

Technical Memorandum

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Project Name	Queenstown Alliance SH6 / SH6A design review		
Subject	Review of the proposed design and modelling assessments completed for the SH6 / SH6A intersection, Frankton / Queenstown		

1. Executive Summary: Key findings for further consideration

After an initial review of the proposed design for the SH6 / SH6A intersection and relevant documents, four key findings have been identified for further consideration:

1. Modelling beyond 2028 is still considered necessary to investigate the impact of Frankton North (at 100% build out) on the intersection. This is recommended to better inform the reputational and operational risks that arise from the North Frankton Plan Change that was confirmed after the majority of the assessment and design has been completed and has only been assessed at 50% buildout by 2028.
2. However, if there is confidence in the updated modelling for 2028 scenario, there may be an opportunity to streamline/modify the proposed design, as the level of service (LOS) improved with the inclusion of Frankton North (50% build out). This is considered a low probability of a significant saving, but identifying that there is potential to consider if a lane can be removed/repurposed in the design, which may in turn enable a reduction in utilities relocations, etc.
3. There is risk that a safety audit has not been completed for the design at this stage, and there are concerns that the audit may flag the restricted accessibility for pedestrians and cyclists. An outcome could be to improve these connections, which would require increased land take, and reducing operational capacity.
4. An option for a gyratory intersection using Gray Street and McBride Street, with the Frankton shops located in the centre was identified and dismissed at a very early stage of the business case process. Noting the business case subsequently identified a 2 lane gyratory as the preferred (guavabout), there is a gap in the documentation as to why a gyratory circulating around the shops is flawed.

These points were discussed with the project team and further information and assessments, specifically on the operation post 2028, were carried out as detailed in an Abley/WSP memo dated 3 August 2023. This information shows that going forward there will continue to be several network constraints that will limit the traffic reaching the SH6 / SH6A intersection. And as a result, the proposed layout would be unlikely to be a bottleneck for the foreseeable future, and so in capacity terms, would deliver the intended benefits.

This Technical Memorandum is provided as an interim output under our agreement with Waka Kotahi. It is provided to foster discussion in relation to technical matters associated with the project and should not be relied upon in any way.

The discussions held with the team provided rationale for the design in relation to both the active mode provision and the decision to move away from a gyratory to a conventional signal. I consider that there may remain a risk for the consenting phase if the process for the design is not adequately documented. Equally, the programming for the proposed adjacent and alternate routes for walking and cycling should be co-ordinated with the implementation of the scheme, and full details of this should be provided to the safety auditor to allow this to be considered in an integrated manner.

In conclusion, there are several complex issues impacting travel into and through the Queenstown network that will require a significant change in behaviours in the next 10-20 years. As documented in the work to date, infrastructure changes alone will not be able to deliver a network to provide safety and efficiency at the levels desired. The proposed design for the SH6 / SH6A intersection offers some additional capacity, and provides the support to allow the required mode shift to support the wider access strategy. Therefore, the proposal is considered to be appropriate if implemented in the context of a wider programme of interventions.

2. Introduction

GHD have been commissioned by Waka Kotahi New Zealand Transport Agency (Waka Kotahi) to undertake a review of the traffic modelling and proposed design associated with the SH6 / SH6A intersection, located in Frankton.

This memorandum outlines the aspects we have considered, and potential areas we have identified that could lead to reputational, operational or delivery risks for Waka Kotahi in relation to the SH6 / SH6A intersection and adjacent State Highways.

2.1 Scope and limitations

This technical memorandum has been prepared by GHD for Waka Kotahi. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

2.2 Background

- The Business Case identified the preferred design as the 'guavabout' signalised roundabout. However, subsequently the design form that has been adopted is a conventional four arm signal intersection, as outlined in the Way to Go (W2G) Briefing Paper #78, dated 8 September 2020
- The recommendation by the W2G board considered that while the analysis for the guavabout provides operational and efficiency benefit over the conventional signals, there are scale and land take disbenefits.
- A main driver for choosing signals was to minimise the land acquisition on the golf course (S-E corner of intersection), and other properties fronting SH6A and SH6 between Queenstown and Frankton and beyond. This was to maximise the availability of potentially future developable land.
- The W2G board acknowledged the perception of risks on the performance of large, signalised roundabouts, as they are not common in New Zealand. It was considered that if issues arise from the guavabout, there may be criticism towards Waka Kotahi and W2G for implementing a unique intervention. Therefore, the conventional signals were viewed as a more legible outcome for stakeholders and the public.
- The golf course land actually has multiple future development plans as outlined in the Frankton Masterplan and Queenstown Events Centre Masterplan. This land is marked for Emergency Hub, potential Transport Hub, and Community Hub.
- Other physical constraints include the BP and cemetery on the north side of the intersection, and the shops on the S-W corner.

