocene Alluvium and for Werribee Formation. The Project's EPRs recognise that the potential damage from	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
		consolidation settlement would need to be managed. GM1 links to the groundwater EPRs. GM3 requires the development of a ground movement plan. In my opinion, these EPRs would manage this issue.	
Potential impact on the ability to let a property if subject to cracking.	MM010	While the EPRs are designed to minimise damage to buildings, there would be cases where some cracking cannot be avoided. The assessed impacts are limited to cosmetic damage and would require repairs that are consistent with that carried out during routine or periodic maintenance.	
These submissions raise particular concern about the eight Victorian terrace houses from 222 to 234 Leicester Street, and at other residences of a similar age.	MM100 MM207 MM221 MM228	The preliminary assessments conducted to date take into account the type of construction when estimating the likely response of a building. At the Level 2 analyses described in Section 5.3 of the Ground Movement and Land Stability Impact Assessment, the description of the building type is not very sophisticated. However, the Level 2 analyses are designed to highlight the structures that warrant further consideration, particularly if the Level 2 analyses predict damage greater than minor. As well as identifying structures that might be susceptible to damage through developing a ground movement plan, EPR GM3, the nature and current condition of a building would be assessed in the process of a pre-condition survey, EPR GM4.	
This submission raises concerns about the risk of settlement induced damage when the depth of cover is 15 m	MM119	The preliminary assessments conducted to date take into account the depth of tunnelling when estimating the likely response of a building and therefore the fact that there is 15 m does not change the assessment.	
This submission raises concerns about	MM142	As well as identifying structures that might be susceptible to	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
further damage in a building that has already suffered damage and has required to be stabilised, or has been constructed on fill and is therefore potentially more vulnerable. There was also concern raised concerning buildings that are deteriorating because of age (although not necessarily a heritage building, but past its design life)	MM155 MM308	damage through developing a ground movement plan, EPR GM3, the nature and current condition of a building would be assessed in the process of a pre-condition survey, EPR GM4. It is also noted that the pre-construction survey is an opportunity to consult with the landowner.	
Raises concerns about the possible particular vulnerabilities at Christchurch in Punt Road, South Yarra, and St Paul's Cathedral. In the latter case, Level 3 assessments requested.	MM159 MM274 MM364	The preliminary assessments conducted to date take into account the type of construction when estimating the likely response of a building. At the Level 2 analyses described in Section 5.3 of the Ground Movement and Land Stability Impact Assessment, the description of the building type is not very sophisticated. However, the Level 2 analyses are designed to highlight the structures that warrant further assessment. There are a number of factors that would be considered when addressing specific structures in the ground management plan which forms part of the EPR GM3. In these particular cases, the form of the structures would be used to determine the type of analyses that should be adopted to determine the acceptable ground movement criteria. The preliminary predictions of ground movement from the Concept Design place Christchurch outside the Potential Zone of Influence, but this will be re-assessed as part of the ground management plan.	
This submission raises concerns particularly about the assessment in	MM207	The submission identifies that at the time of the EES, there was a substantial gap in the investigations in the area of Courtney	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
areas with a lack of geotechnical data as the basis in the area shown on Sheet 7.		Street, and between Curzon Street and Flemington Road. The assessment of ground movement was based upon inferred geological conditions based upon a general knowledge of the area, and the confidence in the geological details in the area was noted as very low. The Project has been proceeding with a programme of investigations that has included six additional boreholes in this zone and the confidence has increased to moderate. Some of the concerns about the assessments might be clarified by noting that, while appearing on Sheet 7 of the drawing sets in Appendix A of the Interpreted Geological Setting EES Summary Report (2016a), this length of the alignment is designated Segment 9 within the geotechnical reports.	
These submissions raise a number of issues with respect to the adopted construction technique for tunnelling. Concerns are raised that the use of a TBM increases the risk of ground movement compared with the mined tunnel option adopted for the CBD section. These can arise either through disturbance of the groundwater, or the action of the TBM itself.	MM109 MM228 MM253 MM299 MM300 MM301	It is not intended that the Concept Design preclude the use of other methods of tunnelling, provided that the contractor complies with the EPRs. However, the use of a TBM has a number of advantages over other methods of tunnelling, particularly with regard to limiting ground movement and the inflow of ground water. The TBM is designed to maintain appropriate pressure against the excavation face as it is advancing, limiting movement from that direction, particularly if the tunnelling encounters a more fractured or weathered zone. A TBM also allows the installation of the final structural lining close to the excavation, limiting the ability of the ground to move into the excavation, and sealing the tunnel as quickly as possible. It would be possible to augment these features of a TBM using ground treatment, but in the ground conditions under North Melbourne it is unlikely that this would be needed. Given the depth of the water table in North Melbourne and the stiff nature of	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
		the ground, it is not expected that there would be any effects from overpressure in the ground water.	
Concerns about proximity to the tunnels with already shallow cover, where there is a partial basement	MM250 MM253	As well as identifying structures that might be susceptible to damage through developing a ground movement plan, EPR GM3, the nature of a building would be assessed in the process of a pre-condition survey, EPR GM4. It is also noted that the pre-construction survey is an opportunity to consult with the landowner, and identifies that a data base of as-built information is maintained. Such details would highlight where more detailed assessments are required to predict the effects of settlement on the structure and whether additional measures are required in accordance with EPR GM3.	
