NORTH EAST LINK PROJECT ENVIRONMENT EFFECTS STATEMENT
INQUIRY AND ADVISORY COMMITTEE

NELP TECHNICAL NOTE
– RESPONSE TO TN 41
by Andrew O’Brien dated
20 August 2019

TECHNICAL NOTE NUMBER: 41
DATE: 1 August 2019
LOCATION: N/A
EES/MAP BOOK REFERENCE: N/A
SUBJECT: Initial Response to Andrew O’Brien’s Traffic Expert Witness Statement Traffic and Geometric Design
NOTE: 1. This Technical Note has been prepared to respond to the Traffic and Geometric Design proposed by Andrew O’Brien in his expert witness statement dated 15 July 2019 (the O’Brien Proposal).

REQUEST: N/A
CORRESPONDENCE: N/A
RESPONSE: Responses by Andrew O’Brien are shown in RED text within the original TN41

DESCRIPTION

1) Mr O’Brien’s witness statement includes an ‘Alternative Design’. It is referred to here as the ‘O’Brien Proposal’.

2) In broad terms the O’Brien Proposal includes the following features:
   a) on ramp-metering to manage weaving on the freeway;
   b) a simplified M80 interchange to NEL with a reduced number of structures;
   c) a diverging diamond interchange at Grimshaw Street
      AOB Comment: this is not included in the design – the report said this would be investigated);
   d) an additional connection to Alexandra Parade at the city end of the Eastern Freeway
      AOB Comment: this is a potential future busway connection only;
   e) the relocation of the express busway to the centre median of the Eastern Freeway from Hoddle Street to Bulleen Road, crossing to the north side of the freeway east of Bulleen Road; and
   f) the removal of the braided ramps between Tram Road and Middleborough Road (as provided in the Reference Project).

3) It is noted that the O’Brien Proposal is premised on preserving the functionality of the Reference Project. To the extent that any further design, including aspects of the O’Brien Proposal, can be demonstrated to preserve functionality while complying with all applicable EPRs and other relevant road design requirements, the design could be considered in the preparation and assessment of the final design
   AOB Comment: This seems to be a very positive response to the Alternative Design.

4) In the time available, and to facilitate discussion, NELP has undertaken an initial review of the O’Brien
Proposal and identified a list of items that would require further consideration, design and resolution. These items generally relate to compliance with relevant road design standards and guidelines and impacts on existing and/or future infrastructure and traffic performance.
5) This Technical Note lists the items by reference to the following project areas:

   a) M80 to Eastern Freeway;
   b) Eastern Freeway;
   c) Express Busway Corridor.

6) It considers both the feasibility and functionality of the proposal.

**FEASIBILITY**

**M80 TO EASTERN FREEWAY**

7) The O’Brien Proposal does not meet relevant Austroads Guidelines and Standards (*Austroads Guide to Traffic Management: Part 6*) for some key aspects including minimum distances for changes to the speed environment, merge and diverge configurations, and storage. For example:

   a) Variations in the speed environment along parts of the M80 (and more specifically within proximity to the Plenty Road exit) do not comply with the minimum distances specified in the Guidelines (changing from 80 km/h – 100 km/h – 80 km/h within 1300 metres as opposed to the minimum distance of 1500 metres)

   **AOB Comment:** This note is not clear. I have not suggested any speed limits. The Alternative Design replicates the functionality of the Reference Design for the west to south connection.

   *A word search of AGTM reveals nothing that is relevant to this note.*

   b) The Grimshaw Street entry ramp does not comply with the minimum length specified in the Guidelines (being 60 metres as opposed to the minimum 120 metres)

   **AOB Comment:** This note is incorrect. The southbound ramp is 240 m to ramp meter (see figure below), and the northbound ramp is almost 1 km to the ramp meter, and the merges are in excess of standard length.

