Before the Board of Inquiry
Waterview Connection Project

in the matter of: the Resource Management Act 1991

and

in the matter of: a Board of Inquiry appointed under s 149J of the Resource Management Act 1991 to decide notices of requirement and resource consent applications by the NZ Transport Agency for the Waterview Connection Project

Statement of evidence of André Walter (Construction) on behalf of the **NZ Transport Agency**

Dated: 13 November 2010

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STATEMENT OF EVIDENCE OF ANDRÉ WALTER ON BEHALF OF THE NZ TRANSPORT AGENCY

INTRODUCTION

1 My full name is André Brian Walter. I am employed by the NZ Transport Agency as a Senior Project Manager for the Waterview Connection Project.

2 I have a Bachelor of Engineering (Civil) qualification obtained from the University of Pretoria, South Africa. I have over 30 years experience within the civil engineering industry, of which 20 years has been within large infrastructure projects.

3 I have been involved with tunnel construction in a variety of rock conditions in numerous countries around the world, undertaking various roles ranging from Construction Manager to Project Manager. Projects have included the Lesotho Highlands Water Project, Yuncan Hydro Power Project (Peru), Dartford Cable Tunnel (United Kingdom), Dublin Port Tunnel (Ireland) and the East India Dock Tunnel on the A13 (United Kingdom).

4 Prior to my current role with NZTA, I provided independent consultancy services to contractors and asset owners on construction methodology and problem solutions. This included:

4.1 Undertaking various projects for the Ringway Group PLC in the United Kingdom, between 2005 and 2008, relating the upgrading and construction of elements to the Highways Agency's motorway network. My role in these projects included construction planner and advisor to the construction methodology;

4.2 I was similarly involved in the highspeed dual track project between Pedang Besar and Johor Baru in Malaysia, between 2001 and 2002. My role in this project involved being part of the commercial team responsible to developing the construction method and overall project timing and providing technical advice on the constructability of the project;

4.3 I was the technical advisor to Mowlems and Nishimatsu evaluating the construction methodology and programme for the Dublin Port Tunnel Project, Ireland, between 2004 and 2005;

4.4 I was the technical advisor on programme and construction methods on the Birmingham PFI Project, which entailed the maintenance and upgrading of 2,400kms of motorway network including motorway assets within the City of Birmingham, United Kingdom, between 2007 and 2008;

4.5 Construction of a new baggage conveyer within Heathrow Airport, United Kingdom, in 2008;

4.6 I was lead construction planner and close down engineer on the A13 project in the United Kingdom, which consisted of the construction of 30 kilometres of 8/6 lane urban motorway between Limehouse and Wennington on the east side of London and included almost 2 kilometres of tunnel upgrading, over 3kms of new bridge works and all associated modern motorway management tools.

5 My evidence is given in support of notices of requirement and applications for resource consents lodged with the Environmental Protection Authority (*EPA*) by the NZ Transport Agency (*NZTA*) on 20 August 2010 in relation to the Waterview Connection Project (*Project*). The Project comprises works previously investigated and developed as two separate projects, being:

5.1 The State Highway 16 (*SH16*) Causeway Project; and

5.2 The State Highway 20 (*SH20*) Waterview Connection Project.

6 I am familiar with the area that the Project covers, and the State highway and roading network in the vicinity of the Project.

SCOPE OF EVIDENCE

7 My evidence will deal with the following:

7.1 Executive Summary;

7.2 My role in the Project;

7.3 A description of the Project;

7.4 An overview of the key features and technical challenges of the Project and comments on submissions;

7.5 The construction process;

7.6 Site specific construction processes;

7.7 Further comments on submissions.

EXECUTIVE SUMMARY

8 The Waterview Connection Project is part of the Road of National Significance (*RONS*) Project, completing the missing link of the Western Ring Route Project between SH16 and SH20 by establishing a high-quality motorway connection.

9 The Project is one of the most complex roading projects to be undertaken in New Zealand. With the Project being constructed through an urban and coastal environment, it will require careful planning to ensure that the mitigated effects are given all the due consideration required.

10 The Project has been developed to the highest engineering standards, with safety of the public and contractor(s) staff being paramount.

11 My evidence outlines the scope of the Project, key features and technical challenges in development of the proposed alignment, and the likely scale, duration and type of construction activities which may take place, to enable potential effects to be identified and any necessary mitigation measures developed. In addition, I have responded to submissions relating to design development of the Project and the construction activities.

MY ROLE IN THE PROJECT

12 My role within the Project has been to co-ordinate and manage the integrated engineering elements and to provide a conceptual design for the Project. I have been the NZTA Project Engineer for two years on this Project and, specifically, have been part of the team developing the current option before the Board of Inquiry.

13 Once the current option had been selected by the NZTA Board in May 2009, the engineering process of developing the scheme was under my direct control. This included providing guidance to the engineers as to the requirements of the NZTA in terms of the functionality of the Project.

14 It also included providing the cross-over between engineering and the assessment of environmental impacts, and developing engineering solutions to give effect to mitigation proposed for the Project.

15 My role also includes the constructability of the Project elements within the parameters of the design and the mitigation measures proposed.

A DESCRIPTION OF THE PROJECT

16 In this section of my evidence I will introduce the Project by describing it, in overview. I intend to do this at the Board of Inquiry hearing by talking though the Project, using a computer generated flyover as a visual aid, and discussing the Project from Sector 1 through Sector 9.

17 The flyover was commissioned by the NZTA to provide assistance in evaluating the visual effects of the Project and to assist in explaining the Project to the wider public audience. The flyover is only intended to provide a visual demonstration of the Project and, although developed directly from the engineering drawings, is limited in the amount of detail that can be shown.[1]

18 In summary, through the Project the NZTA proposes to designate land and obtain resource consents in order to construct, operate and maintain:

18.1 The SH20 motorway extension from Maioro Street (New Windsor) to connect with SH16 at the Great North Road Interchange (Waterview). This includes construction of the majority of SH20 in this section via tunnels and improved connectivity at the Maioro Street Interchange.

18.2 The upgrading of the Northwestern Motorway (SH16) between Henderson Creek Bridge and the St Lukes Interchange, to improve the resilience of the Western Ring Route (*WRR*) and wider transport network. This includes:

(a) Raising the causeway on SH16 between the Great North Road and Rosebank Interchanges (in response to historic subsidence of the causeway and to "future proof" it against sea level rise); and

(b) Increasing the capacity on the SH16 corridor, compatible with the strategic corridor, by providing additional traffic lane capacity between the St Lukes Interchange and Henderson Creek, works to improve the functioning and capacity of the Te Atatu Interchange, and improvements to the provision of bus lanes (Quality Transport Network (*QTN*)).

19 The Project is described in detail in the Assessment of Environmental Effects (*AEE*), in particular, Chapter 4 – Project Description (Operation) and Chapter 5 – Project Description (Construction).

20 The geographical sectors of the Project are depicted in Figure 2.1 of the AEE.

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[1] The development and generation of the flyover was undertaken by Buildmedia, which is a company specialising in video simulations. Digital terrain model and aerial photographs were used as a basis for their simulation. This was then combined with design details to provide the most realistic response. Landscape information for the model was provided by Stephen Brown Environments and Jasmax.

21 Between the Te Atatu and St Lukes Interchanges, the following key elements of work will be undertaken on SH16:

21.1 Significant improvements and reconfiguration of the Te Atatu Interchange to accommodate additional lanes, to provide a shoulder on the eastbound onramp for bus priority and other High Occupancy Vehicles (*HOVs*) and a bus shoulder on the westbound offramp (Sector 1);

21.2 A shared use cycle and pedestrian way running parallel to the motorway from Te Atatu (Henderson Creek) to the Great North Road Interchange (Sectors 1 through 5);

21.3 Enlargement of the existing Whau River Bridge to accommodate additional lanes and a separate dedicated cycle/pedestrian bridge (Sector 2);

21.4 Reconfiguration of the existing Rosebank on and off ramps to improve traffic merging on and off these ramps (Sectors 3 and 4);

21.5 One additional lane (in each direction) between the Te Atatu and Rosebank Interchanges to provide four lanes east and westbound and a bus shoulder in each direction (Sectors 1 to 4);

21.6 Two additional westbound lanes between Great North Road Interchange and Rosebank Road Interchange to create a total of five westbound lanes plus a dedicated bus shoulder (Sectors 3 and 4);

21.7 One additional eastbound lane between Rosebank Road Interchange and Great North Road Interchange, to create a total of four eastbound lanes plus a dedicated bus shoulder (Sectors 3 and 4);

21.8 Replacement of the grade-separated cycle/pedestrian bridge in the Patiki Interchange (Sector 3);

21.9 Widening of the existing Causeway and Causeway Bridge to accommodate additional lanes and a separate cycle/pedestrian bridge (Sector 4);

21.10 The existing causeway between Rosebank Peninsula and the Great North Road Interchange will be enlarged by additional reclamation (Sector 4);

21.11 In conjunction with the reclamation, the causeway height will be increased to protect the State highway against inundation and to “future proof” it against predicted sea level rise in the future (Sector 4); and

21.12 Additional lanes, a cycleway and a bus priority lane will be provided between the Great North Road Interchange and the St Lukes Interchange (Sector 6).