- Due to topography, geology and property costs, it was considered that widening SH6A (west of the junction between Queenstown and Frankton) was not feasible, therefore this stretch of road should remain a 2-lane segment which restricts capacity in/out of Queenstown.
 - This option would require the purchase of approximately 60 properties outright, which would be cost prohibitive and also come at a high social cost through the impact on those residents.
- Bus priority is important to maintain in the proposed design. The Shotover Bridge should be kept clear of queues, in order to allow buses to have priority across the bridge accessed from priority lane on the approach.
- The Queenstown Lakes Spatial Plan (July 2021) Moving Forward: Outcome 2 identifies high-level background information regarding public transport, walking and cycling as the preferred option for daily travel, which is trying to be prioritized through the design of SH6/6A intersection.
- The construction staging is still being investigated. WSP said it would be ideal if they could construct offline on the golf course land, while minimizing impact and keeping the traffic flowing on the existing network. This would also be a cost savings from the point of minimal traffic management. However, this is still being worked through.
- The modelling adopted 2018 as base year, with future models for 2028 and 2048.
 - 2028 was referred to as the Frankton Max scenario, because no more vehicles could get into the Frankton network. Traffic routes are restricted by the Shotover Bridge to the East, and Kawarau Bridge to the South.
 - A summer model was adopted, to minimise confusion by switching between different peaks in different seasons. However, the seasonal peaks are starting to spread into seasonal shoulders, creating a more sustained period of demands beyond the traditional narrow seasonal holiday peaks.
- The inter peak was identified as the critical peak. This has been a challenge because a lot of this traffic is likely visitors to Queenstown/Frankton, and it is difficult to get them off the road. E.g. a lot would have rental cars, where Queenstown is just one stop on a bigger road trip, therefore not attractive to use other modes.
- The latest traffic passing through the intersection is similar to pre-covid volumes, with approximately 35,000 vehicles. It is understood that whilst the tourism industry hasn't fully recovered to "pre-covid business as usual", there has been several years of wider development during and since covid which has created a lift in the baseline equivalent to current reduced tourism trips.
- The south corridor to/from Frankton (via Kawarau bridge) has grown by approximately a third since pre-covid volumes. There has been a lot of development south of Frankton (Jacks Point). Noting that a lot of this traffic may be the construction workers associated with the development.
- The proposed signals can handle the 2028 model which reflects the Frankton Max option, where no more cars can get into the Frankton network anyways due to the bridge capacities. Therefore, the capacity issue is just shifted to the bridges.

2.3 Relevant documents reviewed

Table 1 summarises the relevant documents that have been reviewed. We note the extensive volume of work that has been undertaken to document the multiple studies that directly and indirectly influence the design of this intersection. However, we have focussed on these documents as the most relevant due to scope and currency. Additional information has been obtained from individuals who have been involved throughout the life of the Business Case.

Table 1 Documentation

Document Title
Queenstown Integrated Transport Business Case - Queenstown Business Case_B Options Assessment
Queenstown Business Case Appendix B13 Technical Note 35 - SH6 / SH6A Operation and Future Performance
SH6 Frankton Eastern Corridor Operation & Future Performance Frankton North update
Way 2 Go Briefing Paper #78: BP intersection update 8 September 2020
SH6/6A intersection – Pros and Cons; Risks and Issues 1 September 2020
Alliance Design Zone 3
Frankton Masterplan
Queenstown Events Centre Masterplan

3. Initial Key findings

After a review of the relevant documents, four key findings have been identified for further consideration prior to commenting on the confidence of the proposed design:

1. Modelling beyond 2028 is still considered necessary to investigate the impact of Frankton North (at 100% build out) on the network.
2. There may be an opportunity to streamline the proposed design, as the level of service (LOS) improved with the inclusion of Frankton North (50% build out).
3. There is risk that a safety audit has not been completed for the design at this stage, and there are concerns that the audit may flag the restricted accessibility for pedestrians and cyclists. An outcome could be to improve these connections, which would require increased landtake, and reducing operational capacity.
4. Investigate a gyratory intersection using Gray Street and McBride Street, with the Frankton shops located in the centre.