   ![Diagram of M80 to Eastern Freeway with annotations](image)

   c) The Watsonia Road connection is not adequately separated from the adjacent intersection and would not provide sufficient storage to facilitate traffic movements without flow breakdown.
AOB Comment: Banyule does not want high levels of traffic in Watsonia Road but to treat it as a 'shopping street'. The roundabout also provides local Centre U-turning for vehicles parking and un-parking. On viewing the micro-simulation of my proposal, it became clear that the connection across Watsonia Station had not been incorporated, and if it had, there would not be an issue. Potential mitigations, if needed, could be to exclude the pedestrian crossing across the southern leg of the main intersection, or re-phase the pedestrian crossing within a different phase.

8) Other aspects of this component of the design that would require further mitigation or consideration include the following:

a) The connection of the bus interchange over Watsonia Station:
   
   i) The O’Brien proposal includes a bus interchange over Watsonia Station that cannot connect to Watsonia Road whilst meeting Austroads guidelines and standards.

   AOB Comment: I am not aware of particular Austroads documents specifically for bus interchanges. I have designed bus interchanges at Ringwood, Croydon, Frankston and Dandenong over the years and the designs were based on functionality and safety. I have also road safety audited the Auckland Northshore busway through all stages.

   ii) The interchange has been placed above the existing rail levels for clearance however this would result in the interchange being at least 2m above the existing railway car park level and 3.5m above Watsonia Road at the proposed connection point.

   AOB Comment: The existing footbridge appears to be close to ‘at-grade’ with the carpark, but about 2 m LOWER, not higher, than Watsonia Road. A short-span road bridge would not need deep beam construction, and slightly higher levels at the car park accesses could be accommodated.

   iii) If Watsonia Road is adopted as the level for the bus interchange, then it will have flow-on effects for the levels for the station car park, Greensborough Road and the power line easement east of Greensborough Road.

   AOB Comment: There is sufficient space to accommodate the grade changes, and in any case, the whole car park will be rebuilt.

b) The spacing of intersections along Watsonia Road:

   i) The bus interchange is proposed to connect to Watsonia Road, creating a section of that road containing two intersections within 60m of each other.

   AOB Comment: There are numerous urban locations where such conditions exist and operate satisfactorily. It just needs good design to be achieved.

c) Impacts on transmission lines:

   i) The bus interchange crosses the rail line to a new road connection in the transmission reservation that will require towers to be relocated closer to residential areas and potentially impact the clearance requirements associated with the transmission lines.

   AOB Comment: Yes, it is understood that these towers would need to be removed or relocated in the Reference Design as well in order to construct the trenched section of NEL.

   It is noted that Morwell Avenue west of Watsonia neighbourhood centre has been constructed within the transmission line easement (see figure below).
d) Impacts on pedestrian ramps and Watsonia Station:
   i) The bus interchange will require the existing pedestrian ramps connecting to Watsonia Station to be reconstructed and an upgrade to Watsonia Station.

   **AOB Comment:** This is probably self-evident.

e) Proximity of intersections:
   i) The new roundabout at Richards Road is placed 60m from a signalized intersection in Greensborough Road.

   **AOB Comment:** That is so, and it is quite deliberate to assist in the operation of the Watsonia Centre. Movements between Watsonia Road and Greensborough Road will require a right-angle turn (see figure below).
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ii) Consideration of operational difficulties would be necessary if queues at the signalized intersection extend back into the roundabout.

AOB Comment: This is not a problem for the signalised intersection. This issue has likely arisen due to the omission of the link across Watsonia Station and the adopted signal phasing used in the micro-simulation.

f) Safety considerations:
   i) The arrangement at Greensborough Road northbound (north of the Nell Street intersection) would likely cause late lane changes and unsafe operations due to the short distance for commuters to make a decision and select the right lane to match their destination leading up to Grimshaw Street.

AOB Comment: Commuters are usually aware of conditions along a route that they drive regularly. Appropriate signage will be needed for those who may not be familiar.

g) Provision for noise walls:
   i) No provision has been made for noise walls.

