

**In the matter of the Melbourne Metro Rail Project**

**Planning Panels Victoria**

**Proponent: Melbourne Metro Rail Authority**

**Expert Witness Statement of  
Hugh MIDDLEMIS**

**Expert of Melbourne Metro Rail Authority**

## 1 Name and address

---

Hugh Middlemis  
Hydrogeologic Pty Ltd, PO Box 383, Highgate, 5063, South Australia.  
Phone: 0438 983 005. email: hmiddlemis@gmail.com

## 2 Qualifications and experience

---

Annexure A contains a statement detailing my qualifications and expertise and addressing the matters set out within Planning Panels Victoria Guide to Expert Evidence.

## 3 Scope

---

### 3.1 Role in Preparation of the EES

From December 2015 to April 2016, I was engaged by Melbourne Metro Rail Authority to undertake an independent peer review of the Groundwater Impact Assessment component of the EES for the Melbourne Metro Rail Project completed by Aurecon Jacobs Mott McDonald (AJM, 2016) for the Concept Design stage. The instructions for that independent peer review were to consider the assumptions, methodology and assessment of hydrogeological drawdown impacts relating to the Melbourne Metro Concept Design. The aim was to comment on whether the EES Scoping Requirements (Government of Victoria, 2015) had been adequately addressed, and whether appropriate recommendations had been made for the Detailed Design stage (e.g. monitoring, modelling).

Other than providing that independent peer review, I was not involved in preparation of the Groundwater Impact Assessment, nor indeed the EES, nor any detailed design investigations.

### 3.2 Instructions

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

### 3.3 Process and Methodology

Pursuant to the PPV Guide to Expert Evidence, this expert witness statement is based on the report of the independent peer review that I completed (Middlemis, 2016) in relation to the Groundwater Impact Assessment for the Concept Design stage of the project (AJM, 2016). There is no material departure of this statement from the findings and opinions expressed in the (exhibited) peer review report (Middlemis, 2016), which is not incomplete nor inaccurate in any material respect, and no new assumptions have been made for the purpose of this statement.

## 4 Findings

---

### 4.1 Summary of Opinions

- (a) I have reviewed the peer review report (Middlemis, 2016; presented as Appendix B to the Groundwater Impact Assessment (AJM, 2016), exhibited with the Environment Effects Statement (EES) in preparing this expert witness

statement. Save where otherwise indicated I adopt the peer review report (Middlemis, 2016) as the basis of my evidence before the Inquiry and Advisory Committee.

- (b) In summary, the findings from my peer review are that I concur with the Groundwater Impact Assessment (AJM, 2016) that most potential groundwater-related impacts are 'low' or 'very low' (in terms of initial risk), mainly because *"the Concept Design features and assumed construction techniques incorporate features that prevent large groundwater inflows, and therefore minimise groundwater drawdown and associated impacts on groundwater dependent values."* (AJM, 2016).
- (c) It is my professional opinion that the Groundwater section (Chapter 18) of the EES is a cogent descriptive summary of the EES Technical Appendix O (AJM, 2016).
- (d) It is my professional opinion that the Melbourne Metro Groundwater Impact Assessment (AJM, 2016) adequately addresses the EES Scoping Requirements at the Concept Design stage. The recommendations made for further field investigations and modelling studies to be undertaken at the Detailed Design stage are warranted and appropriate. The Environmental Performance Requirements (EPRs) and Groundwater Management Plan (GMP) recommendations are warranted and appropriate. The EPRs are robust and specifically designed for application to minimise or mitigate impacts during the design, construction and operational stages. For example, the GW1 EPR requires design elements to minimise groundwater-related impacts, and GW2 and GW3 effectively require the integrated development of the groundwater model with the GMP (in consultation with the EPA and other authorities), while GW4 and GW5 address the groundwater disposal and monitoring elements of the GMP. These EPRs are required to be applied during the concept design, detailed design and construction phases, to investigate changes to the design, construction and operational aspects, and to reconfirm that the measures proposed are sufficient to mitigate impacts in terms of groundwater levels, flow and quality, with monitoring to measure performance.