3.1 Model beyond 2028 with Frankton North

The methodology used for the assessment and development through the business case process focussed on a 2028 model year. Whilst it is normal for a future design year of approximately 10 years from opening to be used, there is scope for alternate years to be selected for many reasons. Typically, this relates to the availability of transport model future scenarios, in turn frequently related to the timing of census or other model data. In this case the available future model scenarios are 2028 and 2038.

The use of the 2028 rather than 2038 for the assessment was based on the logic that there are external constraints which limit the ability of the network to actually allow any higher demands than the 2028 to get to the SH6 / SH6A intersection. This was logically reasoned and the evidence to support this was robust. If a 2038 scenario had have been used for design it would have delivered an intersection form that would have been able to cope with *unconstrained* flows from outside the area, but those flows would only have occurred with significant four laning projects, including over the Shotover Bridge.

However, in the latest modelling, undertaken as an addendum update in late 2022, the scenario has included the North Frankton Plan change which generates and attracts trips in a part of the network adjacent to the SH6 / SH6A intersection. By 2028 only approximately 50% of the Plan Change Area is assumed to be developed, and therefore included in the model. The effect of this is to actually reduce the trips passing through the SH6 / SH6A intersection, and therefore the level of service appears to be improved.

Where this is considered a concern is that it shows a clear impact on the intersection from the North Frankton Plan Change. And furthermore, it shows that there is sufficient local generator/attractor that has the potential to drive further trips through the intersection beyond 2028 as the remaining 50% of the North Frankton area is developed. This may occur in a way that changes the trip patterns at the intersection.

It should be noted that the issue here is that whilst it may be the external constraints remain the critical bottlenecks in the network, there is nothing to demonstrate that the proposed SH6 / SH6A intersection won't become the constraint beyond 2028. And noting the scale of the investment in the proposed works, that would lead to potential reputational risks for Waka Kotahi as well as operational risks should the intersection fail after 5 years of construction.

It is also noted that traditional signalled intersections can be more sensitive to changes in the balance of the traffic flows than gyratories, where the capacity tends to be governed more by the total flows. Again the proposed change from the gyratory to the signalled intersection hasn't documented consideration of resilience to changes. The North Frankton Plan Change is now a 'known' unknown in terms of the timing and scale of impact, but there are further unknown developments that in partnership with the North Frankton landuse could impact the overall network beyond 2028. Modelling to 2038 would assist in understanding the risks, and allow for the development of appropriate mitigation strategies.

Therefore, to establish confidence in the proposed intersection design, it is recommended to undertake modelling to 2038 to investigate the impact of Frankton North (at 100% build out) on the network, and particularly on the SH6 / SH6A intersection.

3.2 Streamline the proposed design

The commentary in this section could be seen to be contradictory to the previous point in terms of risks of additional demands, but highlights the lack of evidence to provide confidence in the proposed design and operation.

There is risk that a safety audit has not been completed for the design at this stage, and there are concerns that the audit may flag the restricted accessibility for pedestrians and cyclists. The likely outcome would be to improve these connections, which may require increased land take, and reducing operational capacity.

However, if there is confidence that the overall network will constrain the demands, either as a result of throttling vehicles or as a result of inhibiting the actual delivery of the enabled development, due to low access amenity, which would be a poor outcome for the region and indicate wider adverse congestion and efficiency outcomes are present. But, this would then in turn still result in the SH6 / SH6A intersection being justifiably 'scaled down' to meet those reduced demands.

With reference to the memorandum titled *SH6 Frankton Eastern Corridor Operation and Future Performance* (dated April 2022), the corridor and intersection modelling was updated to include 50% build-out of the Frankton North development. It was identified that the travel times improved on the SH6 corridor due to the traffic pattern changes from the increased land use on Frankton North, and the delivery of LOS D performance at the intersection is potentially at a level higher than could be expected in the network (LOS E would seem an appropriate target).