22 For SH20, between Great North Road Interchange (with SH16) and Maioro Street Interchange, a new State highway alignment will be provided over a length of approximately 5km and capacity for up to three traffic lanes in each direction. The following key elements of work will be undertaken:

22.1 A new interchange will be built at the ‘Great North Road Interchange’ to provide motorway-to-motorway connections between SH16 and SH20 (both west and east bound movements) (Sector 5);

22.2 At the Great North Road Interchange, the existing connections between Great North Road and SH16 will be maintained (Sector 5);

22.3 Realignment but retention of the Northwestern Cycleway through the Great North Road Interchange (Sector 5);

22.4 The Project provides future capacity for up to three traffic lanes in each direction on SH20, separated by either central median barrier or separate tunnel construction;

22.5 A cycleway extension to the existing ‘SH20 Cycleway’ (that terminates at the Maioro Street Interchange) will be provided adjoining the carriageway where the motorway is at-grade (Sector 9);

22.6 From the Great North Road Interchange, the alignment will comprise two cut-cover tunnels beneath Great North Road transitioning into two to connect to the openface excavation tunnels (‘deep tunnels’) (Sector 7);

22.7 The construction of the two deep tunnels (one in each direction) from the cut-cover tunnel beneath Great North Road through to the Alan Wood Reserve (Sector 8);

22.8 From the Alan Wood Reserve the carriageway emerges ‘at-surface’ over a length of around 1800m, to connect to SH20 at the Maioro Street Interchange (Sector 9). One kilometre of the Project in this sector is new motorway from the tunnel portals to the Richardson Road Bridge;

22.9 Richardson Road will be bridged 'at grade', with the State highway cut beneath and new north-facing ramps will be built at the Maioro Street Interchange to provide local traffic access to SH20 (Sector 9). The Richardson Road bridge will be 14.2m wide; and

22.10 The design of the State highway has not precluded the future Avondale to Southdown Rail Line and has maintained a land corridor of sufficient width (e.g. for double track with electrification), from the Maioro Street Interchange to the southern tunnel portal in Alan Wood Reserve (Sector 9).

OVERVIEW OF KEY FEATURES AND TECHNICAL CHALLENGES OF THE PROJECT AND COMMENTS ON SUBMISSIONS

23 In this section of my evidence I will expand on the broad Project overview, focusing on the key features of the Project, and more particularly on challenges and technical issues which the NZTA and the Project team has had to resolve.

24 I will also respond to issues raised in submissions where they relate to the Project design and operation. Many of the issues will subsequently be addressed in greater detail in the evidence of the relevant technical experts.[2]

Sector 1 – Te Atatu Interchange

25 In Sector 1, the key elements of the Project include: the widening of SH16; improvements to the Te Atatu Interchange (including pedestrian/ cycle way facilities); and the development of a new stormwater pond in Jack Colvin Park to treat stormwater from the motorway.

[Drawing 910-101][3]

26 The works within Sector 1 will involve the construction of a new permanent stormwater pond within Jack Colvin Park. The development of the new stormwater pond will require a small area of reclamation within the Coastal Marine Area (*CMA*) (approximately 0.1ha). The stormwater pond has been sized to treat both the existing and widened parts of SH16.[4]

[Drawing 910-102]

27 SH16 will be widened, from Henderson Bridge through Te Atatu Interchange, to provide additional lanes in both directions and a bus shoulder. In total, three lanes and a bus shoulder will be provided

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2 I will discuss the construction process in more detail later in my evidence.

3 The first two drawing references are to the Operation Scheme Plans, found in the AEE, Part F.2 (being Drawing No. 20.1.11-3-D-N-910 and 102).

4 Mr Tim Fisher will describe the stormwater treatment features in more detail in his evidence.

westbound (to West Auckland), and four lanes and a bus shoulder will be provided eastbound (to Central Auckland). As part of the works, two substandard vertical curves at the approach and under Te Atatu Interchange bridge will be improved, and the motorway will be lowered by approximately 370mm under the Te Atatu Interchange to improve minimum clearance standards.

28 To accommodate the additional lanes on SH16, the Te Atatu Interchange will be widened and the on and off ramps reconfigured. A bus shoulder is proposed on the westbound off ramp, and an additional priority lane is proposed on the eastbound on ramp (heading into Auckland Central) for Heavy Commercial Vehicles, buses, taxis and HOVs.

29 The pedestrian and cycle way facilities will be improved as part of the works. This includes a new pedestrian / cycleway bridge on the eastern side of the Te Atatu Interchange, and improvements to the pedestrian / cycle way facilities on the western side. The existing pedestrian subway will be replaced with a new pedestrian subway suitably designed to accommodate the environment and users. The new subway (being 5m wide, 2.5m high and 45m long) will have appropriate lighting and overall safety will be improved through providing an open safe environment. A series of at-grade pedestrian crossings will also be provided.

30 In addition, Te Atatu Road, between Titoki Street and Alwyn Avenue, will be upgraded to accommodate an additional northbound traffic lane and pedestrian/ cycle way.

31 The key technical challenges and constraints that the design team has had to take into account within Sector 1 include:

31.1 The need to facilitate a design for the additional lanes which ties into the vertical and horizontal alignments of the existing motorway and structures, and also improve the geometry to achieve the current motorway standards. The works will allow two substandard vertical curves on SH16 to be improved, and improvements to the minimum clearance under the Te Atatu Interchange bridge.

31.2 Construction of large structures required for the enlarged Interchange on and over a live motorway, and the need to minimise disruption to traffic on SH16 and Te Atatu Road. This has influenced the construction timing and phasing and includes the need for night time work in this area.[5]

[5] Mr John Gottler will discuss in his evidence the proposed measures to manage traffic during construction.

31.3 The residential properties adjacent to the Te Atatu Interchange and along SH16 westward require particular consideration in relation to managing noise, during both operation and construction. A series of permanent noise walls is proposed within Sector 1.[6]

Sector 2 – Whau River

32 In Sector 2, the key elements of the Project relate to the widening of SH16 between the Patiki Road Interchange and the Whau River Bridge, and in particular within the CMA, to enlarge the existing Whau River Bridge in order to accommodate the additional lanes. Four lanes will be provided eastbound and westbound, along with a bus shoulder in both directions. The existing pedestrian / cycle bridge over the Whau River on the southern side of the motorway will be removed and replaced with a new 3m wide pedestrian / cycle bridge.

[Drawing 917-220][7]

33 The key technical challenges and constraints that the design team has had to take into account within Sector 2 include:

33.1 Construction works on a live motorway. Given the need to maintain the full operational capacity of SH16 during construction works, the design of the bridge widening has been developed in such a manner that works can be undertaken off-line as much as possible. This is discussed later in my evidence.

33.2 Working over and in the CMA. The construction methodology has been designed to be undertaken from temporary staging platforms (as described later in my evidence).

33.3 Potential effects of the reclamation and the new bridge piers on coastal processes and keeping the navigational channel on the Whau River operational. Both the construction works and the permanent structures have been designed to minimise potential effects on coastal processes. (For example, the new bridge piers are located adjacent the existing piers to minimise effects.)[8]

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6 See AEE, Part F.17, Drawing Nos. 20.1.11-3-D-N-918-101 to 103. Ms Siiri Wilkening will describe the process for determining the noise barriers' location and height within in her evidence, as well as how construction noise will be managed.

7 AEE, Part F.8, Whau River Motorway and Pedestrian Bridges Plan and Cross Section, Drawing No. 20.1.11-D-N-917-220.

8 Mr Rob Bell will describe the coastal effects in more detail in his evidence.

Comments on submissions

34 Submitter No. 110[9] seeks that both the temporary and permanent structures over the Whau River have the same clearance as the current structure.

35 As a result of the widening of the Whau River Bridge, some height is lost due to the 2.5% camber (cross-fall) across the motorway. As the existing bridges are being retained, the loss is limited to that required by virtue of the camber over the distance of the widening. This amounts to 140mm on the Causeway bridge and between 180 and 200mm on the Whau River bridge.

Sector 3 – Rosebank Terrestrial

36 In Sector 3, the key elements of the Project involve the widening of SH16 to provide four lanes and a bus shoulder in both the eastbound and westbound directions between Patiki Road and Rosebank Road interchanges. The widening works will affect the existing Patiki pedestrian / cycle bridge and this will be replaced with a new 3m wide bridge. The access road to the Rosebank Road Domain will also be realigned as part of the improvement works.

[Drawing 910-104][10]

37 The key technical challenges and constraints that the design team has had to take into account within Sector 3 include:

37.1 The existing Patiki Road and Rosebank Road Interchanges are significant existing structures. Given the original complexity of construction they are required to be retained with the existing form and configuration. Given the significant cost involved with moving or replacing the existing ramps, the works have been designed to fit within the existing structures with only minor reconfiguration works being proposed.

37.2 Construction on a live motorway. Most of the construction works within Sector 3 are able to be undertaken off-line, as described in the second part of my evidence, however some night time works will be required in relation to construction activities associated with Patiki Road bridge.

Sector 4 – Reclamation

38 In Sector 4, the key elements of the Project relate to the raising and widening of the causeway.

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9 Being Te Atatu Boating Club.

10 See AEE, Part F.2, Operation Scheme Plans, Drawing No. 20.1.11-3-D-N-910-104.

[Drawings 910-106 to 108][11]

39 It is proposed to raise the causeway by 1.5m above its current level, which will improve security against increasing future tidal inundation, whilst allowing sufficient clearance for SH16 to pass underneath the Rosebank eastbound off-ramp.

40 In addition, the causeway will be widened to provide five lanes and a bus shoulder in the westbound direction (to Rosebank Interchange, where one lane exits and four lanes continue west), and four lanes and a bus shoulder in the eastbound direction. This involves 4.2 ha of reclamation within the CMA to accommodate the widened causeway, and a new Causeway Bridge over the inlet channel.

41 The existing pedestrian / cycle way will be upgraded and increased in width to 3m, and will include a new pedestrian / cycle way bridge adjacent to the westbound carriageway of the Causeway Bridge over the inlet channel.