## **4.2 Any Additional Work Undertaken Since Exhibition of EES**

I have reviewed two additional reports issued by Golder Associates as "July 2016" updates to the Interpreted Hydrogeological Setting and the Regional Groundwater Numerical Modelling. These reports address to a certain degree uncertainties around cumulative construction impacts and aquifer specific storage parameters that were identified in my peer review (Middlemis, 2016). While the uncertainties have been investigated further in this additional work by Golder Associates, they have not yet been comprehensively addressed, although I consider that is not unreasonable at this Concept Design stage. The additional Golder Associates reports help to increase the extent and detail of the already adequate investigation of the EES Scoping Requirements. Indeed, they further support the Environmental Performance Requirements (EPRs) for further field investigations and modelling studies to be undertaken at the Detailed Design stage.

## **4.3 Response to Submissions**

I have reviewed the following submissions which raise issues concerning hydrogeology and/or related modelling: MM023, MM025, MM050, MM091, MM109, MM119, MM159, MM178, MM180, MM182, MM228, MM238, MM250, MM274, MM291, MM299, MM300, MM301, MM318, MM321, MM367, MM370, MM337.

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

## **4.4 Review of MMRA Technical Notes**

I have considered MMRA Technical Notes 1–18, and identified that number 8 (issued 26 July 2016) relates to hydrogeology and related modelling (my area of expertise). MMRA Technical Note number 8 identifies certain design changes (such as vertical alignment at CBD South) that may be required during subsequent stages of the MMRP (e.g. the

Detailed Design stage). However, I consider the potential impacts associated with such changes are within the limits of accuracy of the EES groundwater impact assessment, and that the EPRs are warranted, applicable and effective in helping to manage the effects of new information during the project development.

#### 4.5 Environmental Performance Requirements

I have reviewed the EPRs relevant to hydrogeology and related modelling and have identified one specific recommendation.

EPR No.	Original EPR	Recommended EPR <i>(suggested changes in red italics)</i>	Reason for Modification
GW2	<p>Develop a groundwater model for the detailed design phase to predict impacts associated with any changes to construction techniques or operational design features proposed during detailed design, and reconfirm that the Environmental Performance Requirements and mitigation measures are sufficient to mitigate impacts from changes in groundwater levels, flow and quality.</p> <p>Undertake monitoring during construction to ensure that predictions are accurate and mitigation measures are appropriate.</p>	<p>Develop a groundwater model <i>in a process that involves ongoing independent review consistent with the Australian Groundwater Modelling Guidelines (Barnett et al, 2015). Apply the model</i> for the detailed design phase to predict impacts associated with any changes to construction techniques or operational design features proposed during detailed design, and reconfirm that the Environmental Performance Requirements and mitigation measures are sufficient to mitigate impacts from changes in groundwater levels, flow and quality.</p> <p><i>The groundwater model should be updated to address comprehensively; transient calibration, aquifer specific storage parameter values and their justification, prediction of cumulative impacts during construction and uncertainty assessments.</i> Undertake monitoring during construction to ensure that predictions are accurate and mitigation measures are appropriate.</p>	<p>The peer review that has been undertaken through the EES preparation process (Middlemis, 2016) has occurred post-priori in relation to reports prepared. There has been no opportunity to review the model calibration performance prior to the predictions, nor to review proposed uncertainty scenarios to check that the issues identified by the peer review (e.g. aquifer specific storage parameters) would be comprehensively investigated.</p> <p>The modelling guidelines (Barnett et al, 2012) recommend progressive reviews. In this case, that should involve discussions between the MMRA, the technical team and the independent peer reviewer to accommodate the iterative nature of groundwater modelling and ensure that the project objectives can be achieved and the model performance objectively confirmed as fit for its stated purpose, with key uncertainties investigated to adequate degree of detail.</p>

## 5 Declaration

---

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 Engineering), University of Adelaide, South Australia, 1980
- M.Eng.Sci. (Hydrology and Hydrogeology), University of New South Wales, 1990

### Professional Associations

- Chartered Professional Engineer. Member of National Committee on Water Engineering (1997 to 2004), Institution of Engineers Australia.
- Member, International Association of Hydrogeologists (IAH). Member of National Executive IAH (2002-2005).