AOB Comment: Space has been made available in the design - it is a matter of detail design in consultation with the community – not a strong point with this Project.

EASTERN FREEWAY

9) The O’Brien Proposal does not meet relevant Austroads Guidelines and Standards (Austroads Guide to Traffic Management: Part 6) for entry and exit ramps:
   a) The entry ramp geometry at Elgar Road, Tram Road and Springvale Road has a merge lane from three lanes to one without achieving the minimum distance of 150m. It is also noted that at this location the storage length is less than the requirements of the Project.

AOB Comment: The Elgar Road ramp is 150 m long; Tram Road has a 130 m staggered stop line merge, and Springvale Road is not within the drawing set as it is per the Reference Design.

Note that, at Warrigal Road VicRoads has a recently installed 80 m long 3-lane merge on the westbound on-ramp – see photo below. The merge distance could readily have been increased. (The red arrow shows the merge control – the pier of the pedestrian overpass)
Based on my experience in designing and operating ramp metering systems, 120 m is quite sufficient – particularly entering an auxiliary lane. If desired, the ramp storage could be increased with minimal physical impact, and no operational impact.

b) The entry ramp geometry at Middleborough Road does not comply with VicRoads Guidelines, which require that a merge from two lanes to one lane has a minimum distance of 80m to the nose of the ramp.

AOB Comment: The merge is on the existing ramp – it has a 60 m section beside the right-hand kerb, and extends 20 m beyond – i.e. a total of 80 m and enters an auxiliary lane. This is a detail that is readily modified if needed.
c) The distances between the entry ramps and exit ramps at the following locations do not comply with the Austroads Guidelines which require a distance of 1500m in between entry ramps and exit ramps for carriageway of four or more lanes:

AOB Comment: The Austroads Guide to Traffic Management Part 6 (AGTM 6) Table 6.3 Ramp Spacing addresses this matter:

- Note 1 to the table states: “this table is a guide only. . . ”, and
- Note 6 states “. . . Notwithstanding this table or the HCM analysis, it is desirable that not less than four seconds of travel, at the desired speed of the major road, be provided between the end of the last taper of the entry terminal and the start of the first taper of the following exit terminal”.

Therefore, footnote 6 and section 6.3.1 of AGTM Part 6 indicates that the interchange spacing less than 1500m should be acceptable if:

- Distance is four seconds of travel time between the end of the entry ramp merge taper and the start of the exit ramp diverge taper (i.e. around 100 m for travel at 100 km/h); and
- A complete analysis in accordance to the HCM is undertaken and demonstrates that the desired operational performance is achieved.
- A minimum of four seconds of travel (about 110 m) is available between the end of the merge taper and the start of the next diverge taper

A brief review of micro-simulation models indicated that operational deficiencies in the weave areas are primarily a result of modelling issues (which are discussed later). Minor tweaks of either modelling or the Alternative Design would improve the performance in the weave to the Blackburn Road exit.

i) the Tram Road Entry Ramp and Middleborough Road Exit Ramp (which are approximately 740m apart).

AOB Comment: The Reference Design has the Blackburn Road on-ramp and the Middleborough Road off-ramp noses only 680 m apart on a 5-lane section. Is this OK? Reviewer has not explained why this is a problem in the Alternative Design considering the Reference Design has adopted similar distance.

ii) the Middleborough Road Entry Ramp and Tram Road Exit Ramp (which are approximately 680m apart).

AOB Comment: See above. Note also that the ramp ‘nose’ spacing from the Blackburn Road on-ramp to the Middleborough Road off-ramp is 880 m on the Alternative Design, but only 680 m on the Reference Design.

