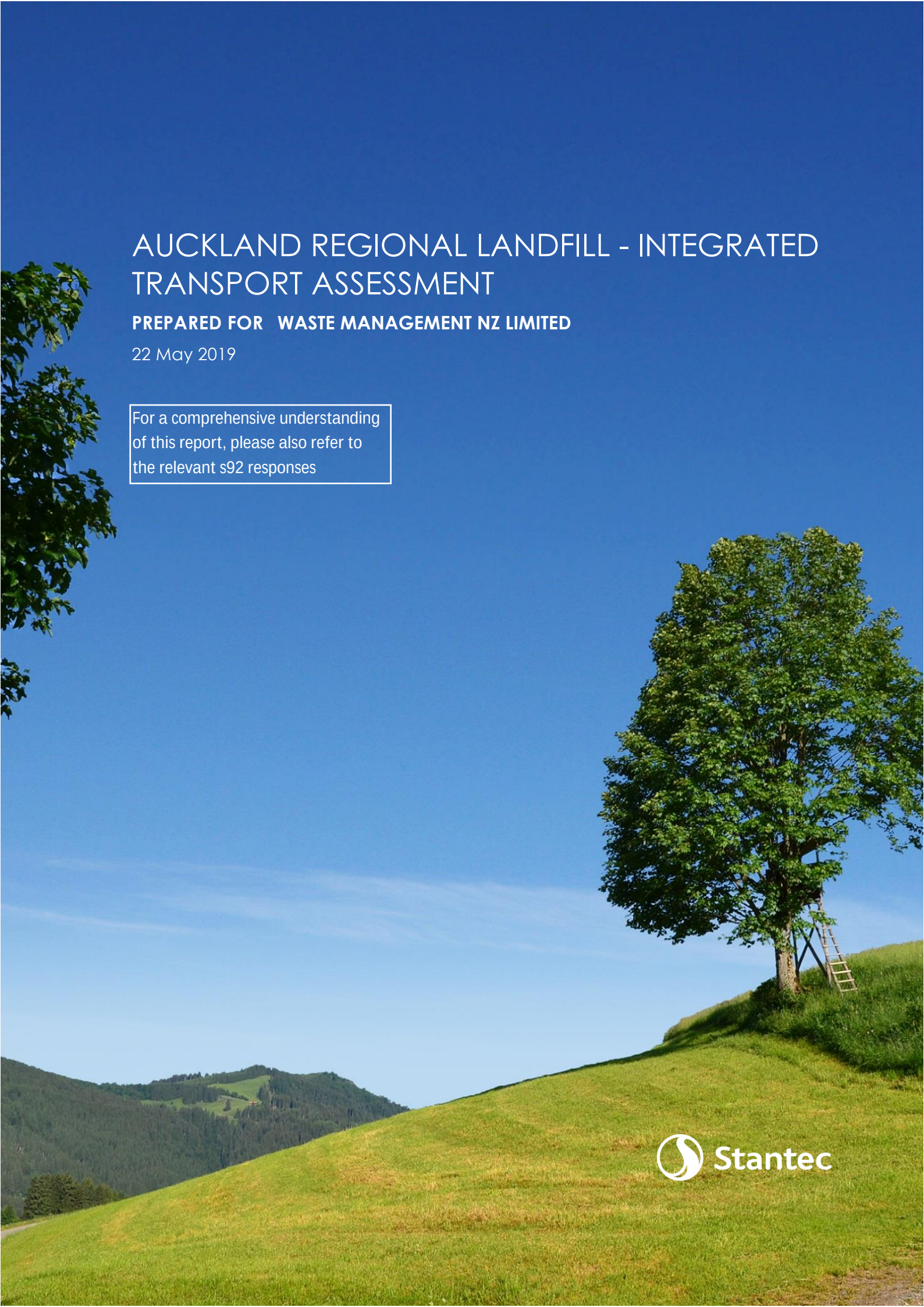
AUCKLAND REGIONAL LANDFILL - INTEGRATED TRANSPORT ASSESSMENT

PREPARED FOR WASTE MANAGEMENT NZ LIMITED

22 May 2019

For a comprehensive understanding of this report, please also refer to the relevant s92 responses



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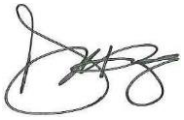
Don McKenzie		22/05/2019
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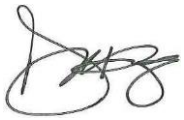
Don McKenzie		22/05/2019
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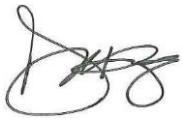
Don McKenzie		22/05/2019

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1	15/08/18		MH	DJM	DJM	
2	18/12/18		MH	DJM	DJM	
3	28/1/19		MH	DJM	DJM	
4	18/2/19		MH	DJM	DJM	
5	10/5/19		ZC	DJM	DJM	
FINAL	21/5/19		ZC	DJM	DJM	DJM

Executive Summary

Stantec New Zealand has been commissioned by Waste Management New Zealand Limited (WMNZ) to prepare this Integrated Transportation Assessment report in support of a proposed regional landfill facility to be known as the Auckland Regional Landfill located at Wayby Valley between Warkworth and Wellsford. WMNZ's Redvale Landfill, which currently serves the Auckland region, is consented to operate until 2028 but is expected to be full in 2026. It is proposed that the Auckland Regional Landfill **(ARL)** at Wayby Valley will be operational by that time, taking over as the primary regional landfill site in the north Auckland area.

The following report considers the transportation effects of the ARL project when it first opens in around 2026, as well as giving some consideration to a possible long-term future scenario towards the end of the ARL life expectancy.

It is considered appropriate that the baseline transport network environment against which the proposed ARL is assessed, should include the planned and committed works being advanced by NZTA including the Pūhoi to Warkworth Northern Motorway extension and the safety-related works being advanced by NZTA through the Dome Valley. The next stage of the Northern Motorway extension from Warkworth to Wellsford is currently in a route protection phase in relation to which a Notice of Requirement is expected to be lodged by NZTA around the middle of 2019. Thus it will not be included in the baseline against which the ARL will be assessed.

The ARL project proposes the establishment and operation of a regional landfill at a site in Wayby Valley approximately 13km north of Warkworth and 6km south of Wellsford. It will be served by a new 2km long Landfill Access Road connecting the landfill area via a new roundabout-controlled access with SH1 to be established as part of the ARL project. The proposed form of the roundabout design has been prepared and consulted on with NZTA including a concept stage Road Safety Audit. Modifications to the preliminary roundabout design were made partly in response to the NZTA safety audit team's findings, as well as for other operational and planning reasons. Proposed conditions of consent are provided such that WMNZ can develop the roundabout design further and continue to engage with the NZTA safety audit process prior to the roundabout being constructed and ultimately made operational.

During the initial phases of site clearance and establishment, a range of processes will be undertaken – some of which will make use of an existing access road Crowther Road, located approximately 3.8km south of the proposed Landfill Access Road roundabout. At most (with the coincident activities of bridge construction, Landfill Access Road construction, liner preparation and forestry – excluding roundabout construction) there could be up to 36 heavy vehicle return trips (72 movements) and 100 light vehicle return trips (200 movements) per day.

The modelling results for this initial establishment phase of the ARL project indicate that there will be negligible congestion or excessive delay present on SH1 as a result of vehicles using this temporary construction/establishment access. As such, there are no operational reasons to require an upgrade of this intersection. The construction of the NZTA safety improvements presently underway along SH1 are expected to be completed by 2021 in this area which will further improve the road safety in the area. The proposed widened centreline along with the existing wide sealed shoulder will allow for a through vehicle to pass a construction vehicle waiting to turn right into the site. A condition of consent is proposed to require the preparation and implentation of a Construction Traffic Management Plan in relation to this period of use of Crowther Road and its intersection with SH 1.

Based on the information provided by WMNZ in relation to the ARL operation, such as waste volume projections and likely vehicle configurations such as payload, the worst-case estimate of traffic movements over a 4 hour peak period have been considered. It is conservatively anticpated that the most likely trip generation of the ARL facilities (once operational) will involve a total of up to 55 vehicle movements (inclusive of inbound and outbound movements) during each of the weekday morning and afternoon peak hourly periods, and up to 740 vehicle movements (inclusive of inbound and outbound movements) across the course of each day, excluding logging volumes.

The intersection modelling and assessment undertaken in relation to the operational period of the ARL shows some queues of slow moving or stationary vehicles are generated on the through movements along the SH1 approaches to the roundabout. However, vehicles do not experience significant delays (generally average delays in the year of opening of less than approximately 10 sec/veh for through vehicles on SH1) and the queues that might form are expected to dissipate quickly.

As the traffic volumes continue to grow through the future years out towards the 2060 future year horizon of the ARL operation, it is expected that some upstream network elements within the wider SH1 corridor such as intersections and passing lane merge points, may limit the amount of traffic that can travel on SH1 in an hour past the ARL site. This would have the effect of limiting the hourly arrival flows at the proposed Landfill Access Road roundabout and lead to reduced queuing generated at the roundabout than have been predicted in this assessment. In this regard, the projected intersection performance of the proposed roundabout in this assessment is considered to represent an upper estimate of predicted delays and queues at the future 2060 assessment year. If the pattern of peak period traffic volumes along SH1, or generated waste haulage traffic volume is spread across more hours of each day, or the achievement of further gains in waste diversion, recycling and the like is achieved, then the intersection performance will be better than that presented.

Overall, it is considered that the proposed roundabout is readily able to accommodate the traffic volumes generated by the proposed facility out to a theoretical 2060 future horizon year (despite the expectation that by this time there will be alternative transport facilities in place such as the Warkworth to Wellsford Northern Motorway project) and will continue to perform well as background traffic volumes on SH1 increase.

Should the Warkworth to Wellsford project be delivered within this future time horizon, there would be a significant reduction in passing through traffic on SH1 and performance levels will be further improved. Should this occur, then the design of the roundabout which has been prepared to meet full NZTA design standards, will provide a much higher level of operational and safety performance than would be required if the roundabout was to be designed and operated under the jurisdiction of Auckland Transport.

By way of a summary, it is considered that the ARL facility can be established, subject to the proposed condtions of consent, in such a way that the transportation effects of both the construction and operational phases of the project are suitably managed with minimal adverse effects on the surrounding receiving transport environment.

Stantec New Zealand

Abbreviations

ADT	Average Daily Traffic
ARL	Auckland Regional Landfill
AUP	Auckland Unitary Plan
CAS	NZTA's Crash Analysis System
LOS	Level of Service
NZTA	New Zealand Transport Agency
P2WW	Pūhoi to Warkworth, part of the SH1 motorway upgrade between Pūhoi and Warkworth
SH1	State Highway 1
vph	vehicles per hour
vpd	vehicles per day
WW2W	Warkworth to Wellsford, a possible SH1 motorway upgrade between Warkworth and Wellsford
WMNZ	Waste Management New Zealand Limited

Glossary

Trip	Return vehicle journey inclusive of one arrival and one departure movement
Movement	A single-direction vehicle journey either inbound (arrival) or outbound (departure)

Waste Management NZ Limited

Auckland Regional Landfill - Integrated Transport Assessment

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1. Introduction

Stantec New Zealand has been commissioned by Waste Management New Zealand Limited (**WMNZ**) to prepare an Integrated Transportation Assessment in support of a proposed regional landfill facility to be known as the Auckland Regional Landfill (**ARL**) located at Wayby Valley between Warkworth and Wellsford. WMNZ's Redvale Landfill, which serves the Auckland region, is consented to operate until 2028 but is expected to be full in 2026. It is proposed that the ARL at Wayby Valley will be operational by that time, taking over as the primary regional landfill site in the north Auckland area.

The site is rural in nature, with the landfill footprint area being covered with trees for commercial forestry purposes. The harvesting of trees within the landfill footprint is expected to occur before the main part of the landfill is constructed, although there may be some overlap of the harvesting and the ARL initial site construction works (e.g., construction of the sediment retention ponds etc).

Access to the site will be from the existing State Highway 1 (**SH1**) carriageway via a new roundabout located approximately 1.5km south of the intersection between SH1 and Wayby Valley Road. The highway safety improvements proposed by the New Zealand Transport Agency (**NZTA**) along SH1 through Dome Valley have been considered in the design of the access along with the Pūhoi to Warkworth (**P2WW**) project. A possible extension of the P2WW project between Warkworth and Wellsford motorway (**WW2W**) has been considered but due to its early stage of investigation has not formed part of the baseline transport environment used for evaluating the ARL project.

The transportation issues that are related to the proposed landfill include:

- The effect of additional traffic on SH1 between Warkworth and Wayby Valley
- The design of the site access onto SH1 to accommodate trucks entering and exiting the site and ensuring that suitable acceleration and deceleration opportunities are provided
- Integrating the site access with the proposed NZTA improvements along the Dome Valley corridor
- Providing a suitable bin exchange area within the site to ensure safe and efficient movement of trucks
- Providing a suitable access road between the bin exchange area and the landfill face.

This report considers the transportation effects of the ARL project when it first opens in around 2026 as well as giving some consideration to the long-term future scenario when Valley 1 of ARL nears the end of its life expectancy and is anticipated to receive the most waste. By way of a summary however, it is considered that the ARL facility can be established in such a way that the transportation effects of both the construction and operational phases of the project are suitably managed with minimal adverse effects on the surrounding receiving transport environment.

2. Baseline Environment

2.1 Strategic Location

Figure 2-1 below shows the strategic location of the Wayby Valley site within the context of the surrounding environment located broadly north of the SH1 corridor and east of Wayby Valley Road.

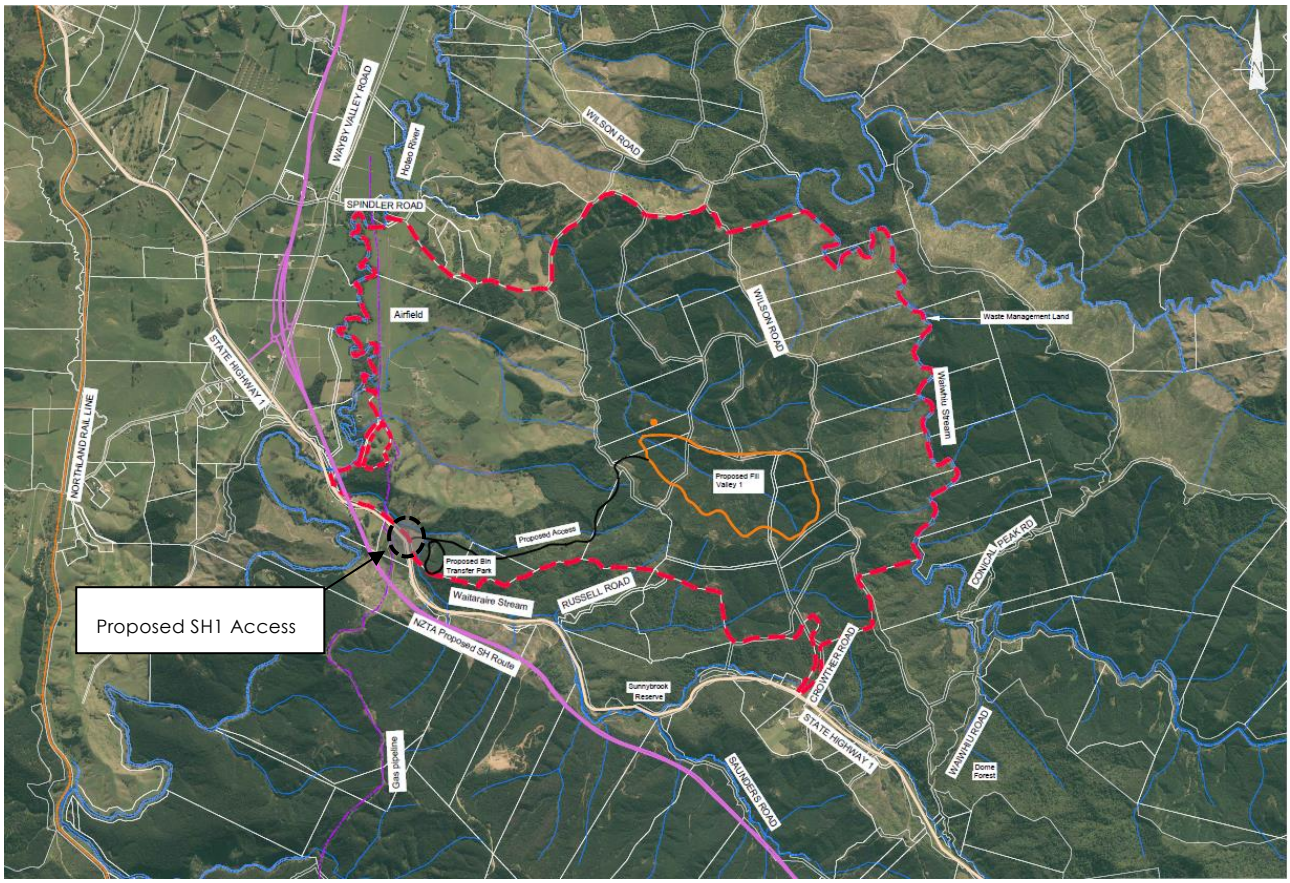

Figure 2-1: Site Location

The proposed site is situated within the Rural – Rural Production Zone in the Auckland Unitary Plan Operative in Part (AUP).

SH1 and Wayby Valley Road are the key roads in the vicinity of the site. The North Auckland Railway Line is located approximately 2.5km west of the site and west of SH1. The key transport routes and their relationship to the ARL site are discussed in further detail in following sections of this report.

2.1.1 State Highway 1

SH1 is the key national transport route passing through the North Auckland – Northland region passing close to the southern edge of the ARL site. In its current form of a two-lane, two-way road with two northbound and one southbound passing lane opportunities between Warkworth and Wellsford, it is currently the key regional transport link in the area.

Stantec has been asked to assess the baseline transport environment on the basis that NZTA's planned improvements within the P2WW and along the current SH1 corridor through the Dome Valley are in place. Given that:

i. the ARL project is planned to commence construction within the next five years (assuming the resource consents are granted);

ii. construction is already well-advanced on the P2WW project, with an expected completion by late 2021; and

iii. preparations are currently underway for the SH1 safety improvements through Dome Valley, with planned completion by 2022.

It is considered appropriate that the baseline transport network environment against which the proposed ARL is assessed should include these planned and committed works, however the future WW2W route which is still currently in a route protection phase leading towards the Notice of Requirement (see Section 2.1.3 of this report) should not be included in the baseline. NZTA expects to lodge the Notice of Requirement in respect of the WW2W designation by the end of June 2019.