### Employment History and Achievements

Hugh Middlemis has over 35 years' experience on engineering, hydrogeology, hydrology and modelling investigations and related management for natural resources, the built environment and mining/energy projects across Australia and internationally. Hugh was principal author of the 2001 groundwater modelling guidelines and was awarded a Churchill Fellowship in 2004 to benchmark groundwater modelling against international best practice. Hugh established Hydrogeologic as an independent consultancy in 2013.

Hugh is a leading groundwater modeller and independent reviewer, with more than 25 years' experience in this field specialising in flow and solute models, stream-aquifer interactions and groundwater dependent ecosystems. Hugh Middlemis has appeared before PPV and VCAT regarding the following recent cases.

- In 2014, Hugh Middlemis provided expert Hydrogeologist and Groundwater Modelling inputs to the PPV EES Inquiry Panel hearings on the Stockman Base Metals Project (before Chair Ms Cathie McRobert on 24 June 2014 at Lakes Entrance).
- In 2014, Hugh Middlemis appeared as an expert Hydrogeologist at the Victorian Civil and Administrative Tribunal Compulsory Conference in relation to Tutchewop Lakes (before Senior Member Levine on 28 April 2014).

Hugh has completed projects across Australia, and in Africa, Indonesia, Ireland, Mongolia, Oman, South America, the UK and the USA, and was based in the UK for 4 years in the early 1990s. Professional experience summary:

- Principal Groundwater Engineer, Hydrogeologic Pty Ltd, since July 2013.
- Senior Principal Water Resources Engineer, Aquaterra and RPS-Aquaterra in Perth (WA) and Adelaide (SA), 1998 – 2013.
- Senior Water Resources Engineer, Woodward-Clyde, Perth (WA), 1994–98.
- Senior Modeller, Water Management Consultants, Shrewsbury (UK), 1990-94.
- Senior Groundwater Modeller, SA Department of Agriculture, 1989-90.
- Hydrologist (Hydrology and Hydrogeology Units), NSW Department of Water Resources, Sydney, 1985-1989.
- Engineer Operations, NSW Department of Water Resources, Wakool and Deniliquin Irrigation Districts, 1982-85.
- Graduate Engineer, Minenco Pty Ltd, Melbourne, 1981.

### Expertise to Make Report

My key expertise to make this witness statement is in the fields of hydrogeology and groundwater modelling.

Key areas that fall outside my expertise and were not considered during the independent review nor in preparation of this statement include:

- groundwater contamination risks that are addressed in the EES Technical Appendix Q on Contaminated Land and Spoil Management, including acid sulfate soils and also the risk of contaminated groundwater ingress to the proposed tunnels and stations
- land settlement risks due to groundwater drawdown discussed in the EES Technical Appendix P on Ground Movement and Land Stability.

**Other Significant Contributors to the Report (if any)**

Not applicable.

**Instructions to Prepare Report**

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

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

Not applicable.

**Reports Relied Upon to Prepare Expert Witness Statement**

Primary report that was subject to independent review (Middlemis, 2016) and was exhibited as EES Technical Appendix O:

- Aurecon Jacobs Mott McDonald Joint Venture (2016). Melbourne Metro Rail Project Groundwater Impact Assessment. Prepared for Melbourne Metro Rail Authority. Dated 20 April 2016. AJM Reference MMR-AJM-PWAA-RP-NN-00826. 325pp.

Secondary report in the form of Chapter 18 of the EES that was prepared as a more descriptive summary of the AJM (2016) Groundwater Impact Assessment.

Secondary reports considered during the preparation of this statement:

- Golder Associates (2016a). Melbourne Metro Rail Project Concept Design. Interpreted Hydrogeological Setting – EES Summary Report. Prepared for AJM Joint Venture. Dated 14 April, 2016. Presented as Appendix G to Technical Appendix O of the exhibited EES.
- Golder Associates (2016aa). Melbourne Metro Rail Project. Interpreted Hydrogeological Setting EES Summary Report – July 2016 Update. Prepared for AJM Joint Venture. Dated 29 July, 2016.
- Golder Associates (2016b). Melbourne Metro Rail Project Concept Design. Regional Groundwater Numerical Modelling – EES Summary Report. Prepared for AJM Joint Venture. Dated 14 April, 2016. Presented as Appendix H to Technical Appendix O of the exhibited EES.
- Golder Associates (2016bb). Melbourne Metro Rail Project. Regional Groundwater Numerical Modelling EES Summary Report – July 2016 Update. Prepared for AJM Joint Venture. Dated 1 August, 2016.
- MMRA Technical Note no.8. Soil and Rock Bore Logs. Response to item 8 of the IAC request dated 13 July 2016. Potential Modification to vertical alignment at CBD South.