10) The Proposal also adopts a number of arrangements along the Eastern Freeway corridor that need further consideration to meet Project requirements. These include:

a) The eastbound carriageway:

i) The realigned and regraded eastbound carriageway of the Eastern Freeway from Alexandra Parade under the loop entry ramp to Hoddle Street would impact the main drain to Merri Creek, which is located in the median of Alexandra Parade (and under the loop entry and outside of the Project boundary);
AOB Comment: In my report, this is provided as a future option – one way to demonstrate how the busway could be extended along Alexander Parade – it is not a part of the Alternative Design.

b) The NEL/Eastern Freeway ramp connections:

i) The arrangement of the NEL southbound to Eastern Freeway westbound ramp adopts a radius of 200 – 220m which would not meet the minimum 240m distance specified in the Guidelines and sight distance standards for a design speed of V80kph;

AOB Comment: The Alternative Design has a 175 m radius curve, which is above the ‘absolute minimum’ specified in AGRD (157 m). It would typically have a 70 km/h advisory speed, and when the ramp signals are operating, under either the Reference Design or the Alternative Design, the speed limit would need to be dropped to 60 km/h on exiting the tunnel. There is also a steep upgrade on exiting the tunnel which would assist in slowing traffic.

AGRD Part 4C Section 6.2.

Table 7.6: Minimum radii of horizontal curves based on superelevation and side friction at maximum values

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c) Impacts on the golf course overpass:

i) While the attempt to minimize impact on the sports and recreation facilities is acknowledged, the alignment of the Eastern Freeway eastbound to the NEL northbound ramp would remove the northern abutment of the golf course access overpass and would require earthworks impacting the golf course.

AOB Comment: The Alternative Design is further from the northern abutment than is the Reference Design. I am advised that the hole on the golf course would need modification, but would still be viable – unlike with the Reference Design.

d) The Doncaster Road entry ramp:

i) The Doncaster Road westbound entry ramp is shown as splitting into separate entries directing commuters to the Eastern Freeway carriageway and NEL carriageways. No details were provided to demonstrate the dual right turns within the Doncaster Road interchange and any impact on overpass width, interchange functional layout and the High Street intersection.
AOB Comment: In my opinion, this interchange is probably significantly overdesigned. Managing a 'split' right turn from Doncaster Road to the two ramps will require well-designed linemarking and direction signage.

ii) Due to the number of lanes on the Eastern Freeway under Doncaster Road, this structure would need to be reconstructed and would need to include the additional width shown in the Proposal.

AOB Comment: The Reference Design is about 3 m wider under the bridge than the Alternative Design.

**EXPRESS BUSWAY**

11) The busway arrangement shown in the O'Brien Proposal requires further consideration, including in respect of:

a) The busway connection to the Eastern Freeway median:

i) The busway connection in the median of the Eastern Freeway carriageway under the Hurstbridge rail overpass to the Hoddle Street overpass would require grades exceeding current standards (8-10%).

AOB Comment: Having no useful level data, I worked on the basis that if the existing off-ramp to Hoddle Street can go under the railway and rise up to Hoddle Street, then there should be no problem with doing the same for the bus.

ii) To mitigate these grades, the ramps would need to be extended and would potentially impact upon existing infrastructure.

AOB Comment: See above.

b) The location of the busway in the Eastern Freeway median:

i) Locating the busway in the median of two freeway carriageways introduces safety issues that would require mitigation.

AOB Comment: No specific detail of safety issues was provided. An example of locating public transport facilities in the median of two freeway carriageways is Mitchell Freeway in Perth (see photo below).
ii) The busway would at the least need to have provision for emergency access and egress points in the event of an incident.

AOB Comment: The proposed busway is about the same width as the Auckland North Shore busway, and it has similar constraints in terms of total access control. The width is sufficient to pass between two disabled buses if needed. Emergency access would be easier for a central location than a side location, as it could be accessed from either carriageway.

c) The dimensions of the busway and its capacity to be modified in the future:

i) The dimensions and arrangement of the proposed busway restricts flexibility for the construction of future infrastructure such as future stations at Chandler Highway and Burke Road.

AOB Comment: It restricts ‘flexibility’ but does not prevent stations being created.

ii) The proposed busway also does not have sufficient width to be converted to a rail corridor in the future (unless the overall freeway carriageway is realigned into public open space).