In terms of the current highway alignment and operation (which are expected to remain following the planned safety improvements along SH1), the first northbound passing lane is located approximately 2.5km north of Goatley Road at the northern end of Warkworth and is 680m long. The second northbound passing lane is approximately 1,040m long and terminates 2km south of Wayby Valley Road. This is approximately 500m south of the proposed access location serving the proposed site. The southbound passing lane is approximately 700m long and commences just south of Waiwhiu Road to the south of the ARL site.

2.1.2 Pūhoi to Warkworth

NZTA's P2WW project is currently in its construction phase and will extend Auckland's Northern Motorway from the current termination of the motorway on the northern side of the Johnstone's Hill tunnels at Pūhoi , to a new major roundabout connecting with the current SH1 alignment just north of Warkworth. The new alignment is proposed to carry the SH1 designation, leaving the existing SH1 alignment to revert to an arterial road under the control and management of Auckland Transport.

Once completed, the P2WW route will provide the ability for longer-distance travel between Auckland City (as well as origins further south) and the subject site to avoid the urban roads, intersections and property accesses/driveways within Warkworth. This project is also intended to ease the congestion that occurs during weekends and holiday periods, in particular at the Hill Street intersection.

An outline of the designation for the Pūhoi -Warkworth project is shown in **Figure 2-2.**

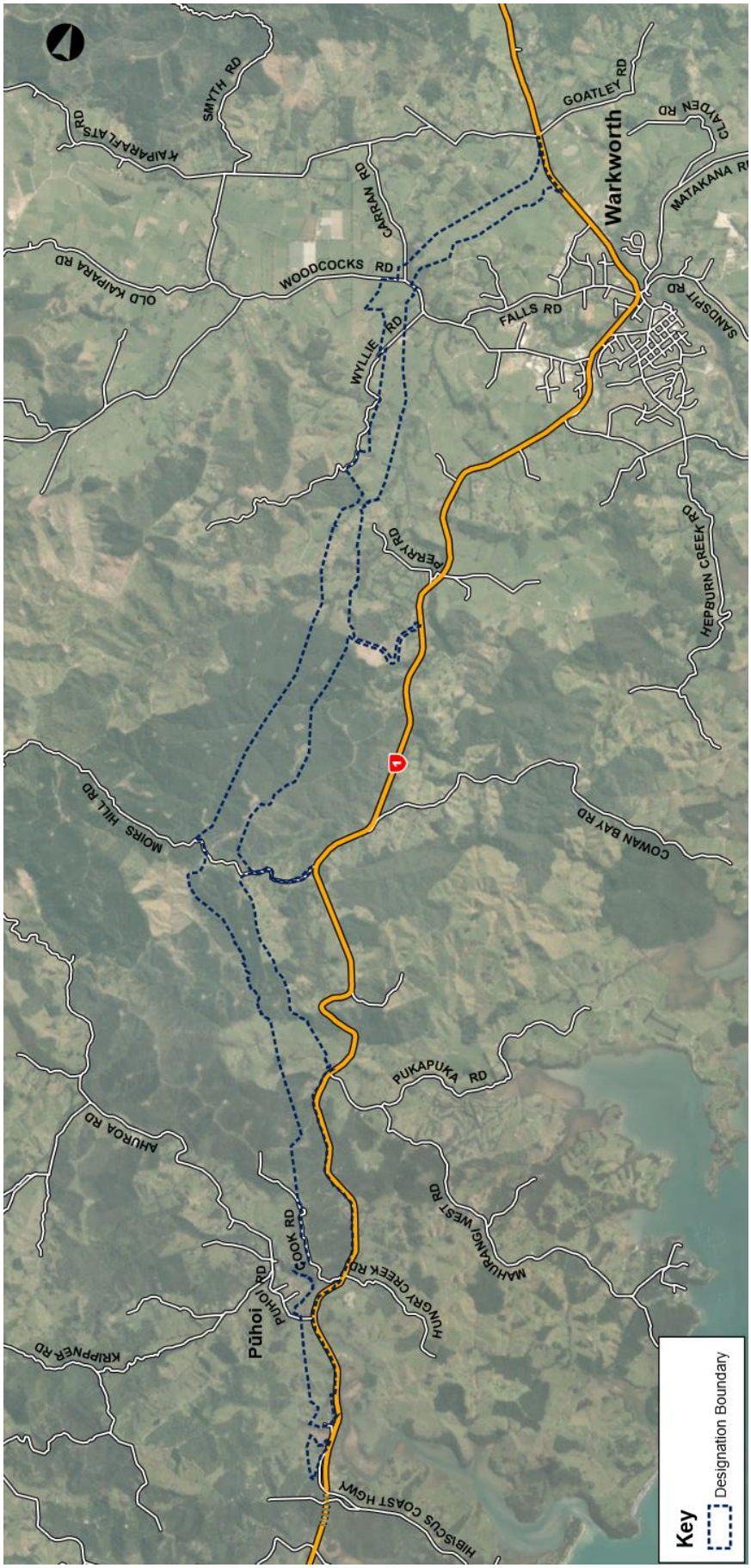

Figure 2-2: Pūhoi -Warkworth Project Designation

It is noted that NZTA have selected a major roundabout intersection as the most appropriate form of intersection control for the northern termination of the P2WW. This provides for the connection of travel movements between the new P2WW route and the existing SH1 corridor, as well as providing an effective safety measure requiring all vehicles passing through the roundabout to slow to a safe speed.

2.1.3 Possible Warkworth-Wellsford Extension

Stantec understands that NZTA is currently undertaking a route protection process leading towards the submission of a Notice of Requirement in relation to the designation for the WW2W motorway extension. Once in place, this will form a continuation of the P2WW alignment; from Warkworth in south to Te Hana in north. The project is currently still in its investigation stage with NZTA currently undertaking consultation with property owners and affected parties including WMNZ, and a Notice of Requirement for to protect the route protection is expected to be lodged around the middle of 2019.

The current indicative alignment is shown in **Figure 2-3.**

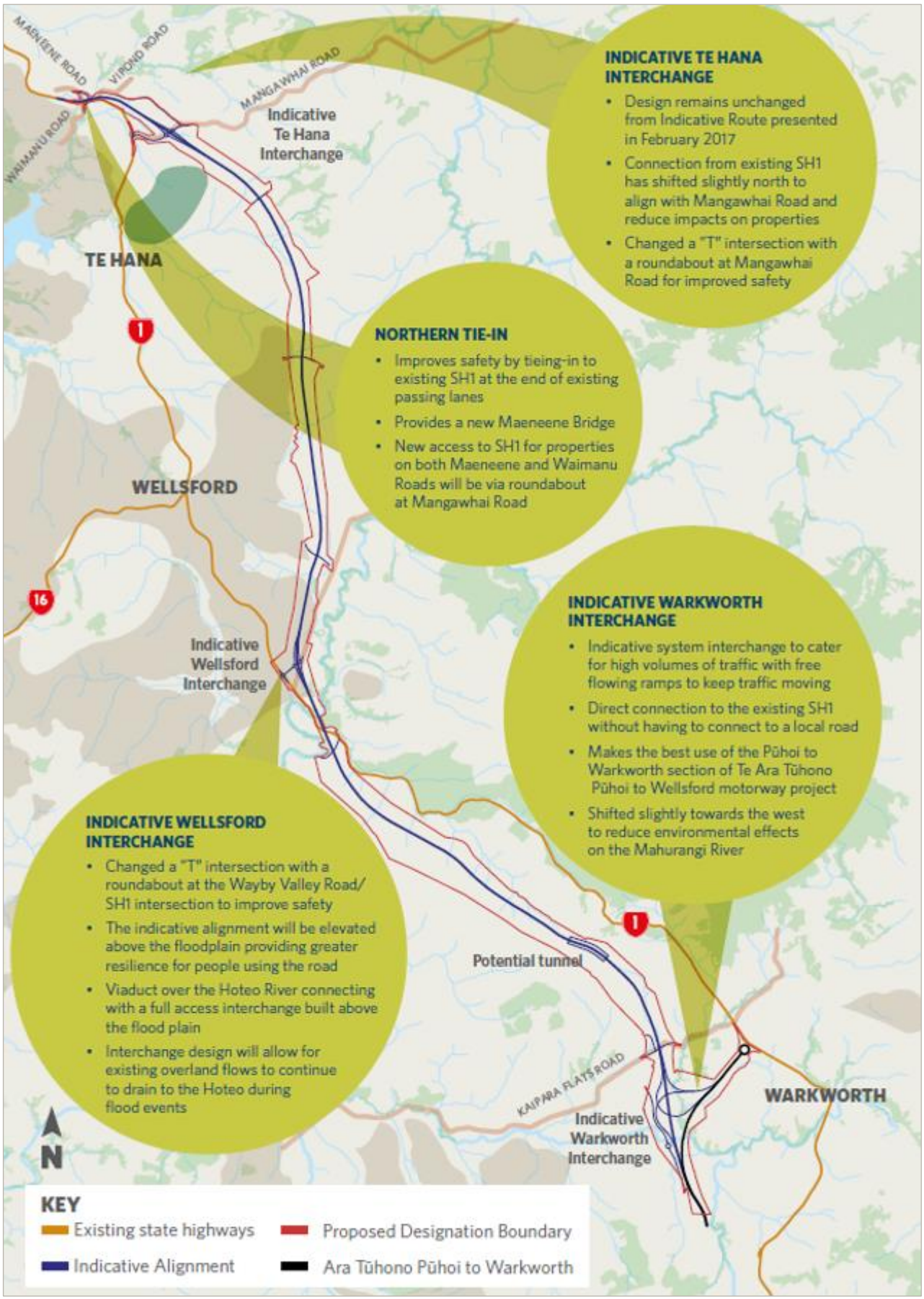

Figure 2-3: Warkworth-Wellsford Indicative Alignment

The preliminary alignment released for consultation is shown in **Figure 2-4** below.

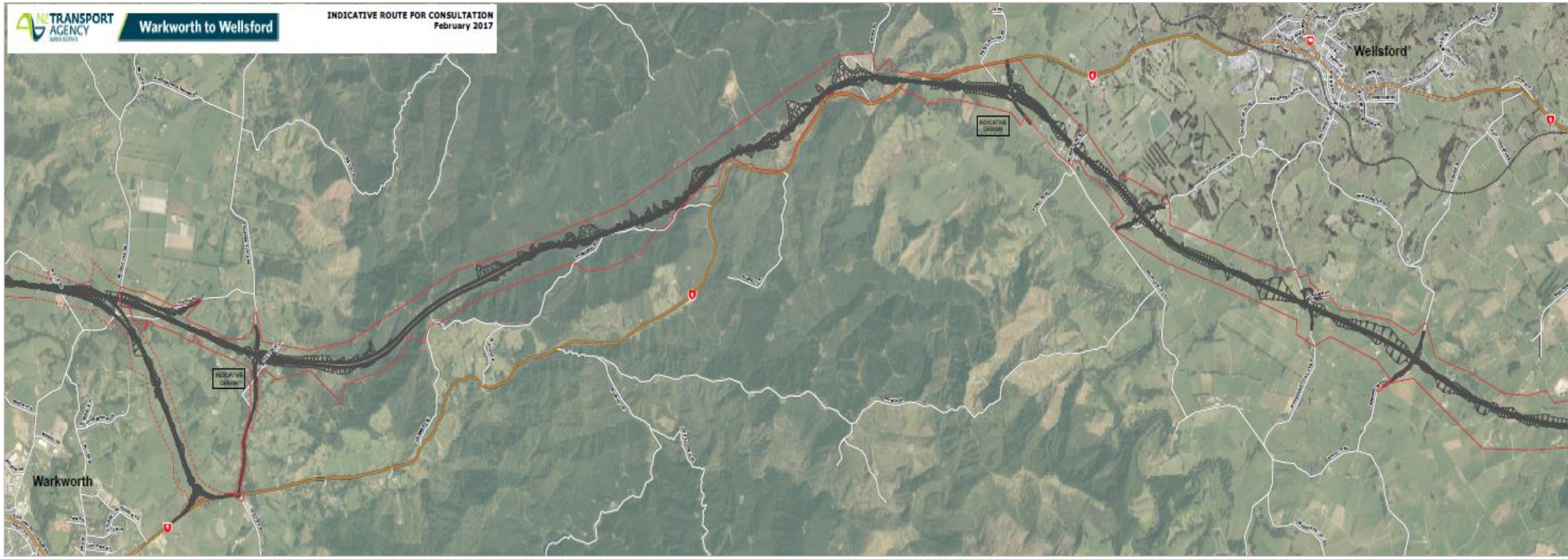

Figure 2-4: Warkworth-Wellsford Alignment for Consultation

Based on the indicative alignment, the nearest roading access point to the possible new alignment of the WW2W corridor with respect to the ARL site, would be a grade separated interchange at Wayby Valley Road.

For the purposes of this assessment, the WW2W project has been not been included in the baseline environment due to the current uncertainty over funding within the NZTA's forward capital works programme in respect of this project, and the current early stages of work completed to date. Should the WW2W project proceed with an intersection/grade-separated interchange at Wayby Valley Road, then all (northbound) ARL traffic would be likely to exit SH1 at Wayby Valley Road and travel south along the current SH1 carriageway to the ARL site. The effect of this would be to remove the ARL northbound traffic from the Dome Valley section of SH1- in other words the external transport effects of the ARL project would be further mitigated if the WW2W project was to proceed in the future.

2.1.4 Wayby Valley Road

Wayby Valley Road is located to the north of the site and provides a connection between SH1 and Pakiri/Tomarata, as well as being an alternative route to Mangawhai bypassing Wellsford.

Wayby Valley Road is a two-way, two-lane road with a posted speed limit of 100km/h. The intersection between Wayby Valley Road and SH1 was upgraded in 2014 by adding right turn bays on SH1 to separate turning traffic from through traffic.

No access or changes to Wayby Valley Road are included as part of the subject proposal.

2.1.5 Warkworth Urban Area

The existing SH1 carriageway is the key arterial route through Warkworth. At present, prior to completion of the P2WW project, a number of key transport constraints exist including the Hill Street intersection, which often causes significant levels of congestion especially at the start and end of holiday periods and normal weekend periods. The urban section of SH1 through Warkworth features a single through lane in each direction with additional lanes provided on approaches to intersections to cater for turning traffic.

The speed limit is 60km/h and on-street parking is prohibited. A painted flush median separates the opposing traffic flows and allows for safer and more convenient access to properties through the urban area.

Following the completion of the P2WW project (in late 2021), many of these issues will be mitigated as the through-traffic movements along SH1 are carried by the alternative SH1 carriageway to the west of Warkworth and dispersed through the wider Warkworth network. In parallel with the P2WW project currently being constructed, Auckland Transport and NZTA are currently in the process of designating the Matakana Link Road which, when constructed and operational, will divert a proportion of the traffic destined for the area including Matakana, Sandspit, Snells Beach and Leigh away from this intersection.

2.1.6 Existing Traffic Volumes and Speed Data

A range of data collection tasks have been undertaken to inform the analysis and assessment of the future baseline environment that will exist when the ARL project is operational. A summary of this data is provided in Appendix C.

2.1.7 Future Baseline SH1 Traffic Demand

The background traffic demands along SH1 have been calculated using the traffic data collected **(Appendix C)** by the NZTA traffic counter[1] located approximately 1.3km south of Wayby Valley Road in the close vicinity of the proposed ARL roundabout. The count site records traffic volumes for approximately 10 weeks during the year. These weeks are distributed throughout the year rather than only capturing volumes during a single season.

The calculated 5% average growth rate over the last five years, as presented in **Appendix C** of this report, is considered by Stantec to be unrealistic and inappropriate when forecasting beyond 2028 due to network capacity constraints and the range of future transport improvement projects proposed to be completed prior to the opening of ARL.

[1] NZTA Site ID 01N00347 (SH1, approximately 1.5km north of Wayby Valley Road)

The two most recent years of growth have yielded annual increases of 2% and 3% respectively. Forecasting to 2028, Stantec considers that adopting a 3% growth rate to SH1 traffic volumes is appropriate and is in accordance with the most recently available traffic counts. This growth rate has also been adopted when forecasting traffic volumes to 2022 for the assessment of the site establishment, construction and forestry movements at Crowther Road.

For reference, the transportation report for the P2WW project[2] adopted a 4.4% growth rate. This was derived from a SATURN model, developed in 2013, that covered the northern sector of Auckland from Auckland's North Shore to Whangarei - in which traffic volumes in 2009 were compared with those forecasted for 2026. The 4.4% rate was a linear growth rate over that time period. Of note, the report also stated that an upgrade to the SH1 / Hill Street / Elizabeth Street / Sandspit Road / Matakana Road intersection was also imminent and was accordingly, included within the SATURN model. However, no such upgrade has yet taken place and this intersection continues to be a major bottleneck that restricts traffic flow through the Warkworth area and points to the north. It is unclear from the Jacobs report what the proposed upgrade of the Hill Street intersection involved, however it is likely that the model would have over-estimated the capacity of the intersection and therefore the forecast traffic volumes on SH1 north of Warkworth may be higher than those that will eventuate. Furthermore, the linear growth rate of 4.4% translates to a compounding growth rate of approximately 3.3% for the same time period. It is therefore considered that the adopted 3% growth rate for this assessment for the ARL near-future years of 2022/2023 (representing the start of ARL construction) and 2026 (representing the commencement of operation) is generally appropriate for the short to medium term.

When forecasting to a long-term future 2060 horizon, it is considered that background traffic growth rates will reduce as the network beyond the proposed ARL access and roundabout intersection nears capacity. While it is possible that SH1 may undergo a fundamental change before 2060 should the WW2W project proceed, this future year has been modelled to estimate the performance of the roundabout under the current SH1 alignment (without WW2W) and therefore, assess the ability of the proposed roundabout to cater for this ultimate (possibly worst case) scenario. An average growth rate of 1% per year for the complete period out to the distant future year of 2060 has been adopted. At this growth rate, the traffic volumes on the SH1 network beyond the ARL site access roundabout are approaching the theoretical capacity for a single lane along the highway and improvements to the road network capacity would be required to accommodate such demands regardless of whether the proposed facility is approved.

The base SH1 traffic volumes have been taken from the nearby NZTA count site[3]. The peak hour adopted is the Friday afternoon peak hour of on-road traffic flows from 26 October 2018 (the week following Labour weekend i.e. not a peak holiday weekend Friday but representing typically busy on-road traffic conditions).

Beyond the peak holiday periods, Friday afternoon is also typically the day of highest traffic flow in a single direction, in this case northbound, which may be affected by traffic associated with the ARL site. At this same time the southbound flows on the highway are also significant although not as high as the peak northbound flows. October is also a month which closely aligns with the Annual Average Daily Traffic volumes and therefore the traffic volumes do not need to be corrected for seasonal fluctuations.