The independent peer review report itself:

- Middlemis, H. (2016). Melbourne Metro Rail Project Independent Review of Groundwater Impact Assessment. Prepared by Hydrogeologic for Melbourne Metro Rail Authority (through Herbert Smith Freehills). 21 April 2016. 10pp.

## Annexure B – Instructions to Prepare Report

---

(insert separate PDF from Herbert Smith Freehills)



Mr Hugh Middlemis  
Principal Groundwater Engineer  
Hydrogeologic Pty Ltd  
PO Box 383  
Highgate, SA 5063  
hugh@hydrogeologic.com.au

22 June 2016  
Matter 82449055  
By Email and Post

Dear Mr Middlemis

Confidential and Privileged

## **Melbourne Metro Rail Project Engagement of Expert Witness - Groundwater**

We are acting as legal advisors to the Melbourne Metro Rail Authority (**Authority**) in connection with the Melbourne Metro Rail Project (**Project**). Your independent review of the groundwater impact assessment has been used 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.

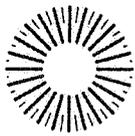
We are unlikely to have all of the public and government agency submissions on the EES until the end of the public exhibition period about mid-July 2016. So that the Authority's case is fully prepared, Herbert Smith Freehills has been asked to begin preparing for the Panel now.

### **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 (**Guide**) 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

Doc 53286687.2



heading 'content and form of expert's 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 any technical report or reports that you prepare and rely upon;
- (b) Technical reports that you reviewed in preparation of your report;
- (c) A statement to the effect that 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;
- (d) Any key assumptions made in preparing your report; and
- (e) 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 Additional information**

As you are aware, the groundwater impact assessment prepared by AJM for the EES identified further work required prior to the commencement of construction. Where such work is undertaken and reported prior to the hearing, you may be asked to provide a peer review of this work.

## **4 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.

## **5 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.

## **6 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 peer reviewing the EES groundwater impact assessment, 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.



## **7 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.

## **8 Your duties and responsibilities as an expert witness**

As set out in the Guide, an expert witness has a paramount 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.

## **9 Important dates**

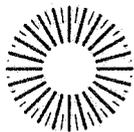
It is important that you be available for the following dates, which assume a Panel commencement date of around 22 August 2016:

- (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 that may have been 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.



HERBERT  
SMITH  
FREEHILLS

Yours sincerely

**Tim Power**  
Partner  
Herbert Smith Freehills

+61 3 9288 1484  
+61 419 104 681  
tim.power@hsf.com

**Heidi Asten**  
Special Counsel  
Herbert Smith Freehills

+61 3 9288 1710  
+61 424 185 663  
heidi.asten@hsf.com

Herbert Smith Freehills LLP and its subsidiaries and Herbert Smith Freehills, an Australian Partnership ABN 98 773 882 646, are separate member firms of the international legal practice known as Herbert Smith Freehills.