AOB Comment: The central median section of busway has a minimum width between barriers which is the same width as the lowered sections of railway used in the Level Crossing Removal program.

d) The introduction of an extended underpass:

i) The O’Brien Proposal features a busway underpass in excess of 80m in length introducing ventilation, flooding and fire and life safety considerations.

AOB Comment: No, the enclosed section is about 30 m – all that is needed is an ‘open structure’ where there is no roadway above. See aerial below of Grafton Gully in Central Auckland, where I was involved in safety auditing the project.

e) The Thompsons Road entry ramps:
i) The proposed underpass at the Thompsons Road entry ramp conflicts with the existing large Koonung Creek culvert and would require the entire Koonung Creek culvert to be reconstructed over a significant length.

AOB Comment: This is incorrect. The busway passes under the raised on-ramp and over the culvert (noting that Thompsons Road is to be raised, and a minimal structural depth is needed for a 10 m long portal structure)

ii) The O'Brien proposal does not provide sufficient length at the Thompsons Road bus station. A minimum of 90m is required and only 45m is provided. A longer length is likely to impact the vertical grade line of the Proposal.

AOB Comment: Around 80 m of platform could readily be provided. A 90 m bus platform seems excessive as it could accommodate up to 6 buses. The suggested 140 buses per hour each way could far better be accommodated with the Alternative Design than with the Reference Design due the congested at-grade intersection in the Reference Design.

f) The section between Doncaster Road and Springvale Road:

i) The busway would need further consideration and design to be feasible from Doncaster Road to Springvale Road.

AOB Comment: This is the same for the Reference Design.

ii) The Doncaster Park and Ride connection is unlikely to be able to be graded below Doncaster Road to the roundabout, and the freeway carriageway does not provide shoulders wide enough to accommodate bus use from Doncaster Road to Springvale Road.

AOB Comment: The first issue is the same for the Reference Design. To add an extra 1 m to the shoulder width is not a significant change.

iii) It would appear to be possible to design lanes with sufficient width for buses and connection to the busway to the Park and Ride, provided further impacts are accepted for loss of public open space and disruption during construction.

AOB Comment: See above

g) Drainage considerations:

i) The busway is within a floodplain and would require significant drainage pumps.

AOB Comment: The only section of the busway which might be relevant in the Alternative Design is where it passes under the outbound Eastern Freeway carriageway near Bulleen Road. Given the Project’s tunnels, draining an underpass should not be particularly problematic.

h) The connection of the busway to Alexandra Parade:

i) The Department of Transport and Bus Operators have not indicated that the buses will need to travel to Alexandra Parade. Therefore, the connection provided could potentially be redundant infrastructure.

AOB Comment: Good planning is about creating opportunities for improvements – not preventing them.

i) Construction considerations:

i) Construction of a busway under the active Eastern Freeway would take considerable time and
would result in significant staging and construction complexity and associated costs. This would arise because of the need to realign the freeway whilst the tunneled underpass is being constructed.

**AOB Comment:** This is a very simple operation. Side track the eastbound carriageway into the median, construct the underpass, relocate the traffic onto the overpass.

**FUNCTIONALITY**

12) The layout of the O'Brien Proposal has been tested within the microsimulation model to assess its performance. It should be noted that, because the O'Brien Proposal is two dimensional, this test does not consider issues with grades or compliance with relevant standards.

**AOB Comment:** This comment implies that the Reference Design has included grades, which until recently, NEL had refused to supply. Each of the grades involved are no greater than with the Reference Design – except that the north to west NEL ramp involves steeper grades.

As such, the assessment provides a best-case scenario. This assessment also does not consider safety issues (such as those associated with the extended sections of six lane freeway and the increased risk of crashes).

**AOB Comment:** Except between NEL and Doncaster Road, the 6th lane is an auxiliary lane – specifically not to be considered under HCM6. Also, the comparison between ‘managed’ and unmanaged’ freeways included in John Gaffney’s study of road safety on urban motorways (tabled document 180) on Monash v Princes Highway West showed no significant differences.