Additionally, the Paramics model identified the overall intersection LOS improved at the SH6 / SH6A intersection with Frankton North, when compared against the previous analysis completed for the Business Case. It was stated that the operation of this intersection did not deteriorate significantly due to wider uptake in public transport use (15% PT), and other traffic distribution effects.

An extract of the LOS outputs is shown on the Figure 1.

On this basis, there may be the potential to streamline the proposed intersection design, as the modelling outputs are indicating the intersection has not reached capacity, and that demands will be reduced with the development of Frankton North.

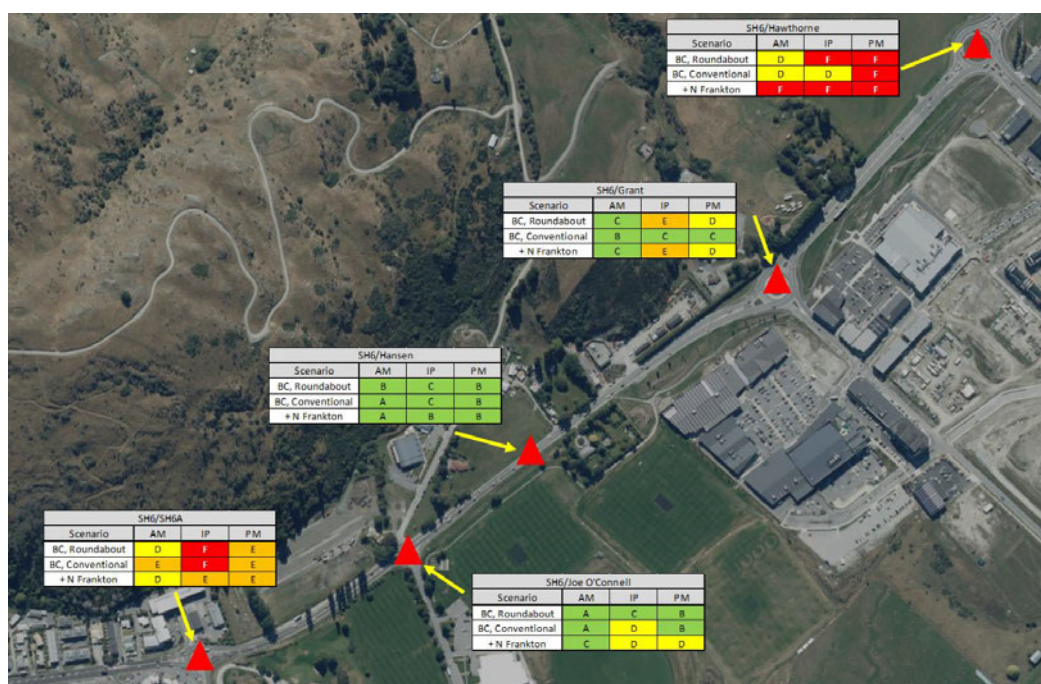


Figure 1 Extract of Figure 12 from SH6 Frankton Eastern Corridor Operation and Future Performance (dated April 2022)

3.3 Gyratory intersection upgrade

It is understood that a signalised roundabout circulating around the local shops at SH6 / SH6A intersection was briefly discussed during the initial stages of the Business Case. It did not advance for reasons such as access disruption, property costs, engagement with multiple landowners, and unfamiliarity to drivers, however there is a lack of documentation explaining why this option was flawed.

A similar comparison to this option may be the guavabout signalised roundabout, which has been investigated through to the final decision made by W2G Board and Waka Kotahi, which rejected this option and recommended conventional signals. The main drivers being the higher land take (+0.42 ha), higher costs (+1M), and high reputational risk, when compared against the conventional signals.

There is increasing potential for these reasons to no longer be as certain as they were. For example, noting the cost of the conventional signals was considered to be \$1M cheaper at \$82M, but is now expected to be in excess of \$130M, there is the potential for the guavabout to be cheaper.

From a high-level perspective, a gyratory intersection around the local shops may not require any significant (or any) land take, nor should have major impacts on the BP property, cemetery, or golf course. Refer to Figure 2, which illustrates a potential formation of the arrangement.