Attached

- 1 Guide to Expert Evidence

## Annexure C – Detailed Response to Submissions (Hydrogeology)

Issue	Submission No.	Response  (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
Impacts of tunnel under Yarra River, including settlement at bridges and recharge well effects (CBD South to Domain precinct).	MM023	EES adequately considered drawdown risks during construction in the area of the CBD South station (mined construction) and Yarra crossing (tunnel boring machine). Potential mitigation measures were identified such as grouting and/or temporary recharge bores (EES 18.8, 18.13; TAO 4.5, 7.6, 12; GA 8.2.1). Predicted drawdown of 0.2 to 0.5 m subsequently during operation (TAO 12) since inflows would be largely prevented by the Haack tightness classification (EES 18.8, 18.13; TAO 4.5, 7.6, 12.4; GA 8.3). Evidence indicates that the Yarra River is not strongly connected to groundwater (TAO 5.6), and thus any drawdown effects would have negligible effect on surface waters (EES 18.5.6). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures, including effects on existing recharge wells.	
Construction - drawdown causing impacts on groundwater and drainage (Arden to Parkville precinct)	MM025	The tunnel boring machine construction method, immediate tanking and Haack 3 tightness classification for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8; TAO 4.5, 9.4). Temporary recharge bore mitigation measures were identified for the Arden station construction (EES 18.10; TAO 4.5, 9.4; GA 8.2.4). Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate for this area and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - drawdown causing settlement near Kensington precinct	MM050	EES adequately considered drawdown risks during construction and identified temporary recharge bore mitigation measures and/or grouting (EES 18.9.1; TAO 4.5; GA 8.2.6). EES also identified minimal drawdown subsequently during operation since inflows would be largely prevented by the Haack 3 tightness classification (EES 18.9.2; TAO 4.5; GA 8.2.6, 8.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures.	

Issue	Submission No.	Response (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
Construction – minimise potential for discharge of groundwater into stormwater system	MM091	EES identified that the Groundwater Disposal Strategy (GDS) must be based on the detailed design phase groundwater model and must be in place for the early works program (EES 18.17; TAO 4.6). The strategy will provide details on disposal methods and monitoring, and the related EPR GW4 is appropriate.	
Construction - drawdown causing settlement and impacting on existing recharge systems (Arden to Parkville precincts)	MM109	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8; TAO 4.5, 7.3). EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed (e.g. near Arden and Parkville stations) such as grouting and/or temporary recharge bores, based on successful experience elsewhere (EES 18.10, 18.11; TAO 4.5, 9.4, 10.4; GA 8.2.4). EES also identified drawdown at Arden and Parkville stations subsequently during operation of 0.2 to 0.5 m since inflows would be largely prevented by the Haack 2 tightness classification for Arden station (EES 18.10.2; TAO 9.4.2; GA 8.2.4) and Haack 3 tightness classification for Parkville station (EES 18.11.2; TAO 10.4.2) indicating low risk of settlement. The groundwater modelling undertaken for the concept design stage has been independently reviewed and was found to be consistent with established guidelines (TAO 4.2, Appendix B). The modelling methodology adequately considered issues including the North Yarra Main Sewer, stream-aquifer interactions and recharge well systems. Further model refinements were identified as worthy of further investigation at the detailed design stage, including assessment of cumulative impacts and of model uncertainty issues, which are captured in appropriate EPRs. Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Disruption to water table (Arden to Parkville precinct)	MM119	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8, 18.10, 18.11; TAO 4.5, 7.3). Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including	

Issue	Submission No.	Response (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates "July 2016 Groundwater Modelling Update" (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
		mitigation options.	
Construction - drawdown causing settlement (Domain to Eastern portal precinct)	MM159	EES adequately considered drawdown risks during construction and identified potential mitigation measures such as grouting and/or temporary recharge bores, especially in relation to the shafts (EES 18.8, 18.15; TAO 4.5, 7.7, 13; GA 8.2.5). EES also identified minimal drawdown subsequently during operation since inflows would be largely prevented by the Haack 3 tightness classification (EES 18.15; TAO 4.5, 7.7.3; GA 8.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures.	
Construction - drawdown causing settlement (CBD South and Yarra crossing)	MM178	EES adequately considered drawdown risks during construction in the area of the CBD South station (mined construction) and Yarra crossing (tunnel boring machine). Potential mitigation measures were identified such as grouting and/or temporary recharge bores (EES 18.8, 18.13; TAO 4.5, 7.6, 12; GA 8.2.1). Predicted drawdown is 0.2 to 0.5 m subsequently during operation since inflows would be largely prevented by the Haack tightness classification (EES 18.8, 18.13; TAO 4.5, 7.6.5, 12.4; GA 8.3). Evidence indicates that the Yarra River is not strongly connected to groundwater (TAO 5.6), and thus any drawdown effects would have negligible effect on surface waters (EES 18.5.6). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures, including effects on existing recharge wells.	
Construction - drawdown causing settlement and other impacts (CBD North station)	MM180	Submission acknowledges acceptance of the EPRs and requests a site specific (RMIT) risk assessment, monitoring and development of relevant controls for impacted properties. The existing general EPRs GW1-GW5 are adequate for further investigation during detailed design and risk assessment phase and to refine mitigation measures. EPR GW3 in particular involves development of a Groundwater Management Plan. The Environmental Management Framework (EES Figure 23-3) involves development of a Construction Environmental Management Plan (CEMP) and a Site Environmental Implementation Plan (SEIP), which should address the specific issues raised.	
Construction - drawdown causing settlement relating to carpark basement and electrical sub-station	MM182	EES adequately considered drawdown risks during construction in the area of the CBD South station (mined construction) and Yarra crossing (tunnel boring machine). Potential mitigation measures were identified	