**EASTERN FREEWAY**

13) Most freeway sectors performed at an average density Level of Service (Loss) D or better. The following items are noted in this respect:

a) It should be noted that the microsimulation model cannot model the capacity impacts of tight radius curves such as those located between Bulleen Road and Doncaster Road with specific regard to lane changing and weaving.

**AOB Comment:** This effect, if any, is likely to impact both Reference Design and Alternative Design.

The O'Brien Proposal proposes this section of freeway to be six lanes wide without addressing the tight radius of this curve. The microsimulation model will be overestimating the performance of this section of the Eastern Freeway.

**AOB Comment:** No evidence of micro-simulation model overestimating the performance of a 6-lanes wide freeway with tight radius.

b) The westbound diverge to Bulleen Road in the AM Peak period performed at LoS E. This appears to be as a result of the single lane diverge and reduced storage provided on the exit ramp when compared to the Reference Project.

**AOB Comment:** Given that this is an ‘Exit followed by a lane drop’, it will have no impact. The micro-simulation showed that the ramp queue oscillated back onto the freeway each signal cycle – potentially requiring a lane designation change on the
ramp (allowing the left lane to be a shared right turn and left turn lane), or to add a couple of seconds to the off-ramp phase. The guiding principle for managed motorways is to ensure off-ramp clearance has the highest priority at an interchange.

c) An examination of density results reveals uneven lane utilisation and significant lengths of lanes with density LoS E and F in the eastbound and westbound weaves between NEL and Doncaster Road, in both peak periods. In the AM peak period, the kerbside lane of the westbound diverge to Bulleen Road performs at a combination of LoS E and F. In the PM Peak period, the ramp from the Eastern Freeway eastbound to NEL northbound sees significant congestion, as the added lane has been removed from the merge with NEL.

AOB Comment: This would appear to be a problem with the modelling of ‘look ahead’ and ‘lane change’ parameters. I have experienced this issue many times with micro-simulation.

d) Density results also highlight changes in performance between Tram Road and Middleborough Road. In addition to reintroducing the Tram-Middleborough weaving movements to a single carriageway, the O’Brien Proposal removes the direct access ramps between the two arterials. (This is self-evident). This results in increased design volumes for the Eastern Freeway and the ramp meters in both directions. The relevant ramp meter cycle times were adjusted to account for the additional demand.

AOB Comment: using fixed time metering is a substantial problem with the micro-simulation – it should be using the dynamic metering algorithm. Having local traffic passing through the ramp signals will reduce the demand for short trips considerable at peak times. If a short trip is subjected to a 4-minute wait at the ramp signal, when travelling one or two interchanges, it is likely to use the local/arterial road network – as it should.

In the eastbound direction in the PM Peak period, significant lengths of the kerbside lanes in the weave perform at LoS E and F. Heavy demand for the eastbound Middleborough Road exit manifests as density LoS E in the two kerbside lanes preceding the weave, extending west past the Elgar Road bridge. Similar effects are seen in the AM Peak period, to a lesser degree of severity.

AOB Comment: This is most likely to be a modelling issue related to ‘look ahead’ and ‘lane change’ parameters and the lack of emulating ‘real world’ conditions.

The brief review of micro-simulation at GHD offices on 14 August 2019 indicates that vehicles unexpectedly stopped ahead of the Middleborough Road off-ramp in an attempt to change the lane to exit. This has resulted in some congestion further west. In reality, this would not happen. Micro-simulation needs to be adjusted to reflect reality.