42 The key technical challenges and constraints that the design team has had to take into account within Sector 4 include:

42.1 Construction within a live motorway environment. Most of the construction works within Sector 4 are able to be undertaken off-line (as described later in my evidence).

42.2 Working within the CMA, particularly in relation to tidal inundation of the works. The construction methodology required must enable works to be undertaken within a dry area. This will provide protection to the construction work and assist to minimise potential environment effects from the works.[12]

42.3 The need to re-align sections of the Waterview Inlet Channel (as shown on Drawings 910-107 and 108).[13]

Comments on submissions

43 Submitter Nos. 110 and 185[14] raise concerns about the navigation by small boats in the Oakley Creek and causeway Area, and the need to ensure that appropriate design of the causeway bridge to allow passage of craft safely.

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11 See AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-106 to 108.

12 A possible construction methodology will be discussed later in my evidence, and in the evidence of technical witnesses.

13 See AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-107 and 108. The evidence of Dr Sharon de Luca and Mr Rob Bell will describe in more detail the effects of this work and I will discuss a possible methodology later in my evidence.

14 Being Te Atatu Boating Club and North Western Community Association.

44 As a result of the widening of the Whau River and Causeway Bridges, some height is lost due to the camber across the motorway. As the existing bridges are being retained the loss is limited to that required by virtue of the camber over the distance of the widening. That amounts to only 140mm on the Causeway bridge and thus small craft should still have the ability to access under the bridge as per the current situation.

45 Submitter No. 247[15] seeks that the Northwestern pedestrian / cycle way be owned and maintained by the NZTA, that it be designed to Austroads standards, and that it remain operational as much as practicable during construction.

46 As is currently the case, the Northwestern pedestrian / cycle way will remain in the ownership of the NZTA.

47 The pedestrian / cycle way has been designed to the relevant Austroads standards.

48 It will remain operational as much as practicable throughout the construction works, as outlined in proposed temporary traffic condition TT.6.

Sector 5 – Great North Road Interchange

49 In Sector 5, the key elements of the Project relate to construction of the motorway to motorway interchange at Great North Road Interchange to facilitate access to and from SH16 and SH20, whilst maintaining the current functionality of the existing interchange in relation to the connectivity of SH16 and Great North Road.

[Drawings 910-108 to 110][16]

50 Four new ramps will be provided within the Great North Road Interchange, these being:

50.1 Ramp 1 – comprising a single lane ramp (315m in length) taking traffic from the City (on SH16) and connecting with SH20 towards Maioro St, the Airport and the south;

50.2 Ramp 2 – comprising a two lane ramp (245m in length) taking traffic from the tunnel (SH20) towards Waitakere (SH16);

50.3 Ramp 3 – comprising a two lane ramp (485m in length) that will take traffic from Waitakere (SH16) and connecting with SH20 towards Maioro St, the Airport and the south; and

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15 Being Yi-Chieh Liang.

16 AEE, Part F2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-108 to 110.

50.4 Ramp 4 – comprising a two lane ramp (550m in length) for traffic emerging from the tunnel (SH20) merging into a single lane prior to connecting with SH16 towards the city in the vicinity of the Carrington Road Bridge.

51 The existing pedestrian/ cycle way will be realigned through this area to avoid the new piers on the ramps and development of the historical Star Mill Site. The existing cycle way bridge that crosses Great North Road in this vicinity will be retained within its current location.

52 The key technical challenges and constraints that the design team has had to take into account within Sector 5 include:

52.1 The construction of new bridges over a live motorway, in particular, construction of the new ramps in close proximity to Great North Road. Notwithstanding any construction methodology for the ramps, night time work will be required where it is impossible to maintain the functionality of SH16 during daylight hours and where SH16 could not be closed or appropriately deviated. (This is discussed further later in my evidence.)

52.2 Detailed consideration had to be given to retaining the critical elements of the historical Star Mill Site in this location. Improving and exposing this site for community recreation (as discussed in Dr Clough's evidence) has required the careful alignment of the ramps in order to minimise the impacts on the historical site, whilst at the same time maintaining engineering standards (e.g. the design speed of the ramps in relation to the tunnel and the motorway).

52.3 Maintaining and improving the pedestrian / cycle way through this section provided a restriction in terms of the minimum height for the ramps.

52.4 The elevation of the causeway, the northern tunnel portal and the existing SH16 motorway under Carrington Road Bridge provides for rather fixed constraints, due to the design of these sections in relation to the vertical and horizontal geometry relationship of the various sections. Any changes in height and /or location of the connecting elements have a direct impact on each of the other sections.

Comments on submissions

53 A number of submitters[17] seek a local connection onto the new SH20 motorway, for example from Great North Road at Point Chevalier.

54 Turning to the engineering constraints,[18] the ability to provide additional local road connections at the Great North Road Interchange is restricted due to safety and sight-distance requirements. In particular, the following are noted:

54.1 A southbound onramp from Great North Road onto SH20 cannot be provided due to either:

(a) The physical conflict with structures associated with SH16 and the city bound SH20 ramp (Ramp 4) (if the connection was from Great North Road, north of SH16); or

(b) The need to cross the northbound flow on Great North Road, the extent of the structure required (e.g. the potential encroachment of Oakley Creek and potentially the Mason Clinic site), and the short distance for a merge of an additional lane prior to the tunnel entrance (for the connection off Great North Road south of SH16);

54.2 A southbound onramp from Carrington Road would require land from the existing education facility of Unitec, have a potentially significant impact on the Category 1 Carrington Hospital Heritage Building and would require additional structure through the interchange to merge with Ramp 2 in the vicinity of the Oakley Creek Inlet (increasing the width of ramps over the CMA in this area);

54.3 An offramp to Great North Road (north of SH16) would require additional structure to pass over the southbound motorway ramps as well as the citybound traffic on Great North Road; and

54.4 An offramp to Carrington Road would compromise safety being located too close to the Carrington Road/Great North Road intersection. This would also likely result in traffic operation impacts at this local road intersection.

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[17] Including Submitter Nos. 188, 200, 30, 160, 215, 180, 251, 62, 185 and 120.

[18] This is explained in the AEE (section 11.6.5.5, Chapter 11.) Mr Andrew Murray's evidence explains why there are no tangible benefits. Mr Tommy Parker's evidence addresses Project scope.

55 A number of submitters[19] have asked for further detailed assessment of alternative interchange designs to reduce effects on Waterview community.

56 It is necessary to maintain a high standard of geometry to cater for the high vehicle volumes and speeds associated with a motorway connection. The design response has sought to maintain the interchange design speed to at least 80km/h to provide a balance between the strategic requirements of the motorway and the numerous constraints outlined above. Physical implications of this design include:

56.1 There are horizontal and vertical design requirements that govern the position of the ramps (particularly to maintain the ability to tie in with the existing motorway); and

56.2 There are minimum requirements for curve radii and superelevation to achieve an 80km'h design speed.

57 Physical design outcomes resulting from the above include:

57.1 The ramps extending further south, into Waterview Reserve, from the existing designation footprint of the Great North Road Interchange; and

57.2 The separation between Ramps 1 and 2 across the CMA (see the Operation Scheme Plans for this interchange in Part f.2 – sheet 109 of this AEE).

58 The extent of the structures has been optimised to provide a balance between the amount of earthworks embankments provided and the structure. Structures have been provided across sensitive areas such as the CMA and archaeological sites, as well as the existing motorway. In other areas, embankments provide increased opportunity for landscaping to be used in visual screening, for example on the northwestern extent of Ramp 3, see the operation scheme plan in Part F.B – sheet 109 of this AEE.

59 I consider that thorough consideration was given to alternative interchange designs in that area.

60 A number of submissions[20] request pedestrian/ cycle connections to be provided from Waterview to both Point Chevalier and Unitec.

61 At present, there is no direct pedestrian/ cycle connection across the SH16 motorway to the west of the Interchange (i.e. Point Chevalier). This movement is currently served by the cycle

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19 Including Submitter Nos. 235, 221, 44, 210, 219, 238, 228, 167, 136 and 167.

20 Including Submitter Nos. 88 and 251.

connection along Great North Road, passing beneath the SH16 motorway, extending up to the Carrington Road intersection.

62 Future development of open space along the coastal margins on the north western side of the motorway may lead to the extension of a pedestrian/ cycle way adjacent to the Great North Road eastbound off ramp. A safe pedestrian/ cycle connection to this area can be achieved by providing a pedestrian and cycle crossing at the eastbound off ramp intersection. This would require some alterations of the existing layout to remove the left turn slip lane and provide adequate crossing points.

63 As this cycle link must be programmed to coordinate with the development of the open space area and extension of the cycle route, it is not proposed as part of this Project. This would be required to be undertaken by Auckland Council.

64 Submitter No. 211[21] has requested a condition that the ramps at Waterview (Great North Road) Interchange are maintained with a high quality, low noise surface in perpetuity.

65 A reduced noise road surface is proposed for the ramps at the Great North Road Interchange as a noise mitigation measure and this will be maintained in accordance with the NZTA's maintenance regime.

Sector 6 – SH16 to St Lukes Interchange

66 In Sector 6, the key elements of the Project relate to the construction of a new stormwater treatment device, an additional eastbound and westbound lane on SH16 between Carrington Road Bridge and St Lukes Interchange, and associated noise walls where required.

[Drawings 910-110 to 112][22]

67 The key technical challenges and constraints that the design team has had to take into account within Sector 6 include:

67.1 The construction of new lanes within a live motorway environment. Most of the works will be undertaken off-line (in the shoulders of the existing motorway).