This option may provide opportunities to improve accessibility and connectivity for the community. It may have the potential to integrate the PT interchange into the gyratory, with several potential locations available. This would allow improved network flexibility and functional enhancement for route interchange compared to the location to the south of the intersection, albeit noting the increased distance to the airport.

The reputational risk associated with implementing an unconventional form of intersection in New Zealand has been overcome in Tauranga, where the first signalised roundabout in New Zealand has been operating successfully since December 2008. The perception of risks on performance was an issue discussed before the introduction of this signalised roundabout in Tauranga. However, the actual performance, in safety and efficiency, has proven to be effective and those reputational risks proven to be unfounded. If appropriately designed, the legibility of the intersection is clear and no harder to navigate safely than more traditional intersections and roundabouts for visitors used to driving in areas without those, or indeed tourists who are used to driving on the right side of the road.

Also the W2G board and Waka Kotahi did recognise the performance benefits with a signalised roundabout compared to the signals.

While this gyratory intersection has not been modelled, it is likely to operate similar to the guavabout, which was identified as the preferred option in the Business Case. The modelling outcomes have been referenced in the memorandum titled *F2Q SSBC & QTC DBC Technical Note #35* (dated 13 August 2020).

On this basis, if comparing the gyratory intersection to the guavabout modelling, some of the key findings include:

- The arrangement could maintain a consistent level of vehicle occupancy on SH6 and SH6A by providing the same number of lanes across the corridor and through the intersection.
- The Frankton Rd approach (SH6A from Queenstown) operates better, which is critical to ensure buses experience as little delay on SH6A eastbound, due geography constraints preventing dedicated bus lanes.
- Bus travel times were consistent across all peaks, which shows effectiveness of the priority bus lanes.



Figure 2 Alternative gyratory location / concept

4. Review of Additional Information

Following the initial review, several discussions were held with the project team from Waka Kotahi and the project team. This allowed for discussion on the issues above which included additional background information that hadn't been documented to be provided.

In relation to the concerns regarding active modes, further information was provided that identified a parallel shared path proposed which would provide an alternate route not through the intersection. This may be considered to be appropriate, but would depend on issues such as proximity, signing and the timing of the implementation of that parallel route. Based on experience from previous safety audit teams, there could still be some commentary for the inclusion of on-road facilities. Whilst the final design decisions would rest with the client, this process has the potential to require some additional iterations and time compared to other audits and so should be programmed accordingly.

The project team provided additional information verbally to support the revised intersection form. Our review hasn't sought to challenge or confirm these factors, but has focussed on assessing if the proposed layout will meet the outcomes sought. Depending on the consenting process for the intersection, and the views of stakeholders, there may be the need to formalise the documentation of the decision making in a manner that provides added robustness to the consideration of alternatives.

Finally, additional assessment has been undertaken to consider the impact of development of the Frankton North Plan Change area beyond the 50% that is considered likely by 2028 and previously assessed. We supported a pragmatic approach of assessing at the 75% level.

The additional modelling was reported in the modelling technical note 'SH6/6A Paramics Sensitivity Test of Frankton North at 75% Developed' dated 3 August. We reviewed the 'Draft A' revision for this memo. Overall, the modelling technical note does show that the network will be significantly overloaded in the future as a result of both external growth and the additional 'internal' growth that is associated with the Frankton North area. However, in terms of the way that the SH6 / SH6A intersection is projected to perform, whilst the interpeak is expected to perform at LOS F, that would be consistent or improved compared to adjacent intersections.

As such, this work has evidenced the reporting in the earlier technical works that suggested that the external constraints, which are assumed to remain into the future, would be bottlenecks that limit the flows arriving at SH6/SH6A, and therefore deliver a ringfencing to the demands on the intersection. Beyond this, wider mode shift away from private vehicles would be required to support growth in residential and employment land-uses.

And so in summary, having reviewed the additional information, we consider that the risks associated with the proposed intersection are understood, and in line with those documented in the assessment reports. We believe that the intersection would perform in the manner assessed by Abley/WSP, and it is our view that this is appropriate if implemented in the context of a wider programme of interventions.

Regards

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