Table 2-1 below summarises the peak hour traffic volumes observed in 2018 and the modelled traffic volumes used by Stantec for the future scenarios.

[2] Pūhoi to Warkworth Transportation and Traffic Assessment Report, August 2013 prepared by Jacobs on behalf of Further North Alliance (Section 3.2.1)
[3] Hourly traffic date from NZTA Site 01N00347 from week commencing 26 October

Table 2-1: Modelled SH1 Traffic Volumes

Year	AM Peak (7:45-8:45)		PM Peak (17:00-18:00)	
	Northbound	Southbound	Northbound	Southbound
2018	348	468	809	491
2022 (approx. start of construction)	392	527	911	553
2028 (approx. start of operation)	468	629	1,087	660
2060	529	711	1,229	746

These future baseline traffic volumes will be used as the background traffic flows along SH1 for the purposes of evaluating the operational performance of the construction and operational access points proposed within the ARL. The overall peak period for performance assessment adopted in this report has been based on the overall peak of on-road traffic volumes and as will be discussed in subsequent sections, the overlaying of peak periods for landfill-related activity represents what is considered to be a suitably robust if somewhat overly-conservative set of predicted effects arising from the ARL operation.

2.2 Road Safety

A search was made of the NZTA's Crash Analysis System for all reported crashes for the full five-year period from 2014 to 2018 including all available results from 2018. The search area covered the length of SH1 from Wayby Valley Road in the north to Goatley Road in the south (representing the northern extent of the Warkworth urban area), a distance of approximately 12km.

Figure 2-5 below illustrates the area within which the road safety study was undertaken.

Figure 2-5: Road Safety Study Area

Between 2014 and 2018, a total of 82 crashes occurred within the study area, of which two resulted in fatalities, 12 resulted in serious injuries, 18 resulted in minor injuries and the remaining only resulted in damage to property. Of all crashes that were reported, 53% were head-on or where the driver lost control, 19% during overtaking, and another 16% during crossing/turning. Poor observation, poor handling and failure to keep left were the three most prevalent contributing factors.

While this stretch of road has a notable number of crashes, NZTA and its safety alliance partners are currently undertaking works to specifically address the safety of this section of road and are expected to be completed by 2021. These works include flexible median safety barriers, wider road shoulders, new right turn bays and replacing north and southbound passing lanes with slow vehicle bays.

2.3 Walking and Cycling

There are no defined walking facilities such as footpaths located on SH1 near the ARL site.

Similarly, there are no defined or formalised cycling routes on SH1. The Auckland Regional Cycling Network does not designate this part of SH1 as a cycle route of any consequence.

In terms of the safety and design of rural cycling facilities, it is generally preferred that the roadside shoulder for any routes identified as cycle routes should provide for cyclists to be at least 1m from the traffic lanes with the ideal being in excess of 1.5m. The current SH1 route through the Dome Valley between Warkworth and the Wayby Valley Road intersection provides a variable width of sealed shoulder (between the painted edgeline and the edge of the seal) with localised narrowing of the shoulder through some features such as bridges and adjacent to passing lanes, however over much of the route the sealed shoulders are between 1 and 1.5m.

2.4 Public Transport

A recently established Auckland Transport bus service between Wellsford and Auckland (Route 998) began operating in late February 2019. The service combines three route sections (Wellsford-Warkworth, Warkworth to Albany Bus Station, and the Northern Express via the Northern Busway through to Auckland CDB). It operates on an hourly service frequency through the day.

Other public transport services operating along SH1 in the vicinity of the ARL site centre on the Intercity services between Auckland and Northland (providing some four or five services through the course of each weekday). At least two school bus services that will pass the frontage of the site however these services do not include stops within walking distance of the proposed site access.

A weekday, term-time school bus service for Mahurangi College and Warkworth Primary stops southbound at the Crowther Road stop (approximately 2.4km south of the proposed ARL access) at around 8.15am each morning and then at the parking area at the Top of the Dome at approximately 8.18am. For the homeward route after school there are two northbound services (one for each school) stopping at the Crowther Road location at 3.25pm and 3.50pm.

3. Proposed Landfill

3.1 General

The ARL project proposes the establishment and operation of a regional landfill at a site in Wayby Valley approximately 13km north of Warkworth and 6km south of Wellsford. The ARL will be served by a new 2km long access road connecting the landfill area via a new roundabout-controlled access with SH1. A bin exchange area will be situated adjacent to the access road and SH1 roundabout.

The general form of the landfill area and the proposed roundabout-controlled access point with SH1 is shown in **Figure 3-1.**

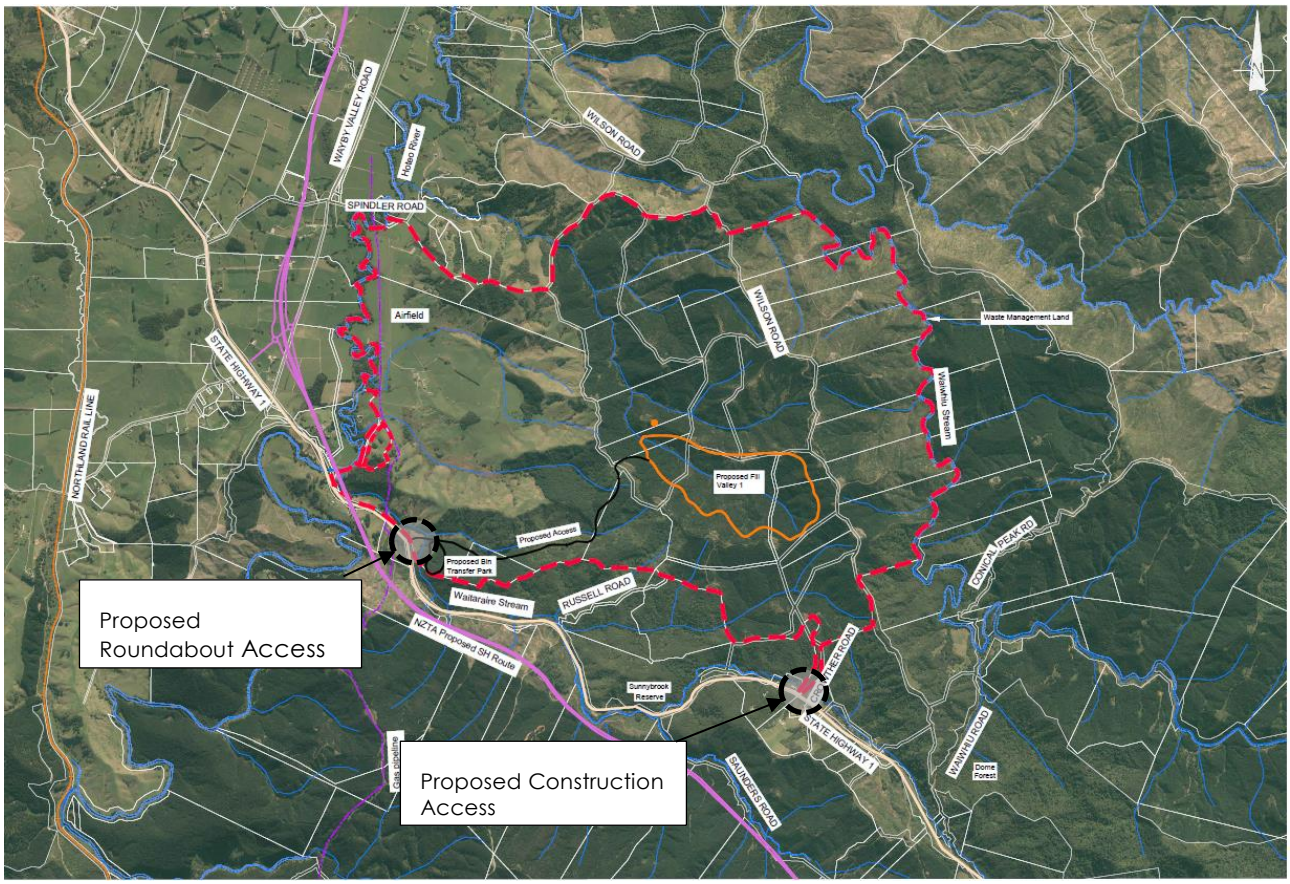

Figure 3-1: Proposed Site Layout

The broader operation of the landfill is described in detail in the Assessment of Environment Effects (**AEE**), with the transportation aspects of the proposal focussing on:

i. Site establishment and construction-related activities needed to clear specific forestry areas within the site and to construct the landfill itself, and

ii. the operational traffic activity associated with receiving of waste from the wider Auckland region to the site, together with the various staff and day-to-day operations associated with running the landfill.

3.2 Site Establishment and Construction Activity

Construction of the landfill will involve a range of activities needed to prepare the site and these will be described in more detail in the other engineering reports supporting the AEE. From a transportation assessment perspective, the key aspects of the construction programme over the first four years of construction (expected to occur during the summer construction seasons between 2022/23 and 2025/26) are illustrated in the following high-level chart with a further detailed description provided below:

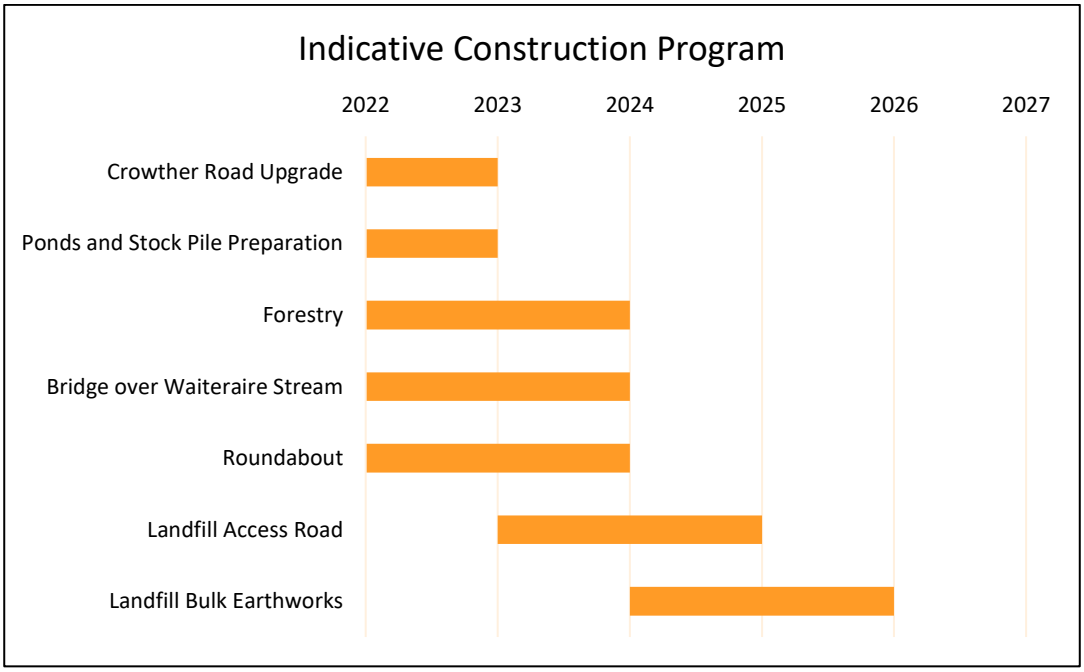

Figure 3-2: High-Level Construction Program

i. Crowther Road Upgrade – The construction and forestry access to the landfill area via Crowther Road located 1.67km north of the Waiwhiu/Conical Hill Road intersection. This will be undertaken during the first construction season and will involve approximately ten return trips of machinery and materials per weekday during this period with an additional ten return trips per weekday over a two-month period for the road basecourse aggregate.

ii. Ponds and Stockpile Preparation – The preparation of stormwater ponds and the stockpiling of cover material will be undertaken during the first construction season. Up to 30 return trips for machinery may be required throughout the construction season via the construction access route via Crowther Road intersection with SH1. Up to two return trips per day of construction materials are expected.

iii. Forestry – The selected logging of forestry within the ARL landfill footprint will occur during the first and second construction seasons to remove the existing forest in preparation for the landfill construction. Up to 14 return trips per day (28 movements per day) will be generated by the logging activities during this period and will occur via the Crowther Road construction access route.

iv. Bridge over Waiteraire Stream – This bridge forms part of the main site access to the landfill. It will be constructed during the first and second construction seasons and will involve approximately 20 return trips of machinery be required per season with an additional ten return trips per day for construction materials.

v. Roundabout – the primary access connection via a proposed roundabout intersection with SH1 will be constructed during the first and second construction seasons.

vi. Landfill Access Road – The access road from the proposed roundabout on SH1 will be constructed during the second and third construction seasons. Up to 20 deliveries per season will be required for the delivery of the major machinery via the SH1 roundabout and an additional ten deliveries will be required per day for a two-month period during the construction season occurring via the SH1 roundabout and Waiteraire Stream Bridge.

vii. Landfill bulk earthworks and Lining – The first part of the landfill liner will be constructed during the third and fourth construction seasons. Up to 50 return trips per season of machinery may be required via the SH1 roundabout and Landfill Access Road, with typically four return trips per day of construction materials.

viii. Fuel – Up to two return trips per day for fuel for construction machinery will also be required. Fuelling trucks will be able to serve multiple construction activities that are occurring in parallel with each other.

ix. Staff Movement – The second construction season will be the busiest when up to 100 construction staff will be working within the site including supervisors.

At most (with the coincident activities of bridge construction, Landfill Access Road construction, liner preparation and forestry – exclusive of the roundabout construction activity which will be separately managed via construction traffic management plans in consultation with NZTA) there could be up to the following traffic movements associated with the construction/site establishment phase:

Table 3-1: Site Establishment/Construction Phase Heavy Vehicle Volumes

Year	Daily Return Trips	Daily Movements	Peak Hour Movements
Forestry	14	28	5
Ponds and Stockpile Construction	10	20	4
Bridge over Waiteraire Stream	10	20	4
Fuel	2	4	1
TOTAL	**36**	**72**	**14**

This therefore equates to a total of 72 heavy vehicle movements per day and 200 light vehicle movements per day visiting the site. During the busiest hour of the day there could be approximately 20% of the daily number of traffic movements representing approximately 14 movements per hour of heavy traffic and approximately 40 movements per hour of light traffic.

The assessment of these vehicle movements generated during the non-roundabout construction periods prior to the landfill operation is provided in Section 5 of this report. While the timing of certain construction and forestry activities have been selected as close as possible to the schedules and programmes provided by WMNZ, the overall conclusions as to the operation and effectiveness of the access provisions are not particularly critical, and minor delays or other changes in the programme are not expected to alter the overall conclusions reached in the respect to either the construction effects or operational assessment presented below.

3.3 Operational Activity

The proposed operating procedure for the ARL site will be similar to WMNZ's site at Kate Valley north of Christchurch in that it will operate a bin exchange area.

This process is broadly summarised in **Figure 3-3** below.

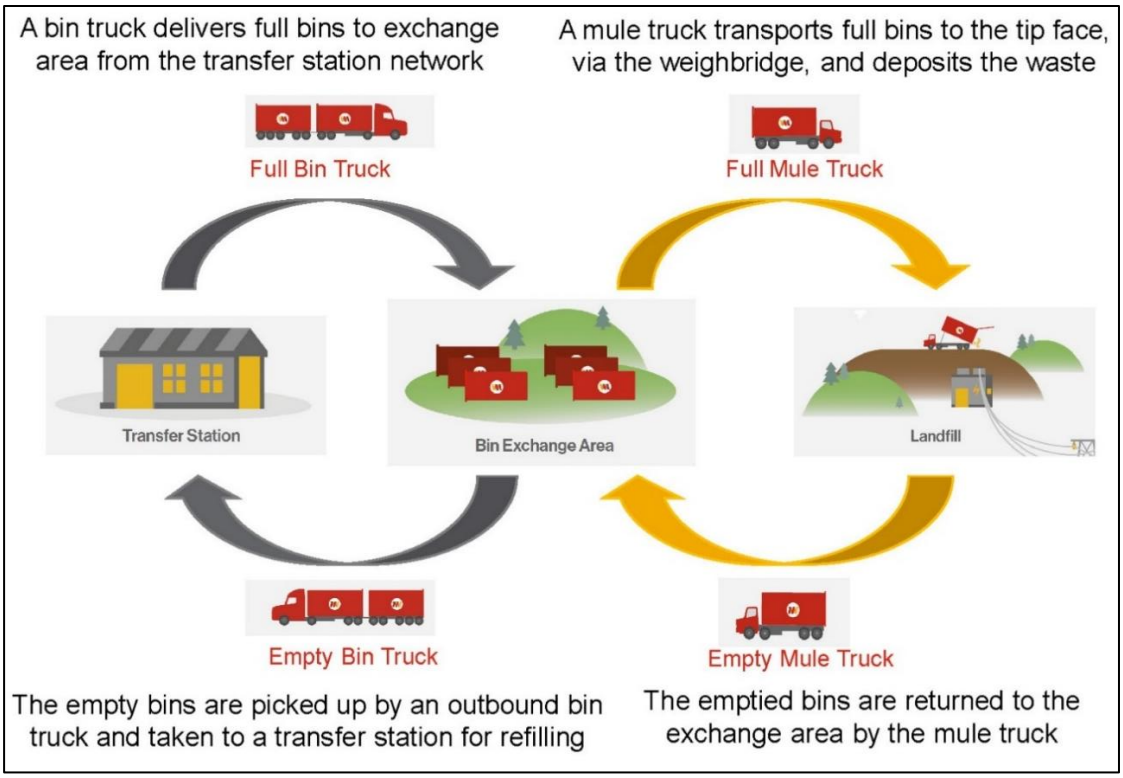

Figure 3-3: Proposed ARL Operating Procedure (for waste delivered from WMNZ transfer stations)

The bin exchange area will operate 24 hours a day, seven days a week, for pre-approved trucks and will be designed to accommodate the delivery and temporary holding of up to 100 bins. Access into the bin exchange area will be automated through the use of Radio Frequency Identification (**RFID**) tags to identify and track loads and bins. There is ample road length (approximately 200m) between the entry point into the bin exchange area and the SH1 roundabout such that any queuing generated in this area will not adversely affect the SH1 intersection or other road users.

The landfill working face will operate up to 17 hours per day on Monday to Saturday (5 am to 10 pm), and up to 10 hours per day on Sunday (7 am to 5 pm).

Outside of working face operational hours, pre-approved trucks (typically from WMNZ transfer stations) will access the bin exchange area to exchange full waste bins for empty bins. There will be no access to the working face for these vehicles. These trucks might also make use of the bin exchange area during the working face operational hours if it is efficient to do so.