67.2 The residential properties adjacent to the motorway require particular consideration in relation to managing noise, during both operation and construction. A series of permanent noise walls are proposed within Sector 6.[23]

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21 Being Mr Paul Cullen.

22 See AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11.3-D-N-910-110 to 112.

23 See AEE, Part F.17, Drawing Nos. 20.1.11-3-D-N-918-110 and 111. Ms Siiri Wilkening will describe the process for determining the noise barriers location

Sector 7 – Great North Road Underpass

68 In Sector 7, the key elements of the Project relate to the construction of a tunnel section to pass underneath Great North Road (i.e. underpass) and the provision of a northern ventilation building and associated ventilation stack.

69 It is noted that post lodgement, the design of the northern ventilation building has been progressed, and the operational (control) facilities that were originally proposed to be included within the building have been moved to the southern ventilation building. This has enabled the northern building footprint to be reduced in size.[24]

[Drawings 910-113 to 114][25]

70 The key technical challenges and constraints that the design team has had to take into account within Sector 7 include the following:

70.1 Undertaking work of this scale within a live local and arterial road network environment. This will require the deviation of Great North Road and Herdman Street. It is important that the existing capacity and functionality of Great North Road is retained throughout the period of construction. It is recognised that access to Waterview Primary School should remain functional at all times, albeit through temporary deviations. This is discussed further in Mr Gottler's evidence.

70.2 The geology of the area. The works proposed are to be undertaken within the Tauranga Group which is an Undifferentiated Alluvium and overlies a layer of weathered East Coast Bays Formation. The design and construction of the works within this section has been developed with due consideration to the soils which are generally fine-grained cohesive silty clays and clayey silts.

70.3 Within this section, lanes diverge from the tunnel motorway into Ramp 2 of the Great North Road Interchange, increasing the width of the northern most part of the structure through a diverging structural cross section from chainage 3900.

70.4 To achieve air quality standards, a tunnel ventilation system is required to be installed to deal with vehicle emissions.[26] The optimal tunnel ventilation system requires that the in-tunnel air be extracted between 80m to 100m prior to the

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and height within in her evidence, as well as how construction noise will be managed.

24 Refer to the evidence of Mr David Gibbs.

25 See AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-113 to 114.

26 Mr Gavin Fisher discusses air quality issues in his evidence.

portal and then placed through a ventilation fan system before it is discharged into the ventilation stack. Conventionally such systems are placed above the tunnel. However, due to the location of Great North Road and the limited ability to provide for its permanent re-alignment within the design standards for local arterial roads, the largest element of the ventilation building (being the fan room), is proposed to be placed underground. This requires that a building of substantial size is constructed adjacent to the underpass, with the building areas that require regular access (e.g. the power supply/transformer and communications rooms) being placed above ground adjacent to Great North Road.

70.5 To provide efficient and economic use of the ventilation fans located within the ventilation building, the ventilation stack should be located directly after the fans. This requires that the stack be located in the vicinity of the tunnel ventilation fans (as shown on drawings within the evidence of Mr David Gibbs). It is proposed to locate water storage tanks in close proximity to the ventilation building to provide sufficient water to supply the in-tunnel deluge system. These tanks must be located so as to be accessed easily by the Fire Service in the event of a fire, and for regular maintenance of the system. These tanks have been placed underground with a surface area directly above to provide for access.

70.6 This sector must also provide for the transition from the driven tunnel cross section into the rectangular cross section required for the Great North Road underpass.

Comments on submissions

71 A number of submitters[27] have raised concerns about the location of the northern ventilation building and stack being located adjacent to the Waterview Primary School and Kindergarten. They have requested that the ventilation stack in particular be relocated away from Waterview Primary School and Kindergarten, such as across the road adjacent to the BP station, or further north between the ramps at the Great North Road Interchange. Concerns have also been raised about the size and height of the northern ventilation building and stack, requesting that the building be underground and the stack be lowered. A number of submitters[28] consider that if the northern ventilation building was underground, this would assist in reducing potential operational noise.

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27 Including Submitter Nos. 111, 190, 156, 180, 232, 210, 219, 176, 175, 228 and 85.

28 Including Submitter Nos. 185, 210, 219, 237, 25, 238 and 191.

72 As stated previously, the optimum location for the ventilation stack is directly after ventilation fans. To move the stack would require an increased size of jet fan to deal with the friction losses of pumping the air over a longer distance. It would also result in the construction of a 40m² concrete duct system underneath the cut and cover tunnel to the new location within the Tauranga Group materials. This would require dealing with the increased settlement effects and would result in a substantial increase in the cost of the Project. The estimated cost of providing the concrete duct is in the order of $1 million per metre.

73 The buildings that require access for regular maintenance should be above ground to ensure that a safe and efficient tunnel can be maintained at all times. The buildings above ground are not expected to generate noise which cannot be appropriately mitigated through design of the building. The ventilation fans, which may have a noise association, are being placed underground.

74 A number of submitters[29] request some form of filtration be implemented on both the northern and southern ventilation stacks.

75 The technical reason why filtration is not required on the stacks is discussed in Mr Gavin Fisher's evidence.

76 In addition, I note that to provide a filtration system would increase the Project capital cost by between $75 and $100 million, and would result in an increased operational cost of $1.5 to $2 million annually.

77 Submitter No. 160 requests that the existing pedestrian access between the Unitec student residential village and the Unitec Campus remain open and in its current form for the duration of construction, or that alternative equivalent safe access be provided in a similar location.

78 The construction of the north portal will require a large work site to be established, and the crossing facility may need to be relocated. A safe pedestrian access will be maintained during construction, although this may be relocated temporarily.

Sector 8 – Avondale Heights Tunnel

79 In Sector 8, the key elements of the Project relate to the construction of two 3 lane driven tunnels.[30]

80 The emergency stack was raised as an issue by a number of Submitters.[31] It should be noted, that post lodgement, further work has determined that the emergency stack originally proposed at 36

[29] Including Submitter Nos. 134, 86, 97, 133, 231, 127, 142, 200, 186 and 179.

[30] From chainage 1795 to chainage 3940 northbound and 3780 southbound.

[31] Including Submitter Nos. 22, 43, 102, 116, 127, 128, 137, 165, 179 and 184.

Cradock Street is no longer required for the tunnel (due to the in-tunnel smoke duct being no longer required).

[Drawings 910-114 to 117][32]

81 The key technical challenges and constraints that the design team has had to take into account within Sector 8 were specifically related to the design of the tunnels, and include the following:

[Drawings 102-402 and 403][33]

81.1 The varying ground profile and the numerous crossings of Oakley Creek required that the depth of the tunnels be such that there are no potential impacts on the Creek, with respect to dewatering or settlement of the Creek bed. To ensure that there are no impacts on the Creek, it was agreed with the geotechnical and tunnelling engineers that the distance from the creek bed to the tunnel crown will not be less than (1) one tunnel diameter.

81.2 Achieving realistic in and out grades for the tunnels without compromising lane capacity of the tunnel motorway through slow moving heavy vehicles or a reduction in heavy vehicle speed due to excessive grades. In general, standards require that grades within tunnels do not exceed 5% as the reduction of vehicle speed impacts directly on the amount of vehicle emission expected.

81.3 The geological profile within which the driven tunnels are to be constructed varies along the alignment as can seen from the drawings. The un-weathered East Coast Bays Formation (*ECBF*) is the only material within the geological profile which provides sufficient internal support strength to enable tunnelling. The position of the driven portals has been determined by the expected geological profile, and also taking into account the grades in and out of the tunnel.

81.4 In terms of the tunnel portals, the location of the northern driven tunnel portal was chosen specifically at a location where the ECBF ends at a depth to which retaining wall structures could be built for the Great North Road underpass, taking into account the cross sectional natural ground profile at this point.

81.5 The location of the southern portal was chosen as it provides sufficient cover to commence with a driven tunnel operation. Generally, this is considered to be at least one tunnel diameter. Further, the dip of the geological profile of the

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[32] AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-114 to 117.

[33] AEE, Part F.3, Long Sections, Drawing Nos. 20.1.11-3-D-C-102-402 and 403.

seam between the weathered and un-weather ECBF is at the maximum grade for the motorway, and the extent of the un-weathered ECBF material is sufficient to provide for the safe commencement of tunnelling.

81.6 Along the alignment, the tunnels cross underneath the Watercare Orakei No. 9 Trunk Sewer five times. Therefore, particular consideration has had to be given to the construction methodology and operation of the tunnel to ensure that the sewer is not affected by the works.[34]

81.7 As described in Sector 7, the provision of water storage at the southern end of the tunnel is required to deal with the in-tunnel deluge system.

Comments on submissions

82 A number of submitters[35] requested that the tunnel section be extended further south to the Maioro Street Interchange to provide further mitigation.

83 If these submitters are seeking that the NZTA revert to the earlier Driven Tunnel option, it is important to note that that was on a different alignment to that now presented for this Project. For the submitters' new alignment, the location of the tunnel portal would be governed by the geology and the grades required for the motorway alignment (as explained previously). The northbound onramp from Maioro Street approaches the motorway at a steep grade as a result of the level of Maioro Street. A portal for a driven tunnel would require the road surface to be at a considerable depth, and therefore the southernmost location for a bored tunnel portal is governed by the ramp grade and the depth at the portal.

84 Further to the south, the motorway passes over Oakley Creek, and would also be governed by the existing creek and potential flood levels in this area.

85 Submitter No. 162[36] expressed opposition to the provision of a deep tunnel, and concern regarding the tunnel safety and fire risk associated with a deep tunnel. Submitter Nos. 149 and 166[37] expressed concern at the risk of fire and collapse of the tunnel.