Issue	Submission No.	Response  (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
(CBD South precinct)		such as grouting and/or temporary recharge bores (EES 18.8, 18.13; TAO 4.5, 7.6, 12; GA 8.2.1). Predicted drawdown is 0.2 to 0.5 m subsequently during operation since inflows would be largely prevented by the Haack tightness classification (EES 18.8, 18.13; TAO 4.5, 7.6, 12.4; GA 8.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures.	
Construction - drawdown causing settlement and impacting on existing recharge systems (Arden to Parkville precincts)	MM228	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8; TAO 4.5, 7.3). EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed (e.g. near Arden and Parkville stations) such as grouting and/or temporary recharge bores, based on successful experience elsewhere (EES 18.10, 18.11; TAO 4.5, 9.4, 10.4; GA 8.2.4). EES also identified drawdown at Arden and Parkville stations subsequently during operation of 0.2 to 0.5 m since inflows would be largely prevented by the Haack 2 tightness classification (EES 18.10, 18.11; TAO 9.4, 10.4; GA 8.3), indicating low risk of settlement. The groundwater modelling undertaken for the concept design stage has been independently reviewed and was found to be consistent with established guidelines (TAO 4.2, Appendix B). The modelling methodology adequately considered issues including the North Yarra Main Sewer, stream-aquifer interactions and recharge well systems. Further model refinements were identified as worthy of further investigation at the detailed design stage, including assessment of cumulative impacts and of model uncertainty issues, which are captured in appropriate EPRs. Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction –drawdown causing settlement (attributed to concept design cut and cover method near Western Portal)	MM238	The EES (section 18.9) and TAO (section 8) and July 2016 update (GA 8.2.6) provide adequate detail on impact assessments in Western Portal area. Secant pile retaining wall and toe grouting during construction will effectively minimise inflows and drawdown impacts. Potential mitigation measures also identified for construction phase, such as excavation grouting and temporary injection bores (TAO 4.5, 8.4; GA 8.2.6). During operation, inflows would be largely prevented by the Haack 3 tightness	

Issue	Submission No.	Response (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
		classification, and related maximum drawdown above tunnels of 0.2 m indicates low risk of settlement damage. The drawdown impacts are predicted to be slightly greater for the Alternative Option, although there are fewer buildings in that area and mitigation options should be effective in any case (TAO 8.4). EPRs GW1-GW5 are adequate for further investigation during detailed design stage to select options and refine mitigation measures.	
Construction - drawdown causing settlement (Arden to Parkville precinct)	MM250	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8, 18.10, 18.11; TAO 4.5, 7.3; GA 8.2.4). Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - drawdown causing settlement (CBD South and Yarra crossing)	MM274	EES adequately considered drawdown risks during construction in the area of the CBD South station (mined construction) and Yarra crossing (tunnel boring machine). Potential mitigation measures were identified such as grouting and/or temporary recharge bores (EES 18.8, 18.13; TAO 4.5, 7.6, 12.4; GA 8.2.1). Predicted drawdown is 0.2 to 0.5 m subsequently during operation since inflows would be largely prevented by the Haack tightness classification (EES 18.8, 18.13; TAO 4.5, 7.6, 12.4; GA 8.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures, including effects on existing recharge wells.	
Construction - mobilisation of existing contaminated groundwater plumes, including potentially causing vapour intrusion into sub-surface building structures	MM291	Submission from EPA identifies key issues that were adequately dealt with in the EES, including the potential for mobilisation of existing groundwater contamination plumes (TAO 5.4), the need for monitoring to establish baseline conditions (EES 18.4, 18.5) with application to inform the impact assessment (EES 18.7) and detailed design phase (EES 18.18) and to develop mitigation measures (TAO 4.5) and to refine the risk assessment (EES 18.6; TAO 4.3, 6). Obligations under the State Environmental Protection Policy (Groundwaters of Victoria) are also highlighted and were addressed in the EES (Table 18-1, section 18.5.4). The existing general EPRs GW1-GW5 are adequate for further	