During working face operating hours, WMNZ and third-party trucks will deliver waste from transfer stations or directly from customers to the working face. In addition, specialised mule trucks will transport full bins from the bin exchange area to the working face for disposal. Access to the working face will be via the access road and the weighbridge situated at the top of the access road.

Initially, it is anticipated that approximately 25% of the trucks delivering waste to the ARL will go through the bin exchange area. The remaining 75% of trucks will proceed directly to the working face via the proposed weighbridge at the upper end of the Landfill Access Road. Further details of the expected operation of bin exchange area and the split of road haulage vehicles and mule truck operation between the bin exchange area and the landfill working face are provided in the AEE and landfill design report prepared by Tonkin and Taylor.

3.3.1 Operating Hours

The bin exchange area will be open 24 hours a day all year round. Truck drivers must have electronic tags to access the bin exchange areas and be delivering compatible bins from pre-approved transfer stations.

These extended opening hours will enable road haulage trucks to deliver full bins when the surrounding roads are less congested. It also enables deliveries to be staggered across the full course of the day, reducing the amount of truck traffic generated within the peak hours. WMNZ staff and approved contractors with security clearance will have access to the site after-hours for maintenance and office duties.

The weighbridge will be open between 5am and 10pm, 7 days per week, except Sunday. Sunday will have shorter hours (7.00am – 5.00pm), but still sufficient to accommodate regional infrastructure excavation works which tend to happen on weekends to avoid commuter traffic. These hours are also the operating hours for the landfill working face.

Table 3-2 below summarises the operating hours of the various landfill activities (with a particular focus on those activities generating traffic movements along the Landfill Access Road and through the SH1 access.

Table 3-2: Landfill Activity Operating Times

Activity	Open	Close
Gatehouse/weighbridge	0500 (Monday – Saturday) 0700 (Sunday)	2200 (Monday – Saturday) 1700 (Sunday)
Bin Exchange Area	Always open - restricted entry	Always open - restricted entry
Construction Season Activity	0600 (Monday - Saturday) 0600 (Sunday) low noise only	2000 (Monday - Saturday) 2000 (Sunday) low noise only

The landfill working face will be open every day except Christmas Day, Easter Sunday and other specific days subject to notification in advance to landfill users (noting that the landfill will not be open to members of the public at any time).

3.4 Weighbridge, Site Office and Workshop

3.4.1 Weighbridge

A weighbridge for vehicles entering the landfill will be located at the top of the Landfill Access Road, approximately 2km inside the site from the bin exchange area. All trucks delivering waste to the working face (be they mule trucks or road haulage trucks) will use the weighbridge, while cars and vehicles not delivering waste will be able to bypass it.

A combination of mule trucks and road haulage vehicles will pass over the weighbridge en-route to the landfill working face. Mule trucks will only carry one bin per load and only operate for up to 17 hours a day.

Based on observations of the existing weighbridge at Redvale and the Kate Valley regional landfill site in North Canterbury, it was observed that it takes approximately 30 seconds for a truck to pass through the weighbridge process. In the event of any queuing that does occur as a result of the weighing and processing of landfill traffic at the weighbridge, the approximate 2km distance between the weighbridge and the bin exchange area offers more than sufficient queuing space on the Landfill Access Road before there would be any adverse delay to other road users.

3.4.2 Site Office

In the vicinity of the weighbridge at the top of the Landfill Access Road, a building is proposed to accommodate offices for landfill management staff. It is expected that this site office would provide office space for an assumed staffing of 17 people, including:

i. the landfill manager, operations management;
ii. administrative staff;
iii. An office accommodating laboratory, safety and compliance functions;
iv. A meeting room;
v. A lunch room/cafeteria; and
vi. Toilet facilities.

It is proposed that parking for approximately 20 light vehicles catering for staff and official visitors would be located adjacent to the building. While the exact location of this site office building has yet to be confirmed, it is currently planned to be located overlooking the landfill where the access road enters the landfill valley.

3.4.3 Workshop and Staff Amenities

A workshop will be established for landfill plant and general maintenance. Further facilities will be developed for approximately 30 landfill operators and gas field and power generation technicians and maintenance staff. These will include supervisor offices, a lunchroom/cafeteria plus toilets, showers and locker facilities and parking. A hard-stand area will facilitate parking and the various maintenance functions associated with this facility.

As with the site office, the precise location of the workshop and staff amenity facility has yet to be designed in detail. It is currently proposed to be located beside the access road after having passed the weighbridge area.

3.5 Bin Exchange Area

The layout of the proposed bin exchange area is shown on Tonkin and Taylor Drawing ENG-31.

The bin exchange area will operate following a strict one-way circulation system for all vehicles undertaking the bin exchange process, with a capacity for up to five road-haulage vehicles to be within the bin drop-off/pick-up area at any time, and with sufficient space for another two or three vehicles to be waiting within the wider area if needed. There will be no weighbridge facility associated with the bin exchange area, instead the automated detection, identification, and processing of trucks entering the landfill will be via the use of RFID tags. Without the need for processing and weighing of trucks as they enter the bin exchange area, the probability of any queuing out from the bin exchange area (given the capacity of the area and available waiting areas for trucks leading into the area) is negligible.

Also included in the bin exchange area will be nominal parking for light vehicles, mule truck drivers (if necessary) and some incidental staff. Parking for landfill operations staff and site management will be provided at the top of the Landfill Access Road. All administrative activities associated with the landfill will be located in the main office at the top of the Landfill Access Road, while there will be limited facilities (mainly for drivers) such as a lunch room, toilets, and some staff office space in the bin exchange area.

As described above, the bin exchange area comprises multiple lanes where inbound road haulage trucks (not able to access the working face itself) will drive in to exchange their full bin for an empty bin. During working face operating hours, a mule truck would then manoeuvre into the lane after the truck has exited the area to collect the bin and deliver the material to the landfill face via the Landfill Access Road.

The critical area, should any truck queuing occur, is between the southern section of the Landfill Access Road (where it leaves the roundabout) and the control point for road haulage trucks delivering bins into the bin exchange area, where those trucks may have to stop briefly before entering the bin exchange area through the automated gate. This area is approximately 200m long which can accommodate approximately seven to eight heavy vehicles. The proposed Landfill Management Plan **(LMP)** will include measures to avoid queuing onto SH1 where possible.

The circulation routes of trucks within the bin exchange area are illustrated in **Figure 3-4** below. A clockwise circulation rule generally applies to minimise any conflict between vehicles.

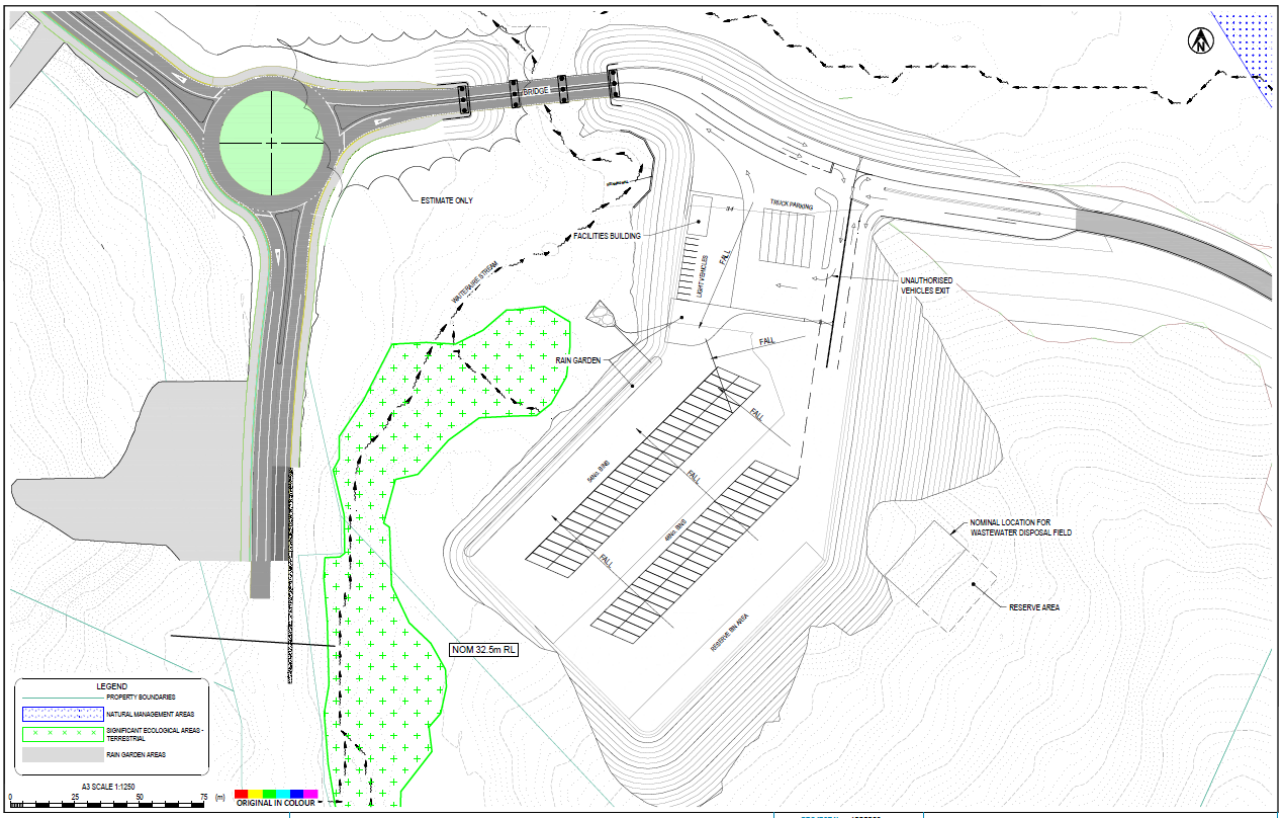

Figure 3-4: Bin Exchange Area Layout

A swept path assessment has been undertaken to ensure that the bin exchange is suitably sized to ensure that sufficient manoeuvring area is provided to accommodate efficient waste truck movements. This is shown in **Figure 3-5.**

Overall, it is considered that the size of the bin exchange area is sufficient to create an area where trucks and bins can be manoeuvred safely and efficiently.

Figure 3-5: Bin Exchange Area – Swept Path Analysis

3.6 Lighting

The preliminary lighting design of the roundabout and its connection to the bin exchange area have been developed in a manner consistent with the Australia New Zealand Standard AS/NZS 1158 series of standards for the lighting of roads and public spaces in New Zealand, and the outdoor workplace lighting standard (AS/NZS 1680.5).

The lighting design and all final details (including scope, design extents, applicable lighting levels and mitigation of obtrusive lighting) will be confirmed during the detailed design stage and is expected to comply with the above standards.

3.7 Signage

The proposed primary access roundabout intersection design will be provided with the required traffic control and driver information signage in accordance with NZTA requirements. An additional sign is expected to be required inside the ARL site between the roundabout and the bin exchange area to indicate the presence of and travel directions towards the landfill and bin exchange area. The positioning and format of this information sign will be determined and agreed with NZTA through the detailed design phase.

4. Proposed Access

4.1 Primary Access – SH1 Roundabout

The primary and permanent vehicular access to the ARL facility will be via a newly constructed roundabout connecting the Landfill Access Road with SH1 approximately 1.5km south of the Wayby Valley Road intersection (as shown on the earlier plans). This access road will be a private road and public access will not be permitted. Public vehicles that inadvertently turn into the site will be informed by signage that the Landfill Access Road and bin exchange area are accessible by authorised vehicles only, and will able to turn around in the vicinity of the bin exchange area or, if they continue to proceed up the Landfill Access Road, the weighbridge access controls prior to the landfill face will ensure that no unauthorised vehicles are able to proceed further.

The identification of this proposed access location was the subject of a detailed technical evaluation based on a number of traffic engineering criteria including:

- Separation from current passing lanes along SH1;
- Driver visibility to and from the proposed Landfill Access Road;
- Current safety performance of the SH1 corridor; and
- Co-ordination with the NZTA safety improvements project discussed previously.

Consultation between ARL and NZTA representatives has been undertaken throughout the preliminary stages of the ARL site project development regarding site access and the safety performance of the proposed roundabout in order to provide the best outcome for both Waste Management and NZTA. It is noted that other roundabouts have been adopted by NZTA as part of the wider access and network development of the State Highway, for example major roundabouts have been included in the termination intersection of the P2WW route at the northern end of Warkworth, as well as at the intersection between SH1 and SH15A Port Marsden Highway at Ruakaka. In this regard, the proposed provision of a roundabout serving this significant regional facility is considered to be entirely appropriate and consistent with the wider network objectives set by NZTA in its management of both traffic volumes and creation of a safer speed environment along the SH1 route.

A roundabout intersection form was preferred by WMNZ and NZTA over a priority-controlled T-intersection as it reduces the number and angle of conflict points between opposing movements and allows for U-turn movements (currently planned to occur at the NZTA's turning facility constructed as part of the safety improvements project at River Road) to ultimately be undertaken at the roundabout.

The approach to the proposed roundabout is proposed to be relatively flat for approximately 200m into the site (through to the entrance of the bin exchange area) and the access gradients in the vicinity of SH1 are not expected to exceed 5%. Further assessment of the details around the roading and pavement design aspects of the Landfill Access Road and bin exchange area are provided within the landfill engineering report prepared by Tonkin and Taylor.

The existing SH1 alignment comprises a single lane in each direction and the northbound passing lane ends over 400m south of the roundabout. The location of the roundabout is therefore considered to be the most appropriate to serve the ARL project and has been confirmed as such through the safety audit findings of NZTA. As will be discussed subsequently, the operation of the roundabout and the effects of generated traffic on the future baseline transport environment once the ARL landfill is constructed, are able to be safely and effectively accommodated.

The roundabout comprises a 40m diameter central island with 3.0 - 3.5m wide approach lanes from each direction. The roundabout design details have been developed based on the latest design criteria referenced in the industry-standard AUSTROADS Guide to Traffic Engineering Practise series. In addition, these design principles have been audited and confirmed as appropriate through the NZTA safety audit process (discussed below).

A diagram indicating the location of the proposed roundabout overlaid with the NZTA's safety improvements in the vicinity of the roundabout including the proposed turning facility at River Road is attached as **Figure 4-1.**

The future operating performance of the roundabout within the baseline receiving traffic environment once the ARL facility is operational has been assessed and is presented in Chapter 5 of this report.

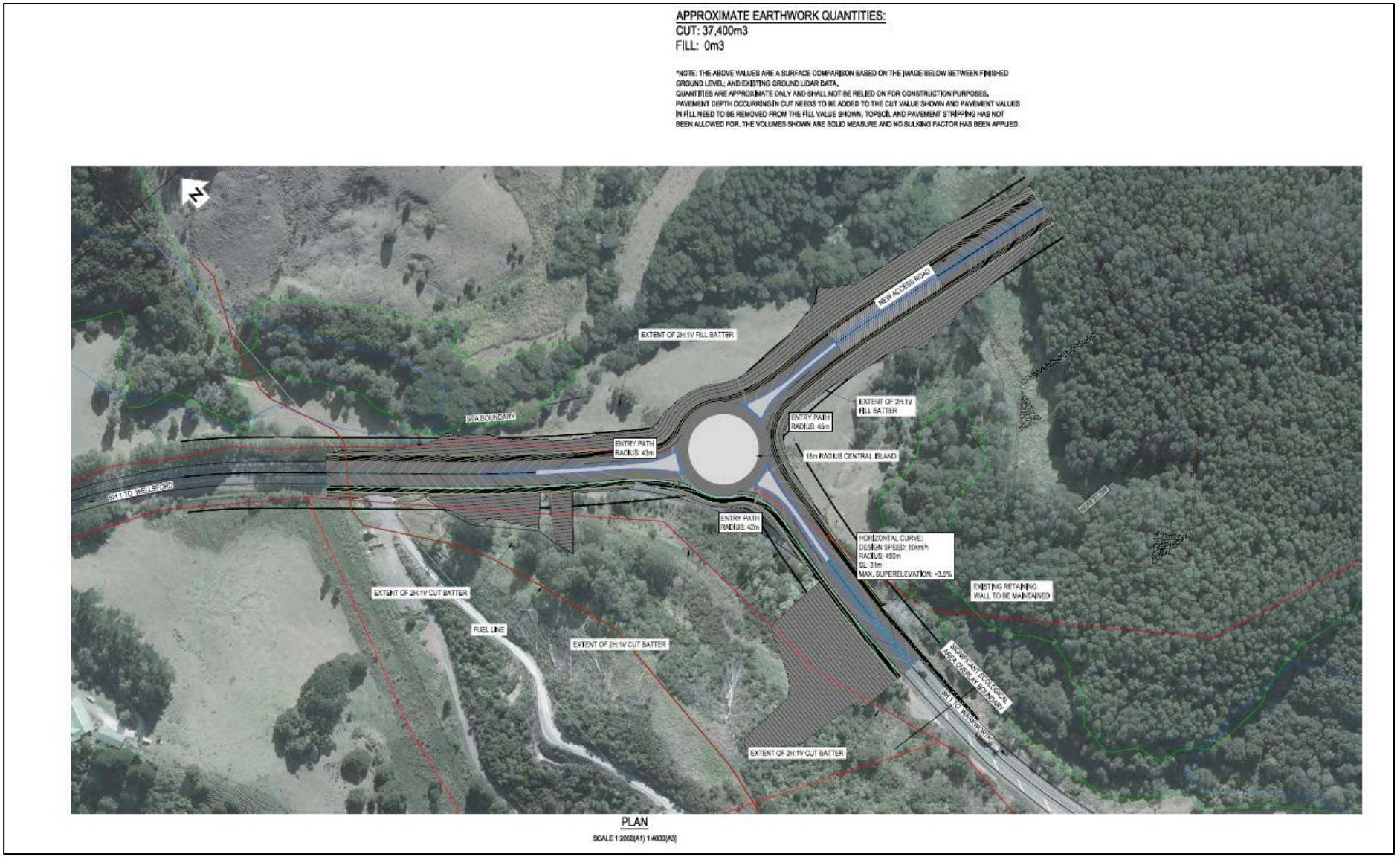

Figure 4-1: Proposed Access Road Roundabout

4.2 Consultation with NZTA and Road Safety Audit

Consultation through the preliminary stages of the ARL project has been held with NZTA with a particular emphasis on how to achieve suitable site access off SH1 while also integrating access with the proposed safety improvements on SH1 through Dome Valley.