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34 In particular, in the vicinity of the northern driven tunnel portal there is a 900x500 sanitary sewer tunnel. The tunnel's current alignment minimises the impact on this sewer. Mr Gavin Alexander will address this further in his evidence.

35 Including Submitter Nos. 70, 167, 170, 185, 204, 206, 218 and 229.

36 Being Bryan Mehaffy.

37 Being Chih Tsung Kwan and Lynn See Yeoh.

86 The tunnels have been designed in accordance with best practice and international standards. The tunnels will be operated in accordance with the international standards for operation of tunnels. A detailed Fire Life Safety Plan will form part of this design and will be approved by the Fire Service.

87 Vigorous commissioning procedures will be undertaken prior to tunnels being opened for public use. During this period, the Fire Service will have an integral role and will need to approve the tunnels being opened to the public.

88 A number of submitters[38] expressed concern at the shallow depth of the tunnel, and requested that a condition of a minimum tunnel depth of 60m below foundations be applied.

89 As explained above, the depth of the tunnel is governed by the geology and the geometry. It would not be possible for the tunnel to be located at a depth of 60m below buildings as the motorway grades required to exit the tunnel would be too steep. (The effect of the tunnel on buildings located above it is addressed in the evidence of Mr Gavin Alexander.)

90 A number of submitters[39] commented on the lack of detailed design and drawings of the tunnel structure and cut and cover portals.

91 The conceptual design as shown on drawings 101-302 and 303 has been developed to a sufficient level for the purpose of assessing the effects associated with it.[40] The detailed design will be undertaken following completion of the statutory consenting process.

92 A number of submitters[41] consider that there has been inadequate consideration given to locating the tunnels in areas other than residential areas.

93 Once again, I note that the location of the tunnel portals has been determined based on detailed consideration of the geology of the area and the geometry on the portal approaches.

94 At the southern end of the SH20 extension, there will be a short straight leading into the tunnels (heading north), before a large horizontal curve is provided to direct the tunnel towards the Great North Road Interchange. The radius of this curve needs to be sufficient to accommodate adequate stopping sight distance in the

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38 Including Submitter Nos. 72, 106, 117, 125, 149, 166 and 181.

39 Including Submitter Nos. 98, 106, 117, 149, 166 and 240.

40 See AEE, Part F.4, Drawing Nos. 20.1.11-3-D-C-101-302 and 303.

41 Including Submitter Nos. 72, 106, 117, 118, 125,149, 165, 166 and 181.

tunnel (i.e. to enable a vehicle to a stop before impacting a stationary vehicle).

95 For the proposed tunnel radius of 1500, the available stopping sight distance (*SSD*) is 180m. The table below[42] indicates the desirable minimum requirements for sight distance for a 90km/h design speed (adjusted for 5% grade).

Reaction Time (s)	SSD Cars (m)	SSD Trucks (m)
1.5	141	171
2.0	154	184
2.5	166	196

96 This table indicates that there is little opportunity to provide a smaller radius curve within the current Project design without compromising road safety associated with sight distance.

97 The proposed alignment provides a relatively direct connection between the two portals. There is limited opportunity to realign the tunnel to the northeast due to the horizontal alignment on the approaches to the tunnel, as a smaller radius curve would be required.

98 Realignment further west would locate the tunnel beneath a larger number of properties beneath Avondale heights.

99 In summary, the alignment has been optimised based on geology and length of tunnel. There would be greater effects associated with providing an increased length of tunnel between the two portals.

100 Submitter No. 244[43] raises concerns that the provision of a 6 lane tunnel motorway is expensive, creating impacts on the local environment and increased cost, and considers that 4 lanes would be adequate.

101 The Project as proposed allows for future proofing of the network.[44] Due to the excessive cost of increasing a tunnel size (i.e. retrofitting it), it is more economical to provide the expected long term requirements of the tunnel when it is first constructed.

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42 Sourced from the 'Austroads Guide to Road Design Part 3: Geometric Design' – Tables 5.4 and 5.5.

43 Being William McKenzie.

44 Mr Tommy Parker's evidence discusses Project scope.

102 It is important to future proof the network requirements and to provide for the long term capacity requirements. It is considered that the provision of 2 lanes in either direction (instead of 3) provides less opportunity for slower vehicles within the tunnel. There are additional safety benefits associated with providing 3 lanes rather than 2.

Sector 9 – Alan Wood Reserve

103 Finally, in Sector 9 the key elements of the Project relate to the construction of two 3 lane motorways from the tunnel, at surface to the Maioro Street Interchange, and the construction of the southern ventilation building and stack.

104 The southern ventilation building and associated ventilation stack must be placed in a location that enables the extraction of vehicle emissions 80m to 100m prior to the portal for the southbound traffic, whilst also providing sufficient space for the construction of a vent fan room in relation to the extraction point and discharge into the ventilation stack. Within the building there is also a requirement to accommodate the power supply and traffic management systems for the proper and safe operation of the in-tunnel.

105 As noted earlier, post lodgement, the operational (or control) elements of the tunnel have been moved from the northern ventilation building to the southern ventilation building. This has resulted in a change to the functional brief for the southern building, which has been accommodated within the revised design option, as explained in the evidence of Mr David Gibbs.

[Drawings 910-117 to 119][45]

106 The key technical challenges and constraints that the design team has had to take into account within Sector 9 include the following.

[Drawings 102-402 and 403][46]

107 The largest challenge within this Sector is the construction of the southern portal which is a 300m cutting from an almost at grade road surface to a rock depth of some 22m. It requires the removal of the basalt and the installation of a grout curtain in those areas where the basalt is being broken through. The purpose of the basalt is to retain the integrity of the aquifer and reduce the amount of water drawdown within the tunnel portal area, thereby reducing the settlement effects from the associated water drawdown.

108 The undertaking of the construction of Richardson Road Bridge within a live local road network environment. This will require the

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[45] See AEE, Part F.2, Operation Scheme Plans, Drawing Nos. 20.1.11-3-D-N-910-117 to 119.

[46] See AEE, Part F.3, Long Sections, Drawing Nos. 20.1.11-3-D-C-102-402 and 403.

deviation of Richardson Road as it is important that the existing capacity and functionality of Richardson Road is retained throughout the period of construction. It is recognised that access to Christ the King School is off Richardson Road, as well as a number of commercial properties, and thus this road should remain functional at all times, albeit through temporary deviations.

109 The residential properties adjacent to the motorway require particular consideration in relation to managing noise, during both operation and construction. A series of permanent noise walls are proposed within Sector 6.[47]

110 It is recognised that within this Sector the motorway is at surface and thus extensive landscaping is being proposed.[48]

Comments on submissions

111 A number of submitters[49] raise concerns about the scale and size of the southern ventilation building, and request that the building be underground.

112 As described above, the southern buildings have been reconfigured and a revised design option is described in the evidence of Mr David Gibbs.

113 Placing the building underground provides significant challenges regarding providing access to the building. This building would require access on a daily basis for operational and maintenance purposes. As such access could not be provided safely from the motorway without closure of the tunnel, it would have to be provided from the reserve above ground. The vehicles which require access for maintenance are in the order of a 10t low level truck with high lifting capabilities. Access to the building would require ramps in the order of 500 to 750m in length. In addition, above ground parking areas would be required to comply with the Fire Service requirements pertaining to access during an emergency event.

114 The buildings would also require special design to recognise that they are placed within a Basalt zone and to deal with possible seismic events and ground movements during such an event.

115 Sector 9 also makes provision for the construction of the Hendon Park pedestrian / cycle way bridge and completing the pedestrian / cycle way from its current termination at Maioro Street to just past

[47] See AEE, Part F.17, Drawing Nos. 20.1.11-3-D-N-918-110 and 111.

[48] Mr Stephen Brown and Ms Lynne Hancock will address this in more detail in their evidence.

[49] Including Submitter Nos. 111, 180, 185, 143, 195, 45, 167, 234, 178, 139, 211 and 120.

the southern portal. The Hendon Park pedestrian/ cycle way bridge is shown on Drawing 919-471.[50]

116 The proposed motorway passes underneath Richardson Road, which requires that a new bridge be constructed at this location, and Oakley Creek is crossed in the vicinity of Hendon Park which requires bridging structures for the motorway and the proposed railway line. The width of the proposed Richardson Road Bridge is 14.2m wide (as shown on Drawing 917-480 and 919-480).[51]

117 Submitter No. 179[52] requested that the motorway safety barriers are located on the motorway side of any planting.

118 Road side barriers are located to protect errant vehicles on the roadway from striking road side objects. The NZTA State Highway Geometric Design Manual (*SHGDM*) requires that a 'Clear Zone' is required adjacent to the roadway and that within this area there should be no roadside hazards. Any planting with an ultimate trunk diameter of over 100mm[53] is considered infrangible and presents a road side hazard. Therefore, this would need to be located behind barriers or outside the clear zone.

119 Motorway barriers present a roadside hazard themselves, and should only be provided where a hazard cannot be removed or relocated. Where this is the case, the barrier should be located as far as practicable from the highway edge line to reduce the risk of being struck by an errant vehicle.

120 Low level frangible planting is normally used within the 'Clear Zone', and potentially between road side barriers and the highway, to reduce maintenance requirements.

121 In summary, motorway barriers will only be provided where required, and when they are provided, only low level frangible planting shall be provided between the barrier and the motorway. Areas of planting with larger tree species should be located outside the clear zone or behind barriers.