Issue	Submission No.	Response  (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
		investigation during detailed design and risk assessment phase and to refine mitigation measures. EPR GW3 in particular involves development of a Groundwater Management Plan that addresses the issues raised by the EPA in relation their recommended Construction Environmental Management Plan (CEMP) and Site Environmental Implementation Plan (SEIP), and the SEPP (Groundwaters of Victoria). EPR GW4 includes a requirement for consultation with the EPA, which is a suitable means of addressing these specific EPA issues.	
Construction - drawdown causing settlement and impacting on existing recharge systems (Arden to Parkville precincts)	MM299	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8; TAO 4.5, 7.3). EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed (e.g. near Arden and Parkville stations) such as grouting and/or temporary recharge bores, based on successful experience elsewhere (EES 18.10, 18.11; TAO 4.5, 9.4, 10.4; GA 8.2.4). EES also identified drawdown at Arden and Parkville stations subsequently during operation of 0.2 to 0.5 m since inflows would be largely prevented by the Haack 2 tightness classification for Arden station (EES 18.10.2; TAO 9.4.2; GA 8.3), and Haack 3 tightness classification for Parkville station (EES 18.11.2; TAO 10.4.2; GA 8.3), indicating low risk of settlement. The groundwater modelling undertaken for the concept design stage has been independently reviewed and was found to be consistent with established guidelines (TAO 4.2, Appendix B). The modelling methodology adequately considered issues including the North Yarra Main Sewer, stream-aquifer interactions and recharge well systems. Further model refinements were identified as worthy of further investigation at the detailed design stage, including assessment of cumulative impacts and of model uncertainty issues, which are captured in appropriate EPRs. Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - drawdown causing settlement and impacting on existing recharge systems (Arden to Parkville)	MM300	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement	

Issue	Submission No.	Response  (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
precincts)		(EES 18.8; TAO 4.5, 7.3). EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed (e.g. near Arden and Parkville stations) such as grouting and/or temporary recharge bores, based on successful experience elsewhere (EES 18.10, 18.11; TAO 4.5, 9.4, 10.4; GA 8.2.4). EES also identified drawdown at Arden and Parkville stations subsequently during operation of 0.2 to 0.5 m since inflows would be largely prevented by the Haack 2 tightness classification for Arden station (EES 18.10.2; TAO 9.4.2; GA 8.3), and Haack 3 tightness classification for Parkville station (EES 18.11.2; TAO 10.4.2; GA 8.3), indicating low risk of settlement. The groundwater modelling undertaken for the concept design stage has been independently reviewed and was found to be consistent with established guidelines (TAO 4.2, Appendix B). The modelling methodology adequately considered issues including the North Yarra Main Sewer, stream-aquifer interactions and recharge well systems. Further model refinements were identified as worthy of further investigation at the detailed design stage, including assessment of cumulative impacts and of model uncertainty issues, which are captured in appropriate EPRs. Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - drawdown causing settlement and impacting on existing recharge systems (Arden to Parkville precincts)	MM301	The tunnel boring machine construction method, immediate tanking and Haack tightness classification 3 for tunnels minimises inflows and limits drawdown to a maximum of 0.2 metres, indicating a low risk of settlement (EES 18.8; TAO 4.5, 7.3). EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed (e.g. near Arden and Parkville stations) such as grouting and/or temporary recharge bores, based on successful experience elsewhere (EES 18.10, 18.11; TAO 4.5, 9.4, 10.4; GA 8.2.4). EES also identified drawdown at Arden and Parkville stations subsequently during operation of 0.2 to 0.5 m since inflows would be largely prevented by the Haack 2 tightness classification for Arden station (EES 18.10.2; TAO 9.4.2; GA 8.3), and Haack 3 tightness classification for Parkville station (EES 18.11.2; TAO 10.4.2; GA 8.3), indicating low risk of settlement. The groundwater modelling undertaken for the concept design stage has been independently reviewed and was found to be consistent with established	