As noted previously, the safety improvements project also includes a turning area some 50m north of the proposed ARL roundabout. Those vehicles currently turning right into or out of properties onto SH1 will no longer be able to do this once the proposed median barrier is constructed. This turning area is intended to cater for these vehicles, who will have to turn left onto SH1 and then subsequently undertake a U-turn manoeuvre before heading in their intended direction. NZTA considers that once constructed the ARL roundabout could provide an enhanced turning facility, possibly removing the need for the additional turning area proposed as part of the safety improvements project. Additionally, the creation of the ARL roundabout will also beneficially reduce vehicle speeds along SH1 (speed being one of the major contributing factors leading to the need for the safety improvements scheme), thereby assisting NZTA in its goal of improving road safety throughout SH1 north of Warkworth. This speed reduction is an added benefit not offered by the proposed NZTA safety improvements.

In December 2018 NZTA commissioned a concept stage Road Safety Audit (**RSA**) to review and consider the preliminary details of the proposed Landfill Access Road roundabout. Design drawings and preliminary traffic generation and initial intersection traffic modelling information was provided to the RSA team, who then met with representatives of WMNZ prior to inspecting and assessing the proposed roundabout location and surrounding SH1 corridor. The RSA team members were familiar with the NZTA Safe Roads Alliance safety improvements project because two of the three RSA team had previously been involved in audits of that safety improvement scheme.

Their audit of the preliminary roundabout scheme (attached in **Appendix A)** confirmed the appropriateness of the roundabout form of intersection control catering for the future traffic flows generated by the ARL facility as well as its positive ability to contribute to the overall safety outcomes sought by NZTA for the SH1 corridor including as a positive speed control measure and provision of a safe U-turn facility. In the RSA audit team's words:

> *"The safety audit team (SAT) concurs that a roundabout is an appropriate intersection form to cater for safe access to/from the proposed landfill site. The location is also considered appropriate to be able to achieve a safe design.*
>
> *Notwithstanding the above comments, the SAT has noted a number of safety concerns with recommendations in the following report which should be considered for incorporation into the design if the project is progressed."*

The audit team's comments with regard to design matters have been considered and addressed within the current design of the proposed roundabout. Most notably, the RSA team recommended a shift of the roundabout towards the west to improve the alignment for through traffic along SH1 and the removal of a proposed left-turn slip lane for vehicles exiting the site. Additionally (since the RSA team's consideration of the design in late 2018) the left turn entry slip lane from the north into the Landfill Access Road has also been removed in favour of a standard approach design from the north.

4.3 Forestry and Construction Access via Crowther Road

Crowther Road, which connects with SH1, approximately 1.67km north of the Waiwhiu Conical Hill Road intersection with SH1, is an existing road serving the existing commercial forestry area now referred to as the ARL site. The alignment of this road is highlighted in blue in **Figure 4-2** below.

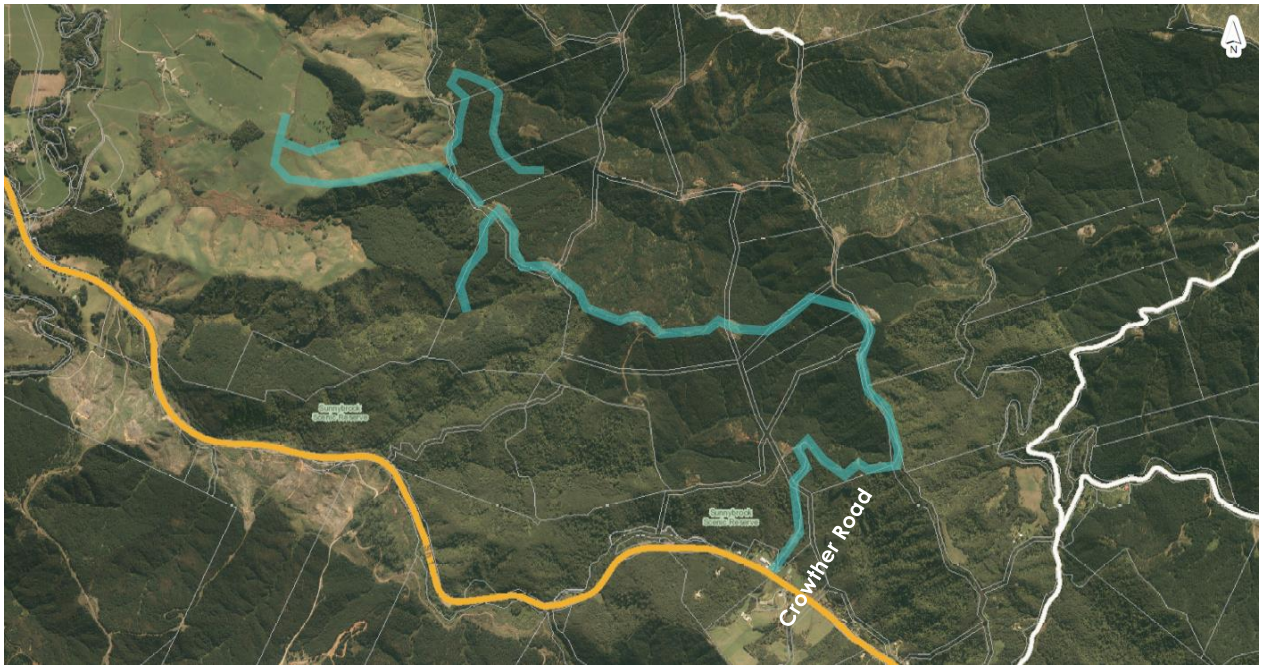

Figure 4-2: Crowther Road Alignment

This road will be used by forestry, site establishment and construction vehicles during the construction and site preparation stages of the landfill. In the future, the Landfill Access Road will be used by forestry related vehicles for subsequent forestry extraction rotations from within the WMNZ landholding (noting that only one cycle of forest harvesting from within the initial landfill development area will occur from the temporary construction access road via Crowther Road).

4.4 Landfill Access Road

A single Landfill Access Road will provide internal access between the landfill working face, weighbridge, bin exchange area and the proposed SH1 roundabout. This road will cater for two-way traffic movement and will be used by a combination of road haulage trucks, mule trucks and other landfill staff and authorised visitor vehicles operating between the bin exchange area and the landfill.

The access to the landfill face is approximately 2km long between the bin exchange area and the weighbridge. Further details of its design and construction will be provided in reports by others attached to the AEE.

The total trafficable width of the Landfill Access Road will be approximately 7.2m wide (with supporting 2m wide sealed shoulders on each side of the trafficable width) which is sufficient to cater for convenient and safe two-way vehicle movement of landfill-related vehicles.

The topography of the site is relatively steep, and the access alignment has been selected to minimise the gradient as much as possible. Further details of the proposed roading alignment and design are contained within the Landfill Engineering Report prepared by Tonkin and Taylor.

The design objective for the grade of the access road was to achieve a longitudinal gradient of no more than 8% so as to be suitable for hauling full waste vehicles uphill. The proposed design achieves a gradient over most of the length of the 2km road of approximately 7.4%. This proposed gradient satisfies the AUP Rule E27.6.4.4.1 which states that the gradient of a vehicle access used by heavy vehicles should not exceed 8%.

5. Assessment of Effects

5.1 Construction Effects

5.1.1 Trip Generation

The worst-case traffic volumes generated during a two-month period in the second construction season and before the primary Landfill Access Road is completed, have been discussed in Section 3.2 of this report. At most (with the coincident activities of bridge construction, Landfill Access Road construction, liner preparation and forestry) there could be up 72 heavy vehicle movements and 200 light vehicle movements associated with the site per day (exclusive of the roundabout construction activity which will be separately managed via construction traffic management plans in consultation with NZTA).

Heavy vehicle movements include trucks taking away forestry products and different trucks delivering construction materials and machinery.

Construction staff arriving in light vehicles are likely to work in shifts with most staff arriving during the morning peak and leaving during the evening peak. Exact shift times will be confirmed closer to the time of construction however, for the purposes of this assessment, it is conservatively considered that the majority of light vehicles associated with the construction workforce will arrive in the morning peak and these vehicles will also leave in the evening peak.

5.1.2 Trip Distribution

It is considered that 90% of light and heavy vehicle trips generated during construction will originate from south of the ARL site as a result of the location of the primary activity areas in Auckland and the sources of many of the construction-related activities. As is typical for most construction related activities, the majority of vehicle trips are considered to be inbound during the morning peak and the majority of vehicle trips will be outbound in the evening peak. This will be a conservatively robust, upper estimate of the expected traffic effects during the construction period as there will be a range of traffic management approaches, especially the transport of larger machinery, that will be arranged outside of the peak periods – sometimes overnight, and also given the fact that the typical working hours adopted during the construction period will commence at 6:30 am prior to the main peak periods of traffic movement on SH1.

Figure 5-1 and **Figure 5-2** illustrate the number and distribution of trips expected to be generated by the forestry/construction access in the morning and evening peak hours. These volumes have been used in subsequent analyses.

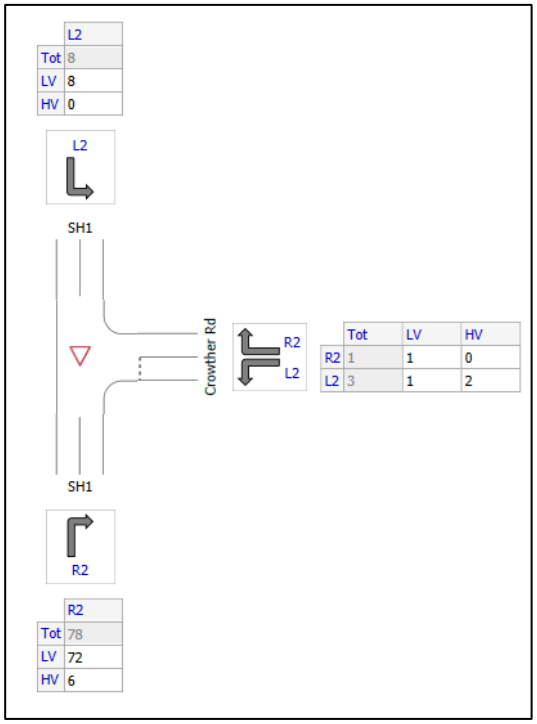

Figure 5-1: Morning Peak Hour Crowther Road Access Movements[4]

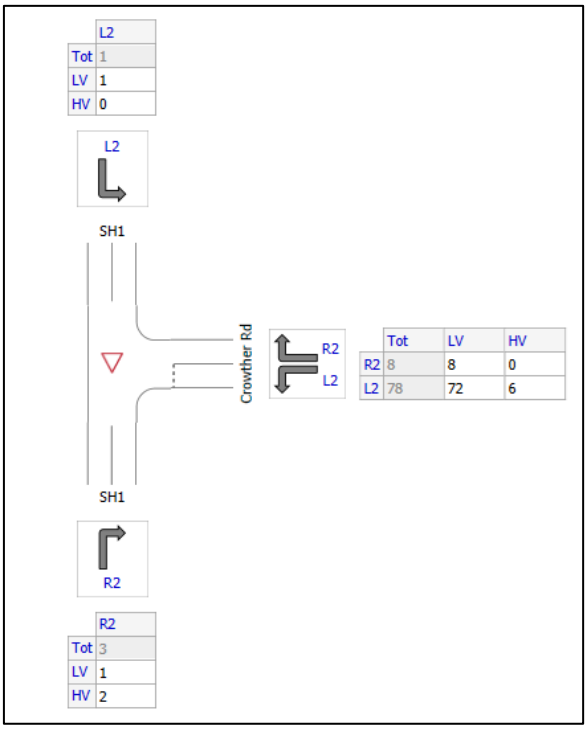

Figure 5-2: Evening Peak Hour Crowther Road Access Movements

This diagram shows the turning movements generated by the combination of construction and forestry related activity accessing the temporary construction access. The numbers referenced on the diagram indicate the hourly volume of light vehicles **(LV)** and heavy vehicles **(HV)** and the total **(TOT)** for each of the left and right turning movements through the Crowther Road/SH1 intersection. The effect of the tidal pattern of inbound/outbound movements can be appreciated with a dominance of the right turn into Crowther Road from the south during the morning peak hour and the complementary movements out of Crowther Road towards the south in the evening peak.

5.1.3 Crowther Road Performance

The current layout of the Crowther Road access with SH1 is not proposed to change given that it will only be used for the short duration that the primary site access via Landfill Access Road is being constructed.

The safety works being undertaken by NZTA along SH1 include a widened centreline across the access frontage, thereby not preventing right turning vehicles into or out of this access. As such, the fundamental design of the intersection is not required to change either as part of the proposed ARL facility or the NZTA SH1 safety improvements. There is an existing widened sealed shoulder on the western side of the highway which provides sufficient waiting space for at least one truck prior to undertaking the right turn into the Crowther Road access.

It is understood that this area is adopted by the school bus movements serving both Mahurangi College and Warkworth Primary School. It is recommended that the construction traffic management plan **(CTMP)** for the ARL make specific provision for major delivery of equipment and supplies to avoid the period between 8.00 and 8.30am, and between 3.15 and 4.00pm during school term time to minimise the risk to school students accessing and egressing these school buses at the Crowther Road location.

Consideration has also been given to the construction and road access during the construction phase when forestry vehicles will also be removing logs from the wider forestry areas surrounding the landfill site. The peak time for use of this access is expected to occur in the first and second seasons of construction which is likely to be the summer construction seasons of 2021 - 2023.

The results from the intersection modelling of the construction/forestry access point at Crowther Road are summarised in **Table 5-1** below.

[4] Within these diagrams LV = hourly volume of light vehicles; HV = hourly volume of heavy vehicles and TOT = total hourly volume of all vehicles executing the turning movements

Table 5-1: Modelling Results – Crowther Road 2021/22

Approach	Movement	AM Peak			PM Peak		
		Ave Delay (s)	LOS	95% Q(m)	Ave Delay (s)	LOS	95% Q(m)
SH1 (South)	Through	1.4	A	9.2	0.1	A	1.4
	Right	10.9	B	9.2	19.7	C	1.4
Crowther Road (East)	Left	12.8	B	0.1	10.1	B	4.1
	Right	14.3	D	0.1	33.1	D	4.1
SH1 (North)	Left	7.0	A	0.0	7.0	A	0.0
	Through	0.0	A	0.0	0.0	A	0.0
All Vehicles		**1.5**	**NA**	**-**	**0.8**	**NA**	**-**

In the weekday evening peak (and with the higher Friday evening through-traffic flows on SH1 plus the consideration of upper worst-case estimate of generated traffic movements), traffic leaving the Crowther Road access may be required to wait for a more appropriate gap in the traffic stream. However, this wait is not expected to exceed around 30 seconds on a busy Friday afternoon and wait times will be less for other days and at other times where background traffic demands are less. The additional waiting time for vehicles leaving the construction access (turning to both the left and the right) is therefore not considered to be significant.

The modelling results indicate that there will be negligible congestion present on SH1 as a result of vehicles using this access. As such, there are no operational reasons to require an upgrade of this intersection.

There is clear sight distance of over 200m on the northbound approach to the intersection which will allow drivers to react to a right turning vehicle within the carriageway. The NZTA safety improvements along SH1 are expected to be completed by 2021 in this area which will further improve the area's road safety. The widened centreline along with the existing wide sealed shoulder allows for a through moving vehicle to pass a vehicle waiting to turn right into the site. Any right turning vehicles are not expected to be stationary for more than 10 seconds, and with adequate forward sight distance to such turning vehicles, the operation of this access is considered to be appropriate.

In this way, both the safety and efficiency of the access movements would be promoted as well as reflecting and respecting the overall objective for improvements in safety for the SH1 corridor in this location.

5.1.4 Effect of Forestry Operations

The development of the above construction period trip generation estimates has already taken into account the likely generated trips to and from the forestry operations accessing the Crowther Road temporary access road. The reported performance results have shown that with the existing widened western shoulder on SH1 (allowing for the pausing of trucks and other vehicles prior to making a turn into the site), the operation of this temporary access can be confirmed as appropriate.

5.1.5 Proposed Mitigation Measures

5.1.5.1 Construction Traffic Management Plan

It is recommended that prior to commencement of site establishment and construction activities that WMNZ prepare a CTMP to the satisfaction of NZTA. This is a standard practise required for all major earthworks or land development activities and would be a minimum requirement for NZTA to approve or endorse any development adjacent to the State Highway. Such a CTMP should (as a minimum) include details of:

i. Construction dates and hours of operation including any specific non-working hours for traffic congestion/noise etc;

ii. Nature and frequency of site establishment, forestry and construction traffic movement;

iii. Truck route diagrams between the ARL site and external road network;

iv. Specific measures to be taken when delivering special loads such as earthworking machinery to avoid peak periods of activity along SH1 (for example, delivery of these items overnight or early in the morning);

v. Temporary traffic management signage/details for vehicles and other road users, to manage the interaction of these road users with heavy construction traffic in a safe manner;

vi. Measures to avoid the interaction between site establishment, forestry and construction traffic with school bus attendance at the Forestry Road/Crowther Road location during school term time; and

vii. Details of site access/egress over the entire construction period and any limitations on truck movements.

Based on Stantec's extensive experience of developing the traffic management strategies for similar projects and bearing in mind the operation of the current road network in this location, it is considered that with the appropriate CTMP in place and the above measures implemented, the site establishment and construction activities can be managed to ensure that any generated traffic effects are appropriately mitigated.

5.1.5.2 NZTA Dome Valley Improvements

The NZTA's proposed Dome Valley safety improvements project is currently underway delivering a wide range of safety features including central median barriers, wider shoulders, wider centrelines and formalised u-turn facilities. It is expected that by the time the site establishment and construction processes associated with the ARL commence, the Dome Valley section of SH1 will be upgraded to provide a higher level of operation and road user safety than is currently the case.

5.1.5.3 NZTA Safety System Approach to Managing State Highways

The NZTA has adopted and is implementing across its organisation a "safety system" approach to road safety with a recognition that road users do make mistakes and that in order to achieve a safe transport system there is a need to consider and "design in" safety within all elements of the transport system. In particular, the NZTA refers to safe vehicles, safe road use, safe roads and roadsides, and safe speeds. These aspects of designing, managing and operating the State Highway system including but not limited to SH1 through Dome Valley, will be progressively seen in day to day operation of the SH1 route and also in NZTA's staff approach to elements of the ARL establishment/construction and design/operation of the permanent roundabout access to ARL.

5.2 Operational Effects

5.2.1 Parking

In terms of the requirements for on-site parking associated with the ARL facility, the Auckland Unitary Plan Operative in Part (**AUP**) sets parking provision standards for various activities throughout the region. There is no specific AUP activity classification related to landfills (other than perhaps the office activity related to administrative offices at the top of the Landfill Access Road). Accordingly, the "All other activities where located in rural zones" standard T80 presented in Table E27.6.2.4 of the AUP is considered applicable for the wider ARL development. This activity has neither minimum nor maximum parking provision rates and therefore the proposed landfill is not constrained by being required to provide a certain number of parking spaces.