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50 See AEE, Part F.8, Drawing No. 20.1.11-3-D-N-919-471. (It should be noted that structural Drawing 20.1.11-3-D-S-917-470 submitted with the application has been withdrawn, as it is a duplicate drawing and incorporates an older alignment of the cycleway.)

51 See AEE, Part F.8, Drawing Nos. 20.1.11-3-D-S-917-480 and 20.1.11-3-D-N-919-480.

52 Being Friends of Oakley Creek – Te Auaunga.

53 NZTA SHGDM, section 6.5.2.

122 Submitter No. 162[54] requested that the details of the rail alignment through this section be developed to ensure it can be provided alongside the tunnel.

123 The rail line has been considered an integral part of the design development. In order to confirm the motorway alignment, the rail alignment was first developed to enable a connection with the existing North Auckland Line running along the northern side of New North Road. This rail alignment has been reviewed by KiwiRail and an agreement with KiwiRail is in place.

124 Submitter No. 177[55] was concerned at the effects on church parking as a result of culvert works on their property.

125 The realignment of the culvert is necessary in this location to enable completion of the Southdown Rail line.

THE CONSTRUCTION PROCESS

126 In this section of my evidence,[56] I will respond to key issues raised in submissions in relation to the construction process.

127 A description of the construction methodology is provided in Chapter 5 of the AEE. For brevity, I will not repeat this here, but rather respond to and provide clarity in relation to points raised in submissions in relation to the construction process. Key issues raised in submissions include:

127.1 Timing and staging;

127.2 Overall construction process and construction management;

127.3 Construction hours, including night time works;

127.4 Utility services;

127.5 Construction yards and site compounds; and

127.6 Construction of the driven tunnels.

128 I note that other witnesses for the NZTA will be giving evidence on specific construction activities and their effects – in particular, Mr Hugh Leersynder (construction environmental management plan), Mr John Gottler (construction/temporary traffic), Ms Siiri

54 Being Bryan Mehaffy.

55 Being the Auckland Samoan Assembly of God Church.

56 See also AEE, Chapter 5, Project Description (Construction) which describes the nature of construction activities for the Project by Sector as the basis for the effects assessment.

Wilkening (construction noise effects) and Mr Peter Millar (construction vibration effects).

Timing and staging

129 It is intended to undertake construction of the Project under a number of work packages. These work packages essentially would be:

129.1 Construction of the SH20 works from Maioro Street Interchange to the Great North Road Interchange, including the driven tunnels, underpass at Great North Road and the interchange ramps;

129.2 Construction of the causeway widening, with related works such as the widening of the bridges;

129.3 Construction of the works at the Te Atatu Interchange; and

129.4 Construction of the lane widening works along SH16 from Carrington Road Bridge to St Lukes Interchange.

130 The AEE (Figure 5.1) shows the approximate timing of the proposed works and how the different work fronts (or work faces) may progress over and within the currently anticipated 5 to 7 year construction timeframe. The specific staging and phasing of the work will be dependent on the sequence of procurement, the availability of contractors and the availability of other resources (such as land, material and construction equipment).

131 Further information has been requested by a number of submitters[57] regarding a detailed timeline for construction of the Te Atatu off ramp. This information will become available as the procurement process for the Project develops (at this stage anticipated to be at the beginning of 2013).

Overall Construction Processes and Construction Management

132 A number of submitters[58] have raised concerns over potential construction effects including, dust, noise, traffic, the potential effects on the local community and the need to ensure that any potential effects are mitigated.[59] A number of submitters[60] suggest that where possible, components should be constructed off site so as to reduce construction debris and dust impacts.

[57] Including Submitter Nos. 73, 38, 124 and 46.

[58] Including Submitters Nos. 101, 176, 175, 121, 126 and 85.

[59] For example, Submitter Nos. 186, 230 and 225.

[60] Including Submitter Nos. 97, 133 and 231.

133 It is expected that due to the constraints on the usage of the construction yards, maximum use will be made of precast elements within the Project and that such elements will be manufactured off site and transported to site.

134 Some activities such a piling must be done in-situ. Further, from the extensive geotechnical testing undertaken to date, it is anticipated that in most cases no dust from such works should be evident. Due to the depth of excavation, that material will be excavated at optimum moisture content (i.e. it will be damp). Works from piling and the construction of diaphragm walls are both wet processes and therefore do not generate dust.

135 The Contractor(s) will be required to deal with the control of dust during construction in accordance with the Construction Environmental Management Plan (*CEMP*).[61]

136 During construction, a variety of measures will be used to manage activities and enable construction to be undertaken in a way that avoids, minimises or reduces effects on the environment. This will include specific mitigation measures, environmental monitoring and environmental auditing.

137 To assist this process a draft CEMP has been prepared for the Project. The CEMP sets out the specific measures required to be put in place by the contractor(s) to manage actual and potential environmental effects during construction. The CEMP is consistent with, and complements the AEE, the anticipated designation/consent requirements, and the NZTA's minimum environmental standards. Once the conditions have been confirmed through the consenting process, the CEMP will be reviewed and updated (if required) and provided to each contractor prior to works commencing. The contractor will be required to undertake construction activities in accordance with the CEMP. This is discussed further in Mr Leersynder's evidence.

Construction hours and night work requirements

138 A number of submissions[62] raise concerns about the need for 24 hour/ day a week construction of the tunnel and seeks the construction hours to be limited. Specific requests have been suggested in relation to limiting construction activities when students at UNITEC are studying (e.g. Submitter No. 149, 166), and Submitter No. 177 specifically seeks construction works to be controlled around church services.

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[61] The evidence of Mr Hugh Leersnyder provides further detail regarding the Construction Environmental Management Plan (CEMP).

[62] Including Submitter Nos. 160, 166, 149, 101, 98, 240, 117, 106, 228 and 85.

139 Tunnel construction will be required to be undertaken within a continuous 24 hour period over 7 days of the week. This requirement is driven by the nature of tunnelling whereby the works cannot be stopped at a specific time when the cycle has not been completed. For reasons of safety of the works and also staff, it is of paramount importance that works be left in a safe and stable state at all times. It is expected that tunnelling operations will be undertaken over a 5.5 day working week, with the remainder of the week being required for the maintenance of equipment. This method of operation for tunnel excavation is an internationally accepted standard. In addition, the equipment purchased to undertake the works is expensive, and the cost of such works is determined by the utilisation of plant and labour, which directly relates to the number of hours being worked. Thus, the more hours worked increases the utilisation and thus reduces the costs to the Project and the overall length of construction.

140 As large sections of the Project are being constructed within an existing live road network, some works will only be able to be undertaken at night when lane or road closures are required to facilitate the construction works. This is expected typically for the following situations:

140.1 Within Sector 1, the Te Atatu Interchange Bridge deck replacement, and when the Te Atatu Interchange on/off ramps off-line works need to be tied in with the existing Te Atatu Road;

140.2 A section of the underpass at Te Atatu eastbound on and off ramp (Sector 1);

140.3 Removal of the existing Patiki Cycle Bridge and positioning of a replacement bridge within Sector 3;

140.4 Within Sector 5, the erection of structures over SH16 and Great North Road within the new interchange over the live motorway;

140.5 Some aspects of the widening works on SH16 between Great North Road Interchange and St Lukes adjacent to the live motorway in Sector 6;

140.6 The Sector 7 works associated with the Great North Road underpass where traffic connections are required to the existing Great North Road arterial;

140.7 The Richardson Road bridge deviation and completed bridge tie in works in Sector 9; and

140.8 General Traffic Management set up, changes and removal throughout the life of the construction across all Sectors.

141 Due to the requirement that tunnelling work will be undertaken continuously over a 24 hour period, it can be expected that there will be some activity within Construction Yards 6, 7, 9 and 10. These yards have been identified specifically for the construction of the tunnel.[63]

142 The night time activities will be directly related to the tunnel excavation and would include making allowance for the arrival of personnel and general tunnel construction administration. Most of the activity will be underground.

143 Following excavation of the driven tunnel face and having advanced the tunnel by 1.5m, there is a requirement for shotcrete to be placed to ensure safety of the workforce, equipment and to maintain support integrity of the excavation works. The shotcrete should be placed as soon as the excavation cycle is completed, which normally would be within 30 min (or less). The shotcrete lining is the primary component of the temporary tunnel support. Should this not occur, it could result in excessive tunnel face and roof deformation with resultant increases in mechanical settlement beyond that considered within the settlement analysis. In the extreme case it could lead to tunnel roof collapse resulting in the loss of life and equipment.

144 In addition, where night time works are required for other sections of the Project, as described within my evidence, night time access may be required to other construction yards, in particular Construction Yards 1 and 2. This will be limited as far as practicable within the constraints of the CEMP.

Utility services[64]

145 A number of submitters have raised issues in relation to construction effects on utility services and requested that:

145.1 Any services are protected or relocated prior to construction (e.g. Auckland City Council Submitter No. 111);

145.2 Overhead electricity lines are undergrounded where possible;

145.3 Infrastructure providers are not prevented from carrying out works on their infrastructure (Watercare - Submitter No. 80);

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[63] The Construction Yard Drawings 913-106, 107, 109 and 110 detail the activities that will occur. See AEE, Part F.06, Drawing Nos. 20.1.11-3-D-C-913-106, 107, 109, 100.

[64] See further discussion in AEE, Chapter 5, Section 5.6 (Services).

145.4 Existing infrastructure is upgraded at the same time (e.g. Submitter No. 151[65]); and

145.5 That continuity of services is maintained and the existing services be monitored (Submitter No. 111).

146 Across the Project area, the proposed works cross and impact on a number of utility services. The utility providers require that all services be kept operational during the construction works. Where possible, and depending on construction sequencing, services will be relocated prior to works commencing into a new location as agreed with the utility provider.