It is noted that criticisms made on the performance of the Alternative Design appear to be based on a lane-by-lane assessment, whereas that of the Reference Design included in the SmedTech TTIA is based on the entire cross-section (i.e. across all lanes) between ramps. Therefore, some notes presented herein provide distorted view on performance of the Alternative Design which does not allow for an apples-to-apples comparison with micro-simulation model results included in the TTIA.

e) On the arterial network, the key O’Brien Proposal changes that affect performance are around the Thompsons Road intersection with the eastbound entry ramp. The O’Brien Proposal reduces the number of stop lines at the ramp meter from three to two, and reduces the combined ramp meter storage from approximately 800 metres to 280 metres. The dual lane storage for the right turn from
Thompsons Road to the entry ramp is shortened from approximately 180 metres to 70 meters. To partially compensate for the changes to ramp metering arrangement, the cycle time was lowered to the reasonable minimum of 6 seconds, in accordance with VicRoads’ ramp metering guidelines. (In the AM Peak period, queueing for the ramp meter exceeds storage and blocks the upstream turning movements from Thompsons Road. The majority of vehicles using the ramp originate from Bulleen Road north, and the single left turn lane from Bulleen Road to Thompsons Road is also severely impeded, resulting in long queues on Bulleen Road north. The delay in this queue is attributed to the north side of Bulleen Road interchange, causing the overall intersection performance to drop from LoS C (Reference Design) to LoS E. Similar effects are seen in the PM Peak period, but are less severe and occur over a shorter time period, meaning the overall interchange performance matches that of the Reference Design (LoS C).

AOB Comments: The ramp storage is the same as currently exists, and which is quite workable. The latest traffic flow data indicates that flows will be about the same as now. This seems odd when so much traffic is supposed to divert to the NEL.
I was informed by modellers that long queues on Bulleen Road north were observed in the Reference Design as well.

**WATSONIA AND M80**

14) A number of items were identified in respect of the following three specific sites:

   a) Grimshaw Street interchange;
   
   b) Watsonia Road/Greensborough Highway;
   
   c) Greensborough Highway/Watsonia Station access.

**Grimshaw Street Interchange**

15) The O'Brien Proposal assumes that the Grimshaw Street interchange would remain as in the case of the Reference Project. However the O'Brien Proposal only allows for two lanes of significant storage on the northern approach rather than the four lanes allowed for in the Reference Project.

   **AOB Comment:** No, I have just allowed for an appropriate connection without going through a complicated design exercise without proper data – which is not available.

   This significantly reduces the performance of the interchange and causes lengthy queues on the northern approach to the interchange in the AM peak period and even greater queues in the PM peak. Re-allocation of green time to try and reduce these queues also had the impact of causing significant queues on the southern approach to the interchange during the PM peak period. In the AM peak period these issues resulted in a Level of Service (LoS) E for the overall interchange with a LoS F on the northern approach. In the PM peak period the interchange operated at a LoS F with further LoS F performance on the northern approach and LoS E performance on the southern approach. Extensive queuing back onto the freeway was noted in the PM peak period affecting both the eastbound M80 and the northbound North East Link carriageways.

   **AOB Comment:** I have assumed that whatever is necessary using the Reference Design would be replicated.

**Watsonia Road/Greensborough Highway**

16) In the O'Brien Proposal the Watsonia Road/Greensborough Highway signalised intersection appears to be slightly over-capacity in the AM peak and more significantly over-capacity in the PM peak. The key issues identified are insufficient storage on the Watsonia Road western approach and the impact of the pedestrian crossings opposing the flow of traffic exiting Watsonia Road. This leads to queues along Watsonia Road regularly extending back through the roundabout located 50m to the west. Bearing in mind the assumptions set out earlier, the microsimulation showed an overall LoS C for the AM peak and LoS F for the Watsonia Road approach due to issues with storage and pedestrian flows. In the PM peak hour the overall site performance was LoS E whilst the Watsonia Road approach was LoS F.

   **AOB Comment:** All that is needed is that Greensborough Road operates satisfactorily, and queuing on Watsonia Road is quite acceptable – to assist in reducing through traffic. See also my response to 8 (e).