Despite there not being any defined AUP parking requirements, it is proposed to provide parking for workers and visitors to the site.

Parking for staff and visitors will be split between the main office (approximately 20 parking bays) and the workshop and staff amenities area (approximately 30 parking bays). Both of these areas are located beside the Landfill Access Road after having passed the weighbridge area.

It is envisaged that most line haul trucks will be based in Auckland with possibly three trucks being based at the ARL site. As such, only nominal parking (three bays) for three trucks will be allowed for in the bin exchange area.

Overall, the provision of parking within the ARL site is considered to be readily able to meet the intention of the AUP to provide adequate off-street parking. There are sufficient areas proposed to supply parking to meet the practical demands of the site, and provision for further spaces to be developed in the future.

5.2.2 Trip Generation

5.2.2.1 Waste

In 2028, it is estimated that there will be a peak of 520 waste truck movements per day (inclusive of inbound and outbound directions of travel) spread over any 24- hour period, and a peak intensity of 110 waste truck movements during the assessed peak hour periods. For the purposes of a robust analysis, the peak intensity of waste truck movements with the peak intensity of non-waste traffic (which in reality will not coincide), have been adopted as a co-incident peak period of activity. This is considered to a provide a conservative over-estimate of expected traffic movements and hence worst-case assessment of traffic effects at the proposed access road roundabout. The traffic generated by the site is only expected to represent approximately 3% of the traffic on SH1 in the morning peak hour and 1% in the evening peak hour.

In 2060, it is estimated that these truck numbers will be factored up by 56% to reflect a 1.4% growth per annum in waste for the period 2028 – 2060 (to a total of 811 waste truck movements per day).

In most cases, inbound waste trucks will be outbound again with little delay for their return trip.

5.2.2.2 Non-waste

Non-waste vehicles comprise staff, fuel and oil deliveries, leachate cartage, light deliveries, servicing and maintenance vehicles, and visitors. It is noted that the logging activity is excluded from these volumes.

In 2028, it is estimated that there will be a peak of 220 non-waste movements per day, and a peak intensity of 25 non-waste vehicle movements during the busiest hour of the peak 4-hour periods around work shift changes.

Notably, the non-waste vehicles numbers will reduce to two-thirds of these numbers in winter when construction works have ceased and will reduce further when leachate cartage is replaced by on-site treatment.

5.2.2.3 Logging

From the point of view of assessment of effects from the landfill, logging will be occurring regardless and is therefore part of the existing environment. However, the exit point onto SH1 for approximately 1000 ha of the Mahurangi Forest harvest will be shifted to the landfill's access road. The relevant next harvest is due in 2030-2034.

During the harvest commencing 2030, it is estimated that there will be a peak of 43 logging-related movements per day, and a peak intensity of 20 logging-related return trips over any 4-hour period.

Notably, logging trucks comprise less than half these numbers, the remainder being crew and service vehicles.

Over the course of the peak day in summer and during logging, it is expected that up to 415 vehicle movements at the entrance roundabout will be generated with 108 of these occurring over the peak 4-hour period. To estimate the peak hour period volume, 40% of the peak 4-hour volume has been conservatively assumed.

Given that the next harvest occurs after 2028, logging volumes have not been included in the 2026 and 2028 year model. Logging volumes have been accounted for in the 2060 scenario, based on the assumption that the volumes remain the same as those in 2030.

5.2.3 Trip Distribution

The road haulage waste trucks will usually depart the site within an hour of arriving, and as such this assessment considers that the number of waste trucks arriving will match the number leaving. Therefore, in the 2028 peak hour, 15 trucks will arrive to offload waste material and 15 trucks will leave the site generally within the same hour period.

Non-waste vehicles typically spend longer on the site with most vehicles arriving in the morning and departing in the evening. Of the 15 vehicle movements generated in the 2028 morning peak hour (non-waste excluding logging movements), it is expected that 90% of these will be inbound movements into the site. In the evening peak, the tidal direction will reverse so that 90% of vehicle movements are exiting the site.

Of the 43 daily logging movements generated in the 2060 horizon year scenario, it is expected that 80% of these will be inbound movements into the site in the morning peak hour and reversed in the evening peak. It is also assumed that there is a 50% split between northbound and southbound traffic.

Table 5-2 below summarises the number of vehicle movements expected to be generated in the morning and evening peak hours, and across the course of the day.

Table 5-2: Vehicle Movement Summary, excluding logging (2028)

Vehicle Type	AM Peak		PM Peak		Daily	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Waste Trucks	15	15	15	15	260	260
Non-Waste Vehicles	21	4	4	21	110	110
Total	36	19	19	36	370	370
	55		**55**		**740**	

It is expected that most trips will arrive from and depart towards the south – the direction of major population and activity in the greater metropolitan Auckland area. Some vehicles may use SH16 via Wellsford to access parts of the region as an alternative route to SH1. If the WW2W is constructed, with an interchange at Wayby Valley Road, then most vehicles would choose to head north out of the site to this interchange for more direct access to the motorway network heading south.

For the purposes of this assessment, it is considered that the WW2W project will not be completed and that vehicles will predominantly continue to head south on the existing SH1 alignment to Warkworth and beyond. As noted previously, the design of the site access onto SH1 has been designed to accommodate the eventuality that the majority of trucks may choose to turn right if WW2W proceeds.

In the peak hour, all waste trucks are considered to arrive from and depart to the south. For non-waste vehicles, 90% are considered to originate from the south and 10% from the north. This accounts for the fact that some workers may live in the Wellsford area which is the closest urban area to the site access.

Figure 5.3 and 5.4 illustrate the number and distribution of trips expected to be generated by the site in the morning and evening peak hours. These volumes have been used in subsequent analysis.

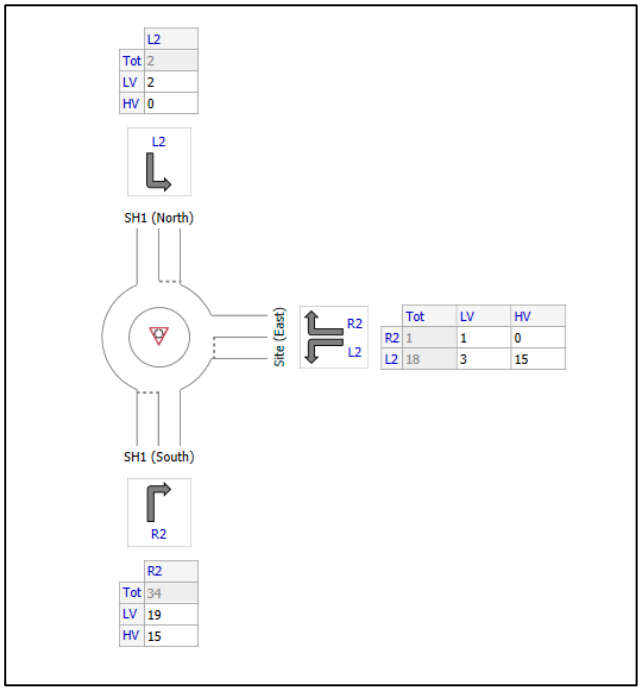

Figure 5-3: 2028 Morning Peak Hour Site Movements, excluding logging

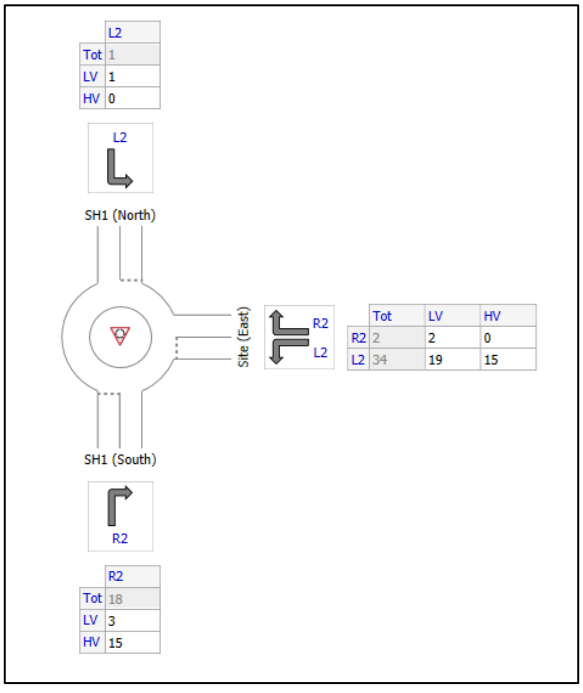

Figure 5-4: 2028 Evening Peak Hour Site Movements, excluding logging

5.2.4 Expected Performance – Operation Start

The facility is anticipated to commence operating in 2026. At this time, Stage 1 of the landfill will have been constructed and ready to start receiving waste. The roundabout intersection serving the entrance to the site has been modelled for 2026 future year for both the morning and evening peak hours. The results from the modelling are shown in **Table 5-3** below.

Table 5-3: Modelling Results – Primary Site Access 2026 (Year of Opening)

Approach	Movement	AM Peak			PM Peak		
		Ave Delay (s)	LOS	95% Q(m)	Ave Delay (s)	LOS	95% Q(m)
SH1 (South)	Through	6.7	A	23.7	6.5	A	74.4
	Right	11.7	B	23.7	12.4	B	74.4
Site (East)	Left	9.0	A	2.6	7.5	A	3.4
	Right	9.5	A	2.6	9.7	A	3.4
SH1 (North)	Left	5.9	A	26.9	5.8	A	25.7
	Through	6.9	A	26.9	6.7	A	25.7
All Vehicles		**7.0**	**A**	**-**	**6.6**	**A**	**-**

The modelling indicates that there is expected to be minimal congestion generated near the entrance to the facility with modest delays and acceptable queueing. The generated queuing is expected to be temporary and generally of a slow-moving vehicle nature (as is demonstrated by the modest delays) and will clear quickly.

5.2.5 Expected Performance - Operational

Although the site may commence limited operations in 2026, it is not expected to be fully operational until 2028 which is the Redvale site consent closure date. It is also anticipated that the peak year for delivery of waste to the site will be 2060 when the region is expected to produce the most waste and just before the facility is full. As such, the modelled operational years have been taken as 2028 and a future possible horizon year of 2060. Both the morning and evening peak hours of the on-road traffic volumes along SH1 (AM peak 7.45 – 8.45am, PM Peak 5.00 – 6.00pm) have been assessed.

The results from the SIDRA modelling are summarised in **Table 5-4** for the 2028 future year and **Table 5-5** for the 2060 future year. It is noted that should the landfill be open and operating sooner than the adopted future year for analysis of 2028, the operational performance metrics presented below will over-estimate the delays and generated queues as the passing volumes on SH1 will not be as great. The overall conclusions reached with respect to the performance acceptability, however, remain the same.

Table 5-4: Modelling Results – Primary Site Access 2028 (Year of Opening)

Approach	Movement	AM Peak			PM Peak		
		Ave Delay (s)	LOS	95% Q(m)	Ave Delay (s)	LOS	95% Q(m)
SH1 (South)	Through	6.7	A	25.7	6.5	A	88.0
	Right	11.7	B	25.7	12.4	B	88.0
Site (East)	Left	9.6	A	2.7	8.0	A	3.5
	Right	9.8	A	2.7	10.1	B	3.5
SH1 (North)	Left	5.9	A	29.4	5.8	A	28.2
	Through	6.9	A	29.4	6.7	A	28.2
All Vehicles		**7.0**	**A**	**-**	**6.6**	**A**	**-**

The possible future year horizon of the landfill operational assessment has been based on the conservative (over-estimated) assumptions that waste vehicle generation to and from the ARL site will grow at 1.4% per annum.

It is considered that such growth rates represent an upper estimate of waste volume generation given the wider, regional and national programmes being implemented to reduce waste generation and increase recycling and re-use. Nonetheless it is considered appropriate to develop an estimate of the operational performance at this future ultimate horizon year (despite the consent for the landfill only being for a duration of 35 years).

Table 5-5: Modelling Results – Primary Site Access 2060

Approach	Movement	AM Peak			PM Peak		
		Ave Delay (s)	LOS	95% Q(m)	Ave Delay (s)	LOS	95% Q(m)
SH1 (South)	Through	6.7	A	35.4	7.1	A	183.1
	Right	12.2	B	35.4	13.7	B	183.1
Site (East)	Left	11.8	B	7.0	11.3	B	13.3
	Right	15.2	B	7.0	16.8	B	13.3
SH1 (North)	Left	6.4	A	42.1	6.0	A	43.1
	Through	7.4	A	42.1	6.9	A	43.1
All Vehicles		**7.4**	**A**	**-**	**7.3**	**A**	**-**

The modelling results indicate that at this future horizon year (and incorporating all of the over-estimated predictions such as co-incidence of waste and non-waste peak periods and continued growth in waste generation), the proposed roundabout performs well with minimal delays from the year of opening between 2026/2028 through to a future long-term horizon 2060.

In all scenarios the roundabout performs at an overall Level of Service (**LOS**) for the intersection of LOS A or B which indicates free flowing traffic with modest average delays. It is noted that the future year horizon of 2060 represents the extrapolation of traffic growth rates along SH1 that fall well beyond what is generally accepted as capable of robust projection and are given here to help demonstrate the general ability of the proposed roundabout-controlled intersection to handle the landfill-generated volumes well into the future.

As already observed in earlier sections of this assessment, NZTA has already identified the desirability for consideration of an alternative to the current SH1 alignment by way of the WW2W scheme to address these long-term travel demands. The above analysis and commentary below show that despite the possibility of the WW2W project coming 'on-stream' during the life of the ARL, the landfill facility itself does not generate the requirement to upgrade the SH1 corridor other than as proposed by way of the access roundabout.

The above tabulated intersection modelling data shows that some queues of slow moving or stationary vehicles are generated on the through movements along the SH1 approaches to the roundabout. Where a notable queue is likely to form northbound on SH1 in both evening peaks of the future years, this can be attributed to the high passing traffic demands on SH1 and the need for these approach movements to Give Way to traffic circulating from the Landfill Access Road . However, vehicles do not experience significant delays (generally average delays in this possible future scenario year are less than only around 6-7 sec/veh for the through movements on SH1) and the queues that form are expected to dissipate quickly (as evidenced by the modest delays predicted by the modelling).

As the traffic volumes continue to grow through the future years out towards the 2060 scenario, it is possible that some upstream network elements such as intersections and passing lane merge points may limit the amount of traffic that can travel on SH1 in an hour. This may limit the hourly arrival flows at the roundabout and would lead to reduced queuing generated at the roundabout. In this regard, the intersection performance presented in these tables is considered to represent an upper estimate of predicted delays and queues. If the pattern of peak period traffic volumes along SH1, or generated waste haulage vehicle volume is spread across more hours of each day, or the achievement of further gains in waste diversion, recycling and the like is achieved, then the intersection performance will be better than that presented.

Overall, it is considered that the roundabout is readily able to accommodate the traffic volumes generated by the proposed facility and will continue to perform well as background traffic volumes on SH1 increase.

Should the possible WW2W project be delivered within this future time horizon, there would be a significant reduction in passing through traffic on SH1 and performance levels will be further improved. Should this occur then the design of the roundabout which has been prepared to meet full NZTA design standards will provide a much higher level of operational and safety performance that would be required if the road was to be operated as an arterial road under the jurisdiction of Auckland Transport (as would be the case if the WW2W project proceeds and the current SH1 designation is lifted).

5.2.6 Effect of Operational Forestry Operations

Once the ARL roundabout and the Landfill Access Road are established and operational, the forestry operations of the surrounding area (within WMNZ-owned land but outside the operational landfill itself) will access SH1 via the proposed roundabout. Information provided by WMNZ indicates that the longer-term logging activity could generate approximately 14 logging trucks (28 movements) per day during the harvesting cycle. In any particular peak hour during the harvesting period, it is anticipated that a maximum of up to four logging truck movements would be generated through the proposed roundabout.

The above analyses show that at the performance levels predicted, the addition of up to an additional four logging truck movements per hour could be readily accommodated without any noticeable adverse effect. The level of additional logging truck movement would represent less than 5% additional traffic movements to and from the Landfill Access Road , and as such have less than minor effect on the predicted performances presented above.

5.2.7 Proposed Mitigation – Operational

The proposed operation of the ARL facility includes a range of operational measures and approaches that will assist in the mitigation of the eternal operation and safety effects of the proposal including:

(i) The adoption of extended operational hours (24 hours a day, 7 days per week) for the bin exchange area adjacent to the proposed SH1 roundabout and access point to ARL so as to minimise the effect of generated traffic volumes on the SH1 corridor and wider transport network;
(ii) The facilitation of High Performance Motor Vehicle (**HPMV**) vehicles within the design of the proposed roundabout, the bin exchange area and Landfill Access Road to minimise the overall number of vehicles required to transport the waste volumes anticipated through the life of the ARL;
(iii) Adoption of NZTA's safety audit procedures in respect of the proposed SH1 Landfill Access Road roundabout design to ensure the highest levels of safety and operational performance for this intersection and to ensure minimal effects on the operation of the SH1 corridor; and

Together with the proposed layout and physical features of the ARL and associated transport-related features of the access roundabout (including incorporation of subsequent stages of NZTA's safety audit process and approval steps for the roundabout design and operation), these measures will suitably mitigate the external transportation effects of the proposal.

6. Conclusions

This report has assessed the construction and site establishment transportation aspects of the Auckland Regional Landfill occurring during the period 2021/2023, as well as two operational time horizons: one associated with the early years of operation of the site (2026/2028) and some consideration of a future year time horizon towards the end of the ARL life expectancy in 2060.

On the basis of this Transportation Assessment undertaken, it is concluded that:

- There could be up to a total of 72 heavy vehicle movements per day and 200 light vehicle movements per day on Crowther Road during the site clearance and establishment phase of the project. Following the implementation of the controls set out in the CTMP, the operational transport effect on SH1 during this phase is expected to be negligible.
- During the operational phase, it is conservatively anticipated that the site will generate a total of up to 55 vehicle movements during each weekday morning and afternoon peak hour period, and up to 740 vehicle movements per day (excluding logging). Whilst queues may develop along the SH1 approaches to the roundabout during the peak periods of the 2026 operational year (and into the future horizon year), the delays are not considered significant (less than 7 sec/veh for SH1 through movements) and queues are expected to dissipate quickly.
- As the traffic volumes along SH1 continues to grow, other elements of the SH1 network such as intersections and passing lane merge points may start to reach their operational capacity limits prior to reaching the landfill roundabout. Accordingly, the projected intersection performance of the proposed roundabout is considered to represent an upper estimate of predicted delays and is likely that the intersection performance will be better than that presented in 2060 year.