147 In a number of instances, such works will be undertaken by an approved contractor who has the experience and knowledge of dealing with such services (i.e. the live gas network).

148 A number of services will only require protection from damage (e.g. sewer lines). These services have been identified and agreed with the utility provider as to the extent of protection that is required.

149 Further discussion is ongoing with the service providers and will continue through the detailed design phase and development of detailed construction methodology to ensure that there is no disruption of service.

150 Consultation with Vector and Watercare has been undertaken over the development of the Project and agreements are being put in place.

Construction yards and site compounds

151 Over the Project area, 12 Construction Yards have been identified and are shown on Drawing 913-100.[66] Each of these yards have been allocated to the functions required for the construction of the works.

152 Specific concerns have been raised by submitters[67] about Construction Yard 5 in relation to its location adjacent the Waterview Primary School and Kindergarten. This includes concerns about noise, dust, and traffic effects. Submitter No. 186 seeks the relocation of the school hall and pool. As explained in Mr Tommy Parker's evidence, the NZTA has met with the School to discuss mitigation requirements of the Project, and will continue to work with the School and Kindergarten to mitigate any impacts of the Project both during construction and operation.

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65 Being Pi Theng Ang.

66 AEE, Part F.6, Drawing Nos. 20.1.11-3-D-C-913-100.

67 Including Submitter Nos. 44, 207, 213, 54, 208, 172, 137, 123, 209 and 231.

[Drawings 913-101 to 112][68]

153 Each Construction Yard drawing indicates the activities that are expected to occur within the yard.

154 The yard specific drawings also indicate activity constraints applicable to the yard and environmental features which will be taken into account when establishing and using the yard by the contractor(s).

155 All yards will be fully fenced and made secure. Site establishment activities will include site clearance, ground preparation, and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the works, the construction yards will be disestablished and the areas reinstated.

156 All yards will be provided with water, telecommunications and power connections, and where required sewers. In most cases, these services are able to be connected directly to the existing adjacent networks. Where there is no existing network adjacent to the yard, a temporary connection will be made. These connections will be removed after the completion of the Project. Construction Yards 6 and 9, located at the northern and southern tunnel portals, will have greater power supply requirements than other yards to allow for the operation of tunnelling machinery and other related tunnel operations. The yards will be fed with two high voltage feeds from separate supplies - Point Chevalier and Mount Roskill substations respectively.

157 In general, the construction yards will operate during daytime from 6am to 7pm Monday to Saturday, and 8am - 3pm on Sunday, to allow receipt of materials and plant for the upcoming week work, and to undertake maintenance work on equipment.

158 As night time works are required on occasions across all of the Sectors, access will be required to yards at night for the activities as described previously in my evidence.

159 As such, perimeter lighting will be required. This will be designed to meet relevant council bylaws and standards. While the construction yards for the deep tunnel (Yards 6, 7, 9 and 10) will be active 24 hours a day, 7 days a week, the night time works within these yards will be limited because the majority of work will be undertaken underground.

Construction of the driven tunnels

160 A number of submitters[69] raised concerns about the construction risks in relation to tunnelling, with potential risks associated with fire[70] and collapse.

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[68] See AEE, Part F.6, Drawing Nos. 20.1.11-3-D-C-913-101 to 112.

161 Tunnel excavation (mining) involves risks relating to the work being underground. The NZTA will expect and ensure that the tunnel contractor will comply with the international code of practice[71] with regards to tunnel safety and construction methods. Stringent procedures are applicable throughout the world with regards to tunnelling and these procedures will also be implemented within this Project. This relates to the restriction of access, type of equipment that can be used and the behaviour of staff.

162 The two 15m wide by 12m high tunnels will be excavated to a minimum depth of 11m to the crown of the tunnel at the portals, and a maximum depth of 65m to the tunnel invert. The two tunnels will be able to be excavated concurrently from both the northern and southern driven tunnel portals.

163 The tunnel will be constructed using mechanised methods and with muck removed via conveyors to stockpile buildings. During excavation, temporary support will be required to be installed directly behind the open face and will comprise combinations of bolts, lattice arches, grouted piles and sprayed steel fibre reinforced shotcrete as determined by the specific geological conditions encountered during construction. The permanent support will comprise a waterproof membrane and either cast in-situ concrete or sprayed shotcrete lining.

164 Ventilation to the tunnel face will be provided by fans at each portal. Power supply will be required for the construction works and thus power and communication cables will extend into the tunnel from the portals. It is possible that some equipment will be diesel and these will have catalytic converters and / or scrubbers for suitable for underground use. Refuelling will be carried out in place.

165 Drainage channels and service ducts will be laid in the invert of the lined tunnel and backfill placed to form the carriageway. The tunnel mechanical and electrical fit out will then be completed.

166 Approximately 1,400,000 m^3 of material is expected to be excavated from the tunnels. This material will either be reused within the Project, such as on the Causeway, or disposed of offsite to an appropriate clean fill facility. A review of clean fill sites indicates that there is sufficient capacity in the Three Kings and/or Wiri clean fill facilities to take all of the material generated from the tunnel excavation.

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69 Including Submitter Nos. 98 and 240.

70 Fire has been addressed earlier in my evidence.

71 Including ITCoP (International Tunnel Code of Practice), ITA Guidelines for Tunnelling Safety 1991, BS6164 Code of Practice for Safety in Tunnelling in the Construction Industry, and New Zealand Health and Safety Act 1992.

167 Material from the southern tunnel portal will either be loaded directly onto trucks for disposal offsite, or temporarily stockpiled in Construction Yards 9 or 10 before being reused in the causeway or disposed of offsite. Trucks from this end of the tunnel will be able to access SH20 directly.

168 Material from the northern tunnel portal will be stockpiled temporarily within Construction Yards 4, 6 and/or 7 before being either reused in the causeway or disposed of off-site.

169 To minimise traffic disruption at and around the construction yard, a temporary conveyance system is proposed from the northern portal to the temporary stockpiles within Construction Yard 4. The temporary conveyance system would be approximately 800m long and is likely to be approximately 6-8m above the existing ground to safely cross the CMA and the motorway. It would run along the new road alignment within the proposed designation.

170 The conveyer would be an enclosed system, to minimise the potential for spoil to spill over the edges and would be insulated to meet District Plan noise requirements. It is envisaged that the conveyor would run 24 hours a day in conjunction with the tunnelling operation. As with all construction, noise monitoring would be undertaken to monitor compliance with the relevant noise requirements.

171 The conveyance system may also be used to transfer material from the stockpiles to the causeway for the reclamation, rather than trucks. Should this be the case, the conveyance system would run from Construction Yard 5 along the northern edge of the causeway to a receiving point. Then, as the causeway reclamation advances west, the conveyor will be advanced with additional cassettes being placed. For the reclamation work on the southern side, the conveyor would be extended across the motorway, and advance on the southern side in a similar fashion.

SITE SPECIFIC CONSTRUCTION PROCESSES

172 In this section of my evidence, I will explain the possible methodology for some of the site specific construction processes. The final methodologies will be determined by the contractor(s), and will include compliance with all relevant consent and designation conditions.

Construction of large structures on/over live motorway

173 An example is given within Section 1[72] where the Te Atatu northbound bridge needs to be replaced with a new steel girder and cast in-situ deck arrangement to accommodate three 3.5m lanes

[72] See AEE, Part F.8, Drawing No. 20.1.11-D-N-917–210.

and 0.6m shoulders. The northbound bridge deck will be constructed upon the existing abutments and central pier.

174 The removal/replacement of the bridge deck will take place at night with a crane that will be located on the SH16 motorway. The working zone required for this work will be approximately 10m wide and 100m long. Enabling works will be put in place to allow for traffic to be diverted around this central working area.

175 The new deck will be positioned on the existing centre line albeit with a wider deck width. As a result, the western edge of the new deck will overlap with the pedestrian footbridge. This will require minor modification to the eastern edge of the footbridge which will result in a reduction in the width of the overall footbridge between handrails, from 4m to 3.3m. All beams will be lifted into place during night time works using a crane positioned in the working zone defined above.

176 As the existing lane capacity cannot be maintained during construction of the northbound bridge, it is proposed to widen the southbound bridge first. This will then be able to accommodate one of the northbound lanes as a contra-flow in addition to the two existing southbound lanes. The remaining northbound lane would be accommodated by staging of demolition and construction of the Te Atatu southbound bridge.

177 The Te Atatu southbound bridge will comprise three 3.25m lanes and 0.5m shoulders. The additional lane capacity can be achieved by relocating the existing footpath together with some modifications to the deck at the eastern edge to accommodate the three lanes.

178 The design proposes to extend the existing pier of the Te Atatu southbound bridge to support a new footbridge at this location. The extended wall will be constructed on four new piles, supporting the loads from the pedestrian bridge and the widened section of the southbound bridge. Four bored pile foundations will be required to provide sufficient strength to the extended bridge pier. Once the piles have been cast and the concrete cured, the bladed pier can be constructed onto the pile foundation. All piling and pier construction work can take place within the working zone during normal working hours.

179 The existing footway bridge on the western edge will be reduced in size to allow for the widening of the northbound bridge. The pedestrian barrier will be replaced with a new 1.4m high barrier complying with requirements for cyclists. A new kerb will be provided by drilling and fixing into the existing deck. The new footbridge will be formed using two 27.5m spans using two 1200 Super Tee beams to form a footway with a width of 3m.

180 The new pedestrian underpass will be constructed using precast concrete sections, which will make up the 45m long underpass. The precast concrete sections will be 5m wide and 2.5m high. The majority of the underpass can be constructed off-line as cut and cover, with lane diversions or night time work being required to install sections of the underpass within the active on/off-ramp areas.