The EES does not include any discussion of a mechanism to preserve the structure and foundations of the building adjacent to the CBD South shaft	MM310	The EPRs are drafted to achieve the broad EES Objective of avoiding or minimising adverse effects on land stability that might arise directly or indirectly from project works. A detrimental effect of excavation works for the shaft construction would occur through ground movement and therefore comes under the requirements of the measures described in the EPRs related to ground movement. The EPRs establish the framework within which the Project would be designed and built, and sets more detail around the processes that will be used to limit any damage on buildings. To confirm the feasibility of achieving the objectives, the EES assessment has used the Concept Design to make preliminary predictions of ground movements and the resulting damage to buildings at representative sections. The predicted outcomes are minor. The predicted outcome, following industry practice (modified to be consistent with other Melbourne Metro	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
		terminology) is described in terms of ease of repair.	
This submission questioned the coverage of assessments, and damage descriptions, and provided historical information from reports from the construction of Princes Bridge	MM364	The assessment carried out for the EES has addressed representative buildings of various types along the alignment. There is also a particular list of specifically heritage listed buildings included in Section 8.2 of the Ground Movement and Land Stability Impact Assessment. Princes Bridge has been addressed specifically in Section 9.7 of the same assessment. Christchurch in South Yarra currently lies outside the Potential Zone of Influence for ground movement. The terminology used to describe the types of predicted damage is based upon standard usage that has been developed in the industry. Table 5-7 of the Ground Movement and Land Stability Impact Assessment shows how the terms used in this EES (modified to be consistent with other assessments within this Project) correlate to the normal terms. It should also be noted that the terms were originally derived to correspond to the difficulty of repair. The report from the construction of Princes Bridge highlights the importance of historical records which provide notice of difficult conditions or other matters that should be investigated further. This particular report related to the southern approaches of the bridge, and is of relevance to the tunnels between the south bank of the Yarra River and Linlithgow Avenue.	
This submission suggests that damage from the proposed cut and cover at Domain would be less if a	MM374	It is not intended that the Concept Design preclude the use of other methods of construction for stations, provided that the contractor complies with the EPRs with respect to ground	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
cavern was adopted.		movement. However the feasibility of any particular method needs to be considered in conjunction with ground conditions, and other requirements of the Project, such as those related to operation of the system.	
A number of submissions requested that a dilapidation survey be undertaken of their property prior to construction with some requesting the right to amend or conduct the survey independently	MM024 MM057 MM059 MM095 MM100 MM134 MM142 MM146 MM159 MM178 MM203 MM253 MM266 MM274 MM285 MM290	The EPRs identify that pre-construction surveys are to be conducted. The extent of the survey is part of the risk assessment carried out during the detailed design, when the ground movement management plan would begin to be developed. In particular, GM4 includes requirements to conduct pre-construction condition surveys for the assets predicted to be affected by ground movement. The results of condition surveys of structures, would be used to establish baseline (Pre-construction) conditions and also to identify any potential vulnerabilities It is also an opportunity to consult with landowners in relation to the condition surveys.	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM299 MM300 MM301 MM310 MM320 MM326 MM350 MM367 MM369 MM371		
Dilapidation survey after construction	MM095 MM100 MM134 MM178 MM203 MM207 MM253 MM285 MM299	The EPRs also identify that post-construction surveys are to be conducted, but allows for these only to be conducted where required. The initiation for this is not described, but would typically be when a landowner or the contractor wishes to confirm whether or not damage has occurred.	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM300 MM301 MM326 MM350 MM371		
These submissions requested monitoring during construction	MM100 MM134 MM142 MM159 MM178 MM266 MM274 MM303 MM320 MM367 MM370	Monitoring of ground movement during tunnelling is a usual good practice. It is used as one of the means of verifying that the assumptions made during the design and the development of the construction methodology. Another important role of monitoring is as a management tool to follow movement trends and to take action before the design limits are exceeded. Reflecting this, EPR GM3 requires monitoring to be included in the ground movement plan.	
A number of submissions requested more information on the mechanism and responsibility for repairs	MM100 MM146 MM159	EPR GM6 requires that properties and assets affected by ground movement have any required repair works undertaken. It is not the place of the EPRs to determine where these responsibilities lie within the Project boundary, but it is implied that an effective process must be established to satisfy this requirement.	No

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM203 MM228 MM253 MM274 MM285 MM299 MM300 MM301 MM326 MM350 MM367 MM370 MM371		
Review and approval of acceptance criteria and construction management plans, consulted as stakeholder	MM100 MM180 MM207 MM274 MM310 MM320	The EES recognises that stakeholders need to be informed of the predicted levels of ground movement and its effects and to be consulted with respect to the expected results, both in terms of effects, and remedial actions. For most residents, this could be included at the time of the condition survey. EPR GM4 and GM5 both refer to consultation with stakeholders.	

Issue	Submission No.	Response	Any Recommended New or Modified Environmental Performance Requirement
	MM364 MM367 MM370		
Width of zone of influence	MM228 MM253 MM367 MM369	The Potential Zone of Influence is discussed in Section 6.3 of the Ground Movement and Land Stability Impact Assessment. It is derived from the predicted settlement and is therefore a function of the depth of the tunnel and the geology. The extents shown in the assessment (Figures 6-5 to 6-9) are based on the analyses of the different conditions and construction methodologies along the alignment and varies accordingly.	