Overall, it is concluded by this assessment that the proposed roundabout will be able to accommodate the traffic volumes generated by the proposed Auckland Regional Landfill out to a theoretical 2060 future horizon year under the existing SH1 layout.

On the basis of the detailed assessment undertaken within this commission, it is considered that with the proposed suite of recommended conditions including traffic and transport related matters, the Auckland Regional Landfill can be established in a manner such that the transportation effects of both the construction and operational phases of the project are suitably managed with minimal adverse effects on the surrounding receiving transport environment.

Stantec New Zealand

Appendices

Appendix A NZTA Road Safety Audit (December 2018)

TRAFFIC PLANNING CONSULTANTS LTD

SH1, Dome Valley:
Roundabout at land fill access

ROAD SAFETY AUDIT
of the
PRELIMINARY DESIGN

A REPORT PREPARED FOR
NZ TRANSPORT AGENCY

Reference: 18571
December 2018

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Project Information:

Client	NZ Transport Agency
Job Number	18571
Title	SH1, Dome Valley – Roundabout at land fill access - Road safety audit of the preliminary design
Prepared By	Steve Reddish (TPC), Bruce Robinson (RTC) and James Hughes (NZTA)
Date	December 2018

Document History and Status:

Revision	Date Issued	Reviewed By	Approved by	Date approved	Status
A	20/12/18	BR, JH		23/12/18	Draft
B	24/12/18		S Reddish	24/12/18	Final

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1.0 INTRODUCTION

1.1 Road safety audit procedure

Road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The safety audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, that is, minimisation of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a safe system and bring those concerns to the attention of the client in order that the client can make a value judgement as to appropriate action(s) based on the guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

> *To deliver completed projects that contribute towards a safe road system that is increasingly free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project*.

A road safety audit should desirably be undertaken at the following project milestones:

- Concept stage
- Scheme or Preliminary design stage
- Detailed design stage, and
- Pre-opening / Post-construction stage.

A road safety audit is not intended as a technical or financial audit and does not substitute for a design check on standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of mitigating the road safety concerns identified should also be considered.

In accordance with the procedures set down in the revised draft NZ Transport Agency Guideline "Road Safety Audit Procedures for Projects" (Interim Release May 2013) this is a report to the client who then refers the report to the designer. The designer should consider the report and comment to the client on each of the concerns

identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the safety audit report recommendation.

For each audit team recommendation that is accepted, the client shall make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, safety engineer and client for each issue documenting the designer response, client decision and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The project

The project for which this is the road safety audit is the preliminary design for a roundabout on SH1 at Dome Valley which will facilitate access to a new landfill site. Bypass left turn slip lanes are proposed from SH1 north onto the new access road and from the new access road to SH1 south.

The current speed limit on SH1 at this location is 80 km/h and operating speeds are consistent with the speed limit. Traffic volume is approx. 13,000 vehicles per day.

In the first instance it is expected that 90% of truck traffic to/from the landfill will be from the south with some 300 trucks per day coming to the landfill ultimately rising to 500 trucks per day.

It is noted that safety improvements along this section of SH1 will have been completed prior to construction of the new roundabout and landfill access road. These safety improvements comprise installation of a median barrier and some additional edge barriers. Some modifications to these safety improvements will be required if the new access road and roundabout proceed.

The safety audit team was provided with the following documentation:

- Layout plan, drawing no. 80510280-0152-103, RevB dated 02-10-18;
- Plan and long sections for each approach leg, drawings nos. 80510280-0152-100, 101 and 102, all RevB dated 02-10-18;
- Slip lanes long sections, drawing no. 80510280-0152-104, RevB dated 02-10-18
- Cross sections, drawings nos. 80510280-0152-200 to 209, 300 to 305, 400 to 403, 500, 600 to 602, 700 to 702, all RevB dated 02-10-18;
- 18m semi-trailer Autoturn sketches dated 11.12.18;

- Information via e-mail on traffic patterns associated with the landfill access road and a preliminary Sidra operations analysis summary.

All drawings were prepared by Stantec, Auckland.

1.3 The road safety audit team

The road safety audit was carried out, as far as practicable, in accordance with the NZ Transport Agency Guideline "Road Safety Audit Procedures for Projects" (Interim Release May 2013) by:

- Steve Reddish, Senior Associate, Traffic Planning Consultants Ltd, Hawke's Bay;
- Bruce Robinson, Robinson Transportation Consulting, Tauranga;
- James Hughes, National Design Engineer, NZ Transport Agency, Wellington.

On Wednesday 12 December 2018, the safety audit team (SAT) attended a briefing meeting at the Stantec offices, Auckland, followed by a site visit in conjunction with reviewing the drawings provided. A debrief meeting was held in the afternoon of the same day so that the SAT could give the designers an early indication of its findings.

1.4 Report format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed based on expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed based on factors such as expected speeds, type of collision, type of vehicle, and road user involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the Assessment Matrix in **Table 1**. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Table 1: Assessment Matrix

Likelihood of death or serious injury	Probability of a crash			
	Frequent	Common	Occasional	Infrequent
Very Likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very Unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each category of concern is given in **Table 2**.

Table 2: Categories of Concern

Concern	Suggested action
Serious	Major concern that must be addressed and requires changes to avoid serous safety consequences.
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate concern that should be addressed to improve safety.
Minor	Minor concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication, but which lie outside the scope of the road safety audit. A comment may include: items where the safety implications are not yet clear due to insufficient detail for the stage of project; items outside the scope of the audit such as existing issues not directly impacted by the project; an opportunity for improved safety that is not necessarily linked to the project itself, or other issues that should be addressed, but are not necessarily safety related. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the safety auditors.

All potential concerns, comments and recommendations set out in this safety audit report should be noted and acted upon if appropriate.

1.5 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and environs, and the opinions of the safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe. Furthermore, no warranty is implied that all safety issues have been identified in this report. Road safety audits do not constitute a design review or an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific advice on matters raised and not rely solely on the report. While every effort has been made to ensure the accuracy of the report, it is made available strictly on the basis that anyone relying on it does so at their own risk without any liability to members of the safety audit team or their organisations.

2.0 SAFETY AUDIT FINDINGS

Preamble:

The safety audit team (SAT) concurs that a roundabout is an appropriate intersection form to cater for safe access to/from the proposed landfill site. The location is also considered appropriate to be able to achieve a safe design.

Notwithstanding the above comments, the SAT has noted a number of safety concerns with recommendations in the following report which should be considered for incorporation into the design if the project is progressed.

2.1 Moderate Concern – Geometry of northbound (southern) approach

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

The relative positions of the northbound entry, the 35m diameter central island and the northbound exit, coupled with the carriageway widths at entry and circulation (scaled at approx. 6m and 7m respectively on drawing 0152-101), mean that northbound vehicles would potentially negotiate the roundabout at an unsafe speed. This can lead to loss of control crashes or crashes with other vehicles already circulating on the roundabout.

The situation is exacerbated by the minimal amount of traffic that will be circulating from the landfill access around the roundabout and exiting northbound. This leads to regular users of the roundabout's expectations being that they do not have to give way and therefore do not slow appropriately and are less alert. Thus it will be critical to manage speeds from the northbound (southern) approach.

In the opinion of the SAT, a number of design adjustments need to be made to provide appropriate entry path curvature to manage northbound vehicles' entry speeds to closer match the speed of circulating traffic, prior to entering the roundabout. As currently designed, this 80 km/h northbound approach is straight with a short final entry curve.

Photo 1 – Existing northbound approach to roundabout location

Recommendations:

a. Enlarge the central island to achieve a more appropriate entry path radius.

b. In conjunction with a. above, move the central island to the west as far as practicable.

c. Revise the northbound approach alignment so that drivers on the approach are initially directed to the right of centre of the central island.

d. Make every effort to ensure that the entry path radius does not exceed 55m.

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

2.2 Minor Concern – Geometry of southbound (northern) approach

Probability of Crash Occurring – Infrequent
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

The long section for the southbound (northern) approach to the roundabout (drawing 0152-100) shows a short crest curve with a K value of 20 just prior to the limit line location. This crest curve would restrict visibility to the limit line markings and could result in vehicles stopping beyond the limit line.

Recommendation:

Increase the K-value or remove the crest curve prior to the limit line to achieve the appropriate sight distance to the pavement markings, in particular the limit line.

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

2.3 Moderate Concern – Southbound bypass lane from access road

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

The SAT is concerned about the potential safety implications of a high speed merge at the termination of the bypass lane southbound from the landfill access road. There is always the risk of car drivers attempting to pass a truck within the confines of the merge area. In addition, this merge will be on a left hand curve, thereby compromising its readability. If the bypass lane is shortened so that the merge occurs prior to the left hand curve, there will be the issue of greater speed differential between trucks and light vehicles at the merge.

Whilst a safety barrier is proposed between the bypass lane and southbound exit from the roundabout to eliminate weaving and overtaking prior to the merge, the SAT considers that it is safer to accept gaps under priority rules at low speed on the roundabout rather than merge at higher speed downstream. Trucks and other vehicles coming to the landfill and turning right at the roundabout will create gaps in the southbound flow of general traffic, enabling unladen trucks exiting the landfill to pull out.

Recommendation:

Remove the southbound bypass lane from the landfill access road and require the landfill traffic to enter and exit the roundabout in a conventional way.

Designer Response:	
Safety Engineer:	

Client Decision:	
Action Taken:	

2.4 Moderate Concern – Southbound bypass lane to access road

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Minor

The diverge at the start of the southbound bypass lane to the landfill access road is shown commencing after a right hand curve (see **Photo 2**). Southbound drivers approaching the roundabout may mistakenly move into the bypass lane, as it appears to provide continuity to the south, whereas southbound drivers on SH1 have to effectively turn right at the proposed roundabout to continue on SH1.

The bypass lane has a broken back vertical curve (K values of 16.9 and 20.0) within a horizontal curve of radius 348m reducing visibility to its termination.

There is the risk that a driver using the bypass lane may continue to travel at speed and will come to a somewhat abrupt end (50m taper) into the landfill access road. There is the risk of a loss of control crash or collision with other vehicles on the access road.

Photo 2 – Looking back from the location of the diverge to the preceding curve

Recommendations:

a. Redesign the bypass lane as a slower speed, conventional auxiliary lane.

b. Provide a safe turnaround area within the landfill access road for any vehicles that mistakenly use the bypass lane.

c. *Ensure that the diagram on the advance destination signage for the roundabout reflects the layout of the roundabout (i.e. it is clear to southbound drivers on SH1 that they need to turn right at the roundabout).*

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

2.5 Moderate Concern – Visibility and conspicuousness of the roundabout

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

The proposed roundabout will be an isolated facility on the Warkworth to Wellsford route. As such it will be important that the roundabout is clearly visible to approaching drivers in order to reduce the risk of their failing to slow to negotiate the roundabout at an appropriate speed.

As the design is developed, ensure that the roundabout central island is clearly recognisable with good target value in terms of mounding, contrasting planting, lighting of the landscaping (as distinct from the lighting of the carriageway – see item **2.6**) and appropriate signage. (NB landscaping on the central island must still ensure that the required Austroads Guide to Road Design Part 4B criterion 2 sight triangles are achieved for each approach with only ground cover utilised in these areas.)

Recommendation:

Ensure that the detailed design of the roundabout central island includes measures to highlight the roundabout including, but not limited to, mounding, contrasting planting, and lighting of the landscaping.

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

2.6 Comment – Street lighting

Street lighting of the intersection and its approaches will be required under the Traffic Control Devices Rule, to highlight the roundabout and traffic islands at night and provide for safe navigation of the roundabout. The SAT was verbally advised that street lighting will be included in the design. (NB placement of the lighting poles can also assist in interpreting the upcoming intersection as a roundabout.)

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

2.7 Comment – Safety barriers

There are steep drop-offs to a stream on the eastern side of SH1 on the approaches to the proposed roundabout. Whilst no safety barriers were shown on the drawings provided to the SAT, the team was verbally advised that barriers will be included to provide protection from roadside hazards.

Designer Response:	
Safety Engineer:	
Client Decision:	
Action Taken:	

3.0 AUDIT STATEMENT

We certify that we have used the documents noted in section **1.2** and visited the site to identify features of the project that could be addressed to improve safety. The issues identified have been noted in this report, together with recommendations, which should be studied for implementation.

Signed :.....Date: 24 December 2018

Steve Reddish, BSc(Eng), CMEngNZ, MCIHT, FITE, DipTE
Senior Associate
Traffic Planning Consultants Ltd, Hawke's Bay

Signed:.....Date: 23 December 2018

Bruce Robinson, PrEng (RSA), MEng, MITE
Robinson Transportation Consulting, Tauranga

Signed:.....Date: 23 December 2018
James Hughes, BSc, CEng, MICE
National Design Engineer
NZ Transport Agency, Wellington

Designer:	*Name……*	*Position……..*
	Signature…….	*Date……*
Safety Engineer:	*Name……*	*Position……..*
	Signature…….	*Date……*
Project Manager:	*Name……*	*Position……..*
	Signature…….	*Date……*
Action Completed:	*Name……*	*Position……..*
	Signature…….	*Date……*

Project Manager to distribute audit report incorporating decision to designer, Safety Audit Team Leader, Safety Engineer and project file. ***Date:……..***

Appendix B SIDRA Traffic Model Results

MOVEMENT SUMMARY

Site: 101 [Forestry 2022 AM]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
2	T1	403	23.0	0.328	1.4	LOS A	1.4	11.2	0.30	0.14	0.36	74.9
3	R2	82	7.7	0.328	10.9	LOS B	1.4	11.2	0.30	0.14	0.36	66.6
Approach		485	20.4	0.328	3.0	NA	1.4	11.2	0.30	0.14	0.36	73.3
East: Forestry Rd												
4	L2	3	66.7	0.009	12.8	LOS B	0.0	0.3	0.60	0.76	0.60	45.2
6	R2	1	0.0	0.009	14.3	LOS B	0.0	0.3	0.60	0.76	0.60	59.3
Approach		4	50.0	0.009	13.2	LOS B	0.0	0.3	0.60	0.76	0.60	48.0
North: SH1												
7	L2	8	0.0	0.312	7.0	LOS A	0.0	0.0	0.00	0.01	0.00	74.4
8	T1	554	12.5	0.312	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.7
Approach		562	12.4	0.312	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.6
All Vehicles		1052	16.2	0.328	1.5	NA	1.4	11.2	0.14	0.07	0.17	76.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Forestry 2022 PM]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1												
2	T1	959	6.8	0.520	0.1	LOS A	0.2	1.4	0.01	0.00	0.02	79.7
3	R2	3	66.7	0.520	19.7	LOS C	0.2	1.4	0.01	0.00	0.02	52.1
Approach		962	7.0	0.520	0.2	NA	0.2	1.4	0.01	0.00	0.02	79.6
East: Forestry Rd												
4	L2	82	7.7	0.163	10.1	LOS B	0.6	4.1	0.61	0.83	0.61	57.7
6	R2	8	0.0	0.163	33.1	LOS D	0.6	4.1	0.61	0.83	0.61	59.5
Approach		91	7.0	0.163	12.2	LOS B	0.6	4.1	0.61	0.83	0.61	57.9
North: SH1												
7	L2	1	0.0	0.315	7.0	LOS A	0.0	0.0	0.00	0.00	0.00	74.5
8	T1	582	8.0	0.315	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
Approach		583	7.9	0.315	0.1	NA	0.0	0.0	0.00	0.00	0.00	79.8
All Vehicles		1636	7.3	0.520	0.8	NA	0.6	4.1	0.04	0.05	0.05	78.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [AM Peak 2026 NoSlip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	464	22.4	0.318	6.7	LOS A	2.8	23.7	0.03	0.52	0.03	62.3
3	R2	36	44.1	0.318	11.7	LOS B	2.8	23.7	0.03	0.52	0.03	51.8
Approach		500	24.0	0.318	7.0	LOS A	2.8	23.7	0.03	0.52	0.03	61.4
East: Site (East)												
4	L2	19	83.3	0.042	9.0	LOS A	0.2	2.6	0.72	0.65	0.72	35.7
6	R2	1	0.0	0.042	9.5	LOS A	0.2	2.6	0.72	0.65	0.72	45.8
Approach		20	78.9	0.042	9.0	LOS A	0.2	2.6	0.72	0.65	0.72	36.1
North: SH1 (North)												
7	L2	2	0.0	0.429	5.9	LOS A	3.5	26.9	0.24	0.48	0.24	49.2
8	T1	624	12.6	0.429	6.9	LOS A	3.5	26.9	0.24	0.48	0.24	63.8
Approach		626	12.6	0.429	6.9	LOS A	3.5	26.9	0.24	0.48	0.24	63.7
All Vehicles		1146	18.7	0.429	7.0	LOS A	3.5	26.9	0.16	0.50	0.16	61.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [PM Peak 2026 NoSlip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	1079	6.8	0.649	6.5	LOS A	9.9	74.4	0.07	0.49	0.07	66.5
3	R2	19	83.3	0.649	12.4	LOS B	9.9	74.4	0.07	0.49	0.07	51.6
Approach		1098	8.1	0.649	6.6	LOS A	9.9	74.4	0.07	0.49	0.07	66.2
East: Site (East)												
4	L2	36	44.1	0.063	7.5	LOS A	0.4	3.4	0.71	0.65	0.71	40.4
6	R2	2	0.0	0.063	9.7	LOS A	0.4	3.4	0.71	0.65	0.71	46.9
Approach		38	41.7	0.063	7.7	LOS A	0.4	3.4	0.71	0.65	0.71	40.7
North: SH1 (North)												
7	L2	1	0.0	0.421	5.8	LOS A	3.4	25.7	0.18	0.48	0.18	49.4
8	T1	655	7.9	0.421	6.7	LOS A	3.4	25.7	0.18	0.48	0.18	65.5
Approach		656	7.9	0.421	6.7	LOS A	3.4	25.7	0.18	0.48	0.18	65.5
All Vehicles		1792	8.8	0.649	6.6	LOS A	9.9	74.4	0.12	0.49	0.12	65.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [AM Peak 2028 NoSlip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	493	22.4	0.336	6.7	LOS A	3.0	25.7	0.03	0.51	0.03	62.3
3	R2	36	44.1	0.336	11.7	LOS B	3.0	25.7	0.03	0.51	0.03	51.8
Approach		528	23.9	0.336	7.0	LOS A	3.0	25.7	0.03	0.51	0.03	61.5
East: Site (East)												
4	L2	19	83.3	0.044	9.6	LOS A	0.2	2.7	0.73	0.66	0.73	35.5
6	R2	1	0.0	0.044	9.8	LOS A	0.2	2.7	0.73	0.66	0.73	45.4
Approach		20	78.9	0.044	9.6	LOS A	0.2	2.7	0.73	0.66	0.73	35.9
North: SH1 (North)												
7	L2	2	0.0	0.453	5.9	LOS A	3.8	29.4	0.25	0.48	0.25	49.2
8	T1	662	12.6	0.453	6.9	LOS A	3.8	29.4	0.25	0.48	0.25	63.7
Approach		664	12.5	0.453	6.9	LOS A	3.8	29.4	0.25	0.48	0.25	63.7
All Vehicles		1213	18.6	0.453	7.0	LOS A	3.8	29.4	0.16	0.50	0.16	61.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [PM Peak 2028 NoSlip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	1144	6.8	0.687	6.5	LOS A	11.8	88.0	0.08	0.49	0.08	66.5
3	R2	19	83.3	0.687	12.4	LOS B	11.8	88.0	0.08	0.49	0.08	51.6
Approach		1163	8.1	0.687	6.6	LOS A	11.8	88.0	0.08	0.49	0.08	66.2
East: Site (East)												
4	L2	36	44.1	0.066	8.0	LOS A	0.4	3.5	0.73	0.67	0.73	40.2
6	R2	2	0.0	0.066	10.1	LOS B	0.4	3.5	0.73	0.67	0.73	46.6
Approach		38	41.7	0.066	8.2	LOS A	0.4	3.5	0.73	0.67	0.73	40.5
North: SH1 (North)												
7	L2	1	0.0	0.445	5.8	LOS A	3.8	28.2	0.18	0.47	0.18	49.4
8	T1	694	7.9	0.445	6.7	LOS A	3.8	28.2	0.18	0.47	0.18	65.4
Approach		695	7.9	0.445	6.7	LOS A	3.8	28.2	0.18	0.47	0.18	65.4
All Vehicles		1896	8.7	0.687	6.6	LOS A	11.8	88.0	0.13	0.49	0.13	65.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [AM Peak 2060 No Slip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	556	22.3	0.382	6.7	LOS A	3.7	31.7	0.03	0.51	0.03	62.3
3	R2	44	54.8	0.382	11.9	LOS B	3.7	31.7	0.03	0.51	0.03	51.8
Approach		600	24.7	0.382	7.0	LOS A	3.7	31.7	0.03	0.51	0.03	61.4
East: Site (East)												
4	L2	27	88.5	0.073	11.5	LOS B	0.4	4.8	0.78	0.74	0.78	34.4
6	R2	1	0.0	0.073	10.9	LOS B	0.4	4.8	0.78	0.74	0.78	44.4
Approach		28	85.2	0.073	11.5	LOS B	0.4	4.8	0.78	0.74	0.78	34.7
North: SH1 (North)												
7	L2	2	0.0	0.522	6.1	LOS A	4.8	37.3	0.31	0.48	0.31	48.9
8	T1	748	12.7	0.522	7.1	LOS A	4.8	37.3	0.31	0.48	0.31	63.3
Approach		751	12.6	0.522	7.1	LOS A	4.8	37.3	0.31	0.48	0.31	63.2
All Vehicles		1379	19.4	0.522	7.1	LOS A	4.8	37.3	0.20	0.50	0.20	61.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [PM Peak 2060 NoSlip]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 (South)												
2	T1	1294	6.8	0.782	6.5	LOS A	19.5	146.2	0.10	0.48	0.10	66.3
3	R2	27	88.5	0.782	12.5	LOS B	19.5	146.2	0.10	0.48	0.10	51.5
Approach		1321	8.5	0.782	6.6	LOS A	19.5	146.2	0.10	0.48	0.10	65.9
East: Site (East)												
4	L2	44	54.8	0.097	10.0	LOS B	0.6	5.7	0.78	0.75	0.78	38.2
6	R2	2	0.0	0.097	11.2	LOS B	0.6	5.7	0.78	0.75	0.78	45.5
Approach		46	52.3	0.097	10.1	LOS B	0.6	5.7	0.78	0.75	0.78	38.5
North: SH1 (North)												
7	L2	1	0.0	0.516	5.9	LOS A	4.9	36.3	0.26	0.47	0.26	49.1
8	T1	784	7.9	0.516	6.8	LOS A	4.9	36.3	0.26	0.47	0.26	64.9
Approach		785	7.9	0.516	6.8	LOS A	4.9	36.3	0.26	0.47	0.26	64.9
All Vehicles		2153	9.2	0.782	6.8	LOS A	19.5	146.2	0.17	0.48	0.17	64.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix C Existing Traffic Counts and Speed Data