Working in and over the CMA

181 The existing Whau River bridge decks will be widened by 7.5m for the eastbound bridge and 8m for the westbound bridge. It is proposed that the widening of the superstructure will adopt a similar girder and deck system to the existing bridge decks to achieve similar characteristics. Bridge widening will require 54 new piles (27 eastbound and 27 westbound) to be constructed within the Whau River. The bridge piles are proposed to be 1.5m in diameter, extending into the seabed to rest on firm material below, and arranged to match the existing Whau Bridge pier locations.

182 The construction of all bridges will be undertaken from temporary staging platforms. The westbound staging platform will be located between the motorway and the new pedestrian/cycle way bridge (located 8m to the south) to enable construction of both bridges (westbound and cycleway) from the same platform.

183 An allowance for a 7m wide temporary platform has been provided for with a 0.5m clearance to the permanent bridge for formwork to be located. The temporary platform will be supported by driven piles, driven into the underlying mud until a sufficient bearing capacity is achieved. The support strength from these temporary piers will provided via skin friction, so the length of pile will vary accordingly. The piles are typically arranged in pairs at 9m centres longitudinally and 5-6m centres laterally. The piles will support a steel superstructure with a timber decking to form the surface of the temporary platform.

184 The deck and supporting beams will be set at a level high enough so as not to reduce the vertical clearance (freeboard) to the water and to maintain the navigation channels. The westbound staging platform will be located between the motorway extension and the proposed Cycleway Bridge to enable construction of both bridges from the same platform. The temporary platform will be designed to provide access from each bank of the Whau River, whilst maintaining the existing navigation channel.

185 Following completion of the bridge structures, the platform will be removed. The piles will be removed through the use of vibration equipment.

186 Construction of the causeway bridge widening will be undertaken using the same methodology.

Construction over a live motorway

187 A new Patiki Pedestrian/ Cycle Way Bridge will be constructed over the Patiki westbound on-ramp (9m span for the approaches and a 25.5m span for the main carriageway). Before the new Patiki Pedestrian/ Cycle Way Bridge can be constructed the existing cycle bridge will have to be demolished. This will require cyclists to use Patiki Road as a diversion during these works. Night closures will be required to accommodate the crane and excavators needed to complete the task.

188 When constructing the new footbridge, construction time over the live motorway will be of a relatively short duration, as the new bridge is currently proposed as a Truss design. This will be constructed off site, and lowered into place by crane when ready. This will require night time works and night closures with traffic diversions.

189 The first 21m length of the eastern approach to the bridge is proposed to be formed with earthworks and retaining walls to eliminate the need for piling works below the existing Patiki off-ramp. The approach spans are proposed to be formed with precast concrete beams supported on piers at 10.2m centres. Sixteen piers are required to support the bridge.

190 The new bridge can only be completed once the westbound on-ramp has been modified and realigned as two of its piers will be positioned in the existing Patiki westbound on-ramp.

191 The main span over the on-ramp will require a temporary closure of the ramp to maintain public safety during the main beam lift and this will be undertaken as night works. The main span will consist of a truss constructed of universal beams for the top and bottom cords. The ends of the truss are proposed to be supported by a blade pier.

Reclamation within the CMA

192 The proposed reclamation will require a large quantity of fill material for Sector 4 and smaller amounts for Sector 2. Approximately 350,000m^3 of fill will be required (± up to 70,000m^3 for compensatory fill). The volume of fill required will either be sourced from a nearby quarry and/or provided from material removed from the SH20 tunnel if this is suitable. The fill requirements need to take into account additional considerations such as coastal erosion, stability of underlying sediments and settlement. As such, the properties of fill materials from the tunnel will require testing to determine its suitability once tunnelling commences.

193 There will be four main fill types used for the reclamation works:

193.1 Bulk and shoulder fill material to be used for raising the causeway to the proposed design level and widening works;

193.2 Rock armour to combat wave attack/erosion on the Causeway embankment;

193.3 Pavement material; and

193.4 Filter materials for the flow of water and to provide protection to internal fill layers.

194 An appropriate method will be used for creating a dry working area adjacent to the motorway and within the area to be reclaimed.

195 A working platform will then be created from durable hard rock being placed on the mudflat. Geogrid or similar material will then be placed on top of the rock fill. Subsequently, a geogrid or similar reinforced raft will complete the working platform. The geogrid reinforced raft has a twin role of providing a safe working platform and also contributing towards the reinforcement and strength of the hard rock and/or global shear restraint of the permanent slope.

196 Once the working platform is in place, construction plant can operate and carry out the specified ground improvement work and subsequent formation of the new geogrid reinforced fill embankment.

197 Construction of embankments may require some form of foundation undercut. This means the formation will be stripped of topsoil or unsuitable marine sediments. The foundation will be inspected by a qualified geotechnical engineer and proof-rolled under their observation before backfilling with suitable material.

198 This method of working describes the typical process within any section of the causeway reclamation.

Construction of new lanes within a live roading environment

199 Construction of the Great North Road underpass within Sector 7 will be separated into three main stages to enable the existing four lanes to be maintained for Great North Road traffic at all time. The stages being:

- Stage 1(a) – North of Great North Road underpass;
- Stage 1(b) – South of Great North Road underpass; and
- Stage 2 – Great North Road underpass.

200 It is expected that Stage 1(a) will commence first to provide construction access to the northern tunnel driven portal, concurrently with Stage 1(b).

201 Stage 2 will be completed once temporary traffic diversions are established for Great North Road traffic.

202 It is expected that the method of construction used will be similar to the internationally accepted method of constructing cut and cover tunnels.

203 The underpass will be constructed using diaphragm walls to support the excavation. The diaphragm walls will be excavated in 5-8 m long trenches and backfilled with reinforced concrete. Two rows of diaphragm walls will extend over the full length of the cut and cover tunnel with a central row of piles in the 'combined' tunnel box section between CH3930 and CH4280 to support the tunnel roof. This central row of piles will also provide separation between the two traffic flow directions. Transverse diaphragm walls will be constructed at the two excavated tunnel portals - CH3930 and CH3785m. These walls will also be used to provide face stability for the commencement of the driven tunnel works.

204 Once in place, excavation of the tunnel will be undertaken between the diaphragm walls to a depth of 3-5m below ground level. A crane will then be used to place the precast concrete roof sections, leaving sufficient distance to provide continual access for removal of excavation spoil. The excavation will extend to carriageway subgrade elevation with temporary props installed to support the diaphragm walls where required. Drainage will be installed to relieve long term groundwater beneath the floor slab.

205 To complete the tunnel box, the remaining sections of the roof will be constructed and fill placed over the roof to provide nominal ground cover to the structure.

206 Construction of the northern ventilation building will start with the construction of a 600mm diameter pile wall around the perimeter of the building. This will be installed from existing ground level.

207 Once the pile wall has been constructed, all material within the building footprint will be excavated down to the level of the plant room floor slab. Temporary props will be required to support the pile wall as the excavation depth increases.

208 Following the excavation works, internal foundation piles will be constructed at the base of the excavation, to support the building column. Drainage will be placed at the base of the excavation to provide relief to groundwater uplift pressures beneath the slab. The plant room floor slab will then be constructed.

209 Internal columns and support beams will then be formed using conventional structural building techniques. These support the precast concrete roof units that will be lifted in by crane and connected to the structure with an insitu concrete topping.

210 Finally, the above ground plant rooms will be constructed, possibly using a steel frame with precast elements. These are supported directly by the precast plant room roof units.

211 The vent stack will also be supported by the pile wall and a series of precast concrete sections that will be craned and fastened into position.

FURTHER COMMENTS ON SUBMISSIONS

212 Submitter No. 99 requested that the tunnel be designed to the highest possible standards to enable freight transport efficiency, safety and effectiveness, including operation and maintenance (*OM*) and /over dimension (*OD*) standards along the full route, a range of safety provisions such as shoulders, stopping areas, and in tunnel fire protection. The submitter also requested that access to interchanges and turning circles are designed for larger classes of HCV (high capacity vehicles).

213 The cost of a tunnel is significantly influenced by the cross sectional area, due to the additional excavation, temporary support, and ventilation required. In addition, there are greater effects associated with the ground conditions, including potential settlement and groundwater issues. The cross section proposed for the Project incorporates a traffic envelope of 12.5m x 5.4m, which is not sufficient for an OD route.

214 Motorways do not generally form part of the over dimension vehicle routes due to the high speed of travel and function of the motorway system. Use of motorways for over dimension vehicles would result in a large speed differential between motorway traffic and slow moving OD vehicles, increasing the risk of crashes associated with weaving and lane change. There is an existing OD route identified across the Auckland Isthmus, including Mt Albert Road, Owairaka Avenue, Richardson Road, Woodward Road and Carrington Road, and the Project will not impact on the use of these roads.

215 The Project will be designed to relevant NZ and Australian standards and guidelines. In exceptional circumstances where this may not be practicable, variations will be sought through the NZTA Value Assurance Committee.[73] Access to interchanges and vehicle

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[73] VAC is an internal NZTA committee that evaluates any proposed relocation of standards.

tracking at intersections will be designed in accordance with Austroads standards.

216 Submitter No. 78 expressed concern about cost and efficiency of the tunnel, and seeks to shorten the distance and depth through redirection from Alan Wood Reserve to Heron Park, with a resultant reduction in cost.

217 The current alignment of the tunnel and the reasons as to the locations of portals and geometry of the road are discussed in detail earlier in my evidence.

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Andre Walter
November 2010