**Greensborough Highway/Watsonia Station Access**

17) For the O'Brien proposal, bearing in mind the assumptions set out earlier, the microsimulation for the
intersection of Greensborough Highway and the Watsonia Station access operated at LoS B in the AM peak and LoS C in the PM peak. However it should be noted that the right turn storage for the south to east movement from Greensborough Highway into the newly included link was significantly exceeded for lengthy periods of the PM peak period and frequently blocked northbound through traffic on the Greensborough Highway.

**AOB Comment:** The Alternative Design was prepared without the access to traffic volumes of individual turn movements used in the preparation of the SmedTech TTIA. It is easy to lengthen the right turn storage at this location to accommodate the likely demand in the PM peak.

18) The proposed location of the bus interchange above Watsonia Station will require connection to/from Watsonia Road itself. This intersection would most likely need to be signalised to allow for buses to turn to/from Watsonia Road. This signalised intersection would be in close proximity to the roundabout with Morwell Avenue and as such, it is possible the queues could extend back into the roundabout blocking flow. Bus route 566 currently runs along Watsonia Road and onto Morwell Avenue to connect to La Trobe University. Route 566 will not be able to use the proposed bus interchange above Watsonia Station as there is no opportunity for buses to turn around and continue its route. As a consequence it is likely that the proposed bus interchange would only be serviced by Bus Route 513.

**AOB Comment:** The traffic issues are readily managed. The bus routes can be altered and improved.

19) Bus route 513 connects to Watsonia Station via Elder Street. In the O'Brien layout, the intersection of Elder Street and Greensborough Road is not signalised. Buses exiting Elder Street will need to find a gap in this traffic, which has free flow connections from the M80 Ring Road and Greensborough Bypass, and then merge across a lane of traffic to turn right into the proposed bus interchange. The design has a limited distance between these two intersections to allow for this to occur (of approximately 70m).

**AOB Comment:** Provision of a proper bus interchange is all about improving bus/rail services. The bus interchange provides the opportunity to re-route the current bus services, then provide improved services.

**FREEWAY**

20) Most freeway sectors performed at an average density LoS D or better.

21) The exceptions to this were in the PM peak period and were located where queues from the Grimshaw Street interchange now blocked back along the ramps and onto the freeway. This was noted on the M80 eastbound between the Plenty Road entry merge and the exit diverge to Greensborough Highway and Grimshaw Street where the lengthy queue from the Grimshaw Street interchange would interfere with the operation of the M80 weave in the latter stages of the PM peak.

**AOB Comment:** The Alternative Design replicates the Reference Design. The ‘lengthy queue’ from Grimshaw Street related to the model not incorporating the assumed Reference Design treatment at Grimshaw Street.

Additionally, the northbound North East Link carriageway between Lower Plenty Road and Grimshaw Street, would also be impeded at times by the queue from the Grimshaw Street interchange stop-line blocking back to the North East Link carriageway.

**AOB Comment:** Again, this is a result of the model not incorporating the assumed Reference Design treatment at Grimshaw Street.

22) As an additional check, the reduction in freeway travel speeds caused by peak period congestion was assessed. This analysis showed that, in the northbound direction, the merge of the Grimshaw Street entry ramp with the M80 and also the subsequent merge of the Greensborough Highway entry ramp
with the M80 are both subject to notable reductions in travel speed when compared with the Reference Project. This occurs in both the AM and PM peak periods.

AOB Comment: Given that these would be dynamically ramp metered, this will not occur. The review of microsimulation models at GHD offices on 14 August 2019 did not show any issues related to this matter.

It should also be noted that a three-lane ramp meter was required for the Grimshaw Street northbound entry ramp whereas the O'Brien Proposal provided only a two-lane ramp meter. The O'Brien Proposal was updated in the model to allow for this and to prevent queues from the meter stop-line interfering with the operation of the upstream arterial network.

AOB Comment: A 3-lane meter is not justified but could readily be provided with no impact. The traffic demand on this link is substantially reduced by our design that takes the connection from Greensborough Highway onto the NEL under Grimshaw Street.

OTHER INFORMATION

Nil