Issue	Submission No.	Response (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
		guidelines (TAO 4.2, Appendix B). The modelling methodology adequately considered issues including the North Yarra Main Sewer, stream-aquifer interactions and recharge well systems. Further model refinements were identified as worthy of further investigation at the detailed design stage, including assessment of cumulative impacts and of model uncertainty issues, which are captured in appropriate EPRs. Low impacts are predicted over this tunnel precinct, and the EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - migration of contaminants from existing plumes (Parkville precinct)	MM318	EES considered the potential for mobilisation of existing groundwater contamination plumes (EES 18.5, 18.11, Table 18-3). EPRs GW1-GW5 are adequate for further investigation during detailed design phase and to refine mitigation measures. EPR GW3 in particular involves development of a Groundwater Management Plan in consultation with the EPA, and EPR GW4 includes a requirement for consultation with the EPA, which are suitable means of addressing these specific issues.	
Construction - drawdown causing settlement (CBD South to Domain precinct)	MM321	EES adequately considered drawdown risks during construction in the area of the CBD South station (mined construction) and Yarra crossing (tunnel boring machine). Potential mitigation measures were identified such as grouting and/or temporary recharge bores (EES 18.8, 18.13; TAO 4.5, 7.6, 12; GA 8.2.1, 8.2.2, 8.2.3). Predicted drawdown of 0.2 to 0.5 m subsequently during operation since inflows would be largely prevented by the Haack 2 tightness classification for CBD South station (EES 18.13; TAO 12.4; GA 8.2.1) and Haack 3 tightness classification for the CBD South to Domain tunnel precinct (EES 18.8, TAO 7.6; GA 8.2.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures, including effects on existing recharge wells.	
Construction - drawdown causing settlement (Domain station and adjacent tunnel precincts)	MM367	EES adequately considered drawdown risks during construction and identified potential mitigation measures such as grouting and/or temporary recharge bores, especially in relation to the shafts (EES 18.8, 18.14; TAO 4.5, 7.7, 13; GA 8.2.5). EES also identified minimal drawdown subsequently during operation since inflows would be largely prevented by the Haack 3 tightness classification (EES 18.14; TAO 4.5, 7.7.3; GA	

Issue	Submission No.	Response  (with references to sections of EES and/or Technical Appendix O (TAO), and/or Golder Associates “July 2016 Groundwater Modelling Update” (GA2016bb), and/or Groundwater EPRs)	Any Recommended New or Modified Environmental Performance Requirement
		8.3). Existing EPRs GW1-GW5 are adequate for further investigation during detailed design stage to refine mitigation measures.	
Construction / Operation - groundwater disposal	MM367	EES identified that the Groundwater Disposal Strategy (GDS) must be based on the detailed design phase groundwater model and must be in place for the early works program (EES 18.17; TAO 4.6). The strategy will provide details on disposal methods and monitoring, and the related EPR GW4 is appropriate.	
Construction - drawdown causing settlement (Domain station)	MM370	EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed in some circumstances (EES 18.14; TAO 4.5, 13; GA 8.2.5). EES also identified drawdown at the Domain station subsequently during operation of 0.2 m since inflows would be largely prevented by the Haack 2 tightness classification (EES 18.14; TAO 13.4; GA 8.3), indicating low risk of settlement. Low impacts and no identified groundwater assets within predicted impact extents, and the general EPRs GW1-GW5 are appropriate for this area and are adequate for further investigation during detailed design stage, including mitigation options.	
Construction - drawdown causing settlement (Arden station)	MM377	EES adequately considered drawdown risks during construction and considered mitigation measures that may be needed in some circumstances such as grouting and temporary recharge bores (EES 18.10; TAO 4.5, 9; GA 8.2.4). EES also identified drawdown at the Arden station subsequently during operation of 0.2 m since inflows would be largely prevented by the Haack 2 tightness classification (EES 18.10; TAO 9.4; GA 8.3), indicating low risk of settlement. EPRs GW1-GW5 are appropriate and are adequate for further investigation during detailed design stage, including mitigation options.	