C.1 Traffic Volumes

C.1.1 Automatic Tube Counts

As a means of enabling a consideration of the current operation of the SH1 corridor adjacent to the ARL site and proposed access, an automatic tube count was organised during mid-2018. It is noted however that such data is relevant to the current traffic environment that will potentially be affected by the proposed ARL, whereas by the time that the ARL is constructed and operational, a future baseline of traffic flow will be the most appropriate against which to assess the effects of the ARL. In this way, the following information collected from the current traffic environment along SH1 was used to develop that future baseline.

Two count locations were selected from which to obtain the traffic count data: one located just north of the proposed site access location and the other some 400m to the south. The location of these was not only to record traffic volumes but also to record vehicles speeds and are discussed in a subsequent section of this report.

The tube counters were in place from 17 August to 23 August 2018, recording a full weeks' traffic movements along the SH1 corridor during a typical traffic activity. This week was considered to be a typical week that did not include any public holidays and was not within the school holidays. However, this time of the year experiences lower demands than average, and an assessment of the seasonal fluctuations in relation to the current SH1 traffic movements are discussed later in this report.

Figure 6-1 below shows the observed hourly 2018 volumes. The volumes at the two count sites are concordant as there are no roads or property accesses between the two count sites.

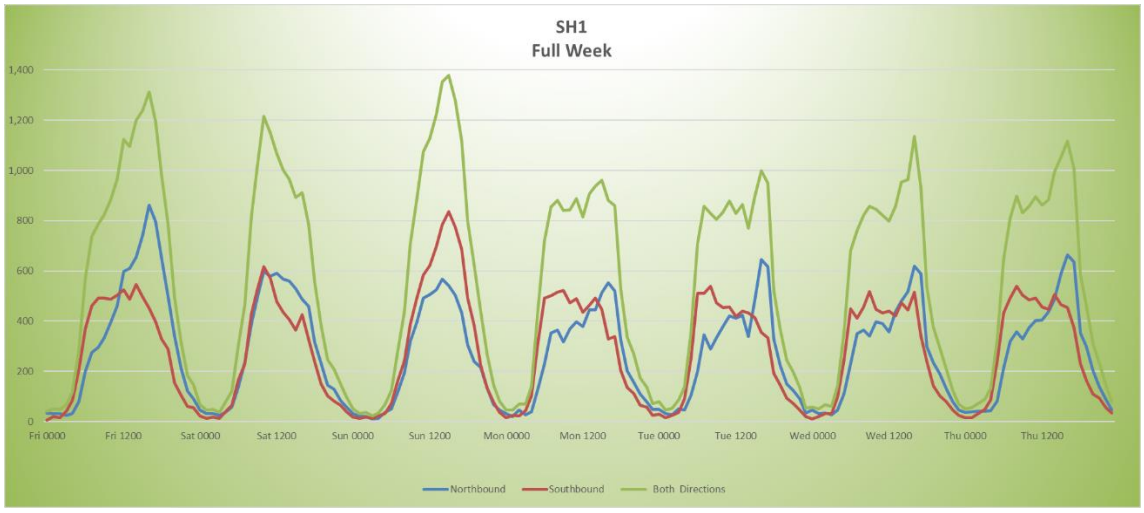

Figure 6-1: Tube Count Traffic Volumes

The busiest volumes on SH1 presently are northbound on Friday evening and southbound on Sunday afternoon. This represents that the busiest demands are during the periods when many travellers from Auckland leave the city heading towards weekend destinations in Northland and surrounds, and then return to the city after weekends and holidays. Volumes on the road over the course of any day are approximately 13,000 vehicles per day (**vpd**) with Friday experiencing the highest demand with approximately 15,500 vpd. While Sunday afternoon experiences the greatest individual peak hour demand with approximately 1,400 vehicles in an hour (**vph**), the demand is concentrated over a short time period.

The recorded daily traffic volumes from the August 2018 automatic traffic count are shown **table 6-1** below.

Table 6-1: Existing Daily Traffic Volumes – Tube Count (August 2018)

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	ADT
Daily Traffic Volume	12,720	12,501	12,774	13,389	15,450	12,632	13,590	13,294

The busiest peak hour for either individual direction occurred on Friday evening where 861 vph (northbound) were observed.

The typically accepted capacity of a single traffic lane unaffected by roadside parking or property access is over 1,500 vph (or between 15,000 - 20,000 vpd) and as such these volumes indicate that this part of SH1 is typically not congested within an ordinary operating. While there are some elements of the SH1 network through Warkworth and through the current Dome Valley as well as the variety of dynamic traffic operations such as slower vehicles in the traffic stream and the reduced capacity of the end point of the passing lanes, which constrains the amount of throughput possible on this part of SH1.

The combination of the committed NZTA projects including the Dome Valley safety improvements programme and the P2WW project will greatly assist in addressing these issues such that by the time of the construction and ultimate opening of the ARL facility, these issues will be at least mitigated is not entirely addressed. The effect of future growth and the baseline traffic environment at the time of constructing/opening ARL are assessed in a subsequent chapter.

C.1.2 NZTA Counts

NZTA's nearest regular traffic count site is located just north of the proposed ARL access location. Traffic volumes from this site have also been reviewed for the full five-year period from 2013 to 2017 to review historical traffic patterns. The count site is not a continuous count site and only records approximately 10 weeks of the year.

Table 6-2 below summarises the average daily traffic counts for each day of the week for the year 2017.

Table 6-2 Daily Traffic Volumes – NZTA Count

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	ADT
Daily Traffic Volume	12,575	12,362	12,418	13,233	16,008	13,325	14,160	13,440

The daily traffic volumes are broadly similar to the tube count observations. The NZTA counts show slightly higher demands during the weekend period suggesting that there were not as many holiday makers on the weekend the tubes were in place compared to other weekends throughout the year. The tube counts from August 2018 did record slightly higher volumes throughout the week, indicating that there is growth in background traffic in the vicinity of the proposed site access.

An additional NZTA count site[5] is located approximately 1.5km north of Wayby Valley Road and continuously records traffic volume data throughout the year. This site has been used to review the seasonal variation of traffic volumes.

The average daily traffic volumes for each month of the year based on counts from 2014 to 2018 are shown in **Figure 6-2** below.

[5] NZTA Count site reference 01N00347

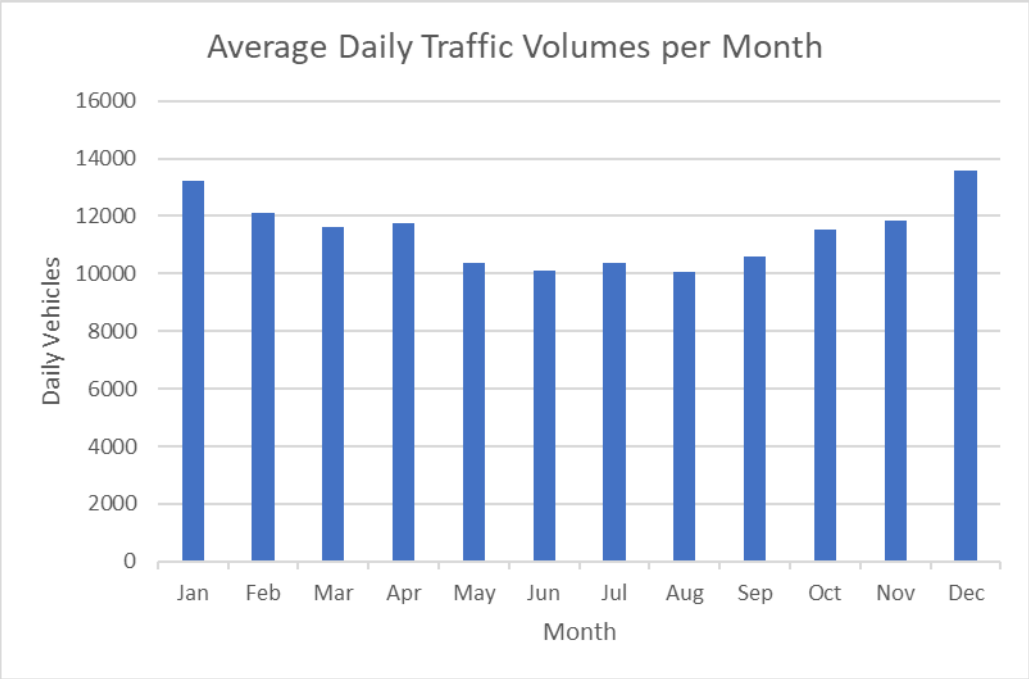

Figure 6-2: Average Daily Traffic Volumes per Month 2013 - 2018

As expected, the busiest times of the year are around the summer holiday periods in December and January. **Table 6-3** below shows the factor between the average daily traffic volumes for each month in comparison to the annual daily average.

Table 6-3: Factor for Daily Volumes per Month to Annual Average

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Factor to Average	1.16	1.06	1.02	1.03	0.91	0.89	0.91	0.88	0.93	1.01	1.04	1.19

The above table indicates that traffic volumes in December and January are 16% to 19% above the annual daily average. This pattern of traffic volumes along SH1 throughout the year are considered later in this assessment when considering the baseline of activity appropriate for consideration of the traffic effects of both the construction and operational phases when they commence.

C.1.3 Traffic Growth

The traffic volumes from the NZTA database have been used to determine background traffic growth on the section of SH1 south of Wayby Valley Road. Traffic volumes have been observed for all years between 2013 and 2017 inclusive with the annual growth for each day of the week calculated for each year. This growth pattern is summarised in **table 6-4** below.

Table 6-4: Average Annual Daily Traffic Volume Growth

Day	2013->2014	2014->2015	2015->2016	2016->2017	2013->2017
Mon	3%	7%	10%	3%	5%
Tue	2%	6%	12%	4%	5%
Wed	3%	5%	11%	3%	5%
Thu	1%	7%	9%	4%	4%
Fri	1%	5%	11%	2%	4%
Sat	7%	4%	14%	-1%	5%
Sun	3%	4%	14%	-2%	4%
Average	3%	5%	12%	2%	5%

Traffic growth along SH1 near the ARL site has been reasonably consistent over the past several years. The 2016 year experienced the greatest recent level of growth which was followed by very modest growth rates across the days of the week and some decreases in 2017. Overall, there has been an average of 5% growth of the most-recent five-year period.

By way of comparison, the traffic assessment completed for the Pūhoi -Warkworth motorway extension, completed in 2013 and reviewed traffic data between 2008 and 2012, adopted a background traffic growth rate of 4.4% for the section of SH1 south of Warkworth. It would be expected that the rates of traffic growth would be greater for locations closer to the centre of the Auckland area as more traffic would likely be heading to or from the south where there is a greater employment and population base.

C.1.4 Vehicle Speeds

As part of this assessment, a speed survey of SH1 using a speed radar gun was commissioned and undertaken just south of the proposed access to the site. The survey recorded the "free speed" (or the speed of vehicles not within a platoon of other traffic) of at least 100 vehicles in each direction. All observed vehicle speeds were between 60 and 100km/h with a maximum observation of 99km/h.

The survey results are summarised in **Table 6-4** with a distribution provided in **Table 6-5.**

Table 6-5: Speed Survey Results Summary

Direction	Observations	Average Speed (km/h)	85th Percentile Speed (km/h)
Northbound	100	82	87
Southbound	115	78	85

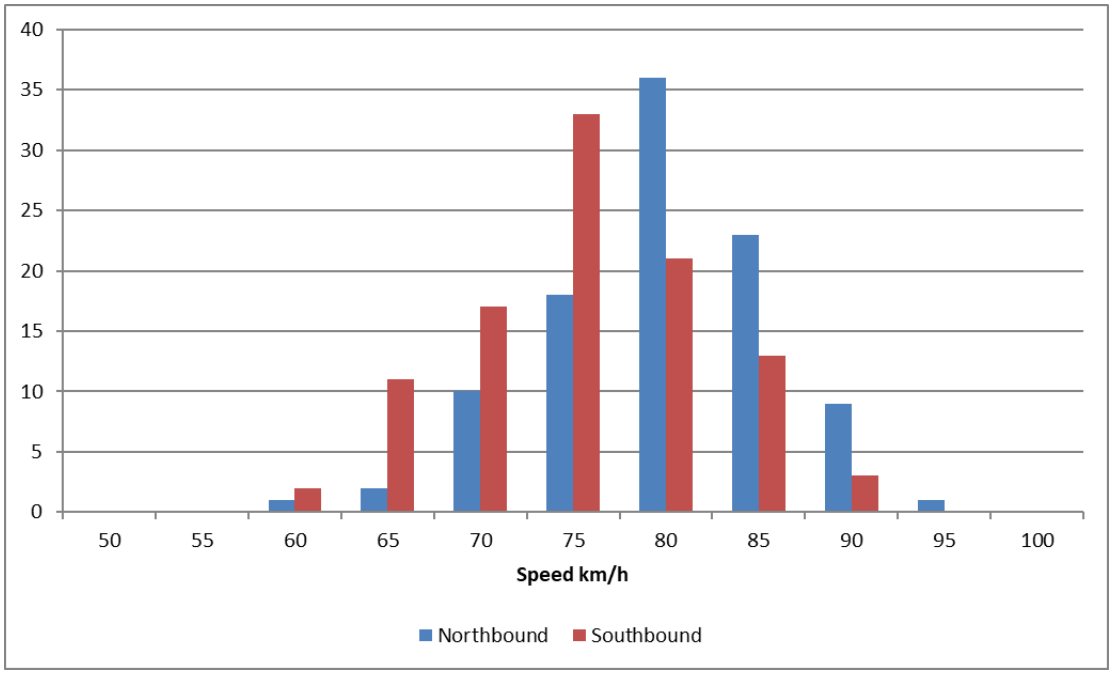

Figure 6-3: Speed Survey Distribution

The speed survey results demonstrate that, on average, both traffic directions operate at about the posted speed limit. The 85th percentile speed (or the speed exceeded by the fastest 15% of the traffic stream) is below 90km/h for both directions.

In addition to the direct free speed surveys undertaken close to the proposed site access, speeds were also obtained from the automatic traffic counts surveys undertaken and reported previously. These surveys measured the speeds of all traffic passing the survey locations not just the lead vehicles in a platoon of traffic.

Figure 6-4 below illustrate the speeds observed by the automatic traffic and speed counts while **Figure 6-5** summarises the observed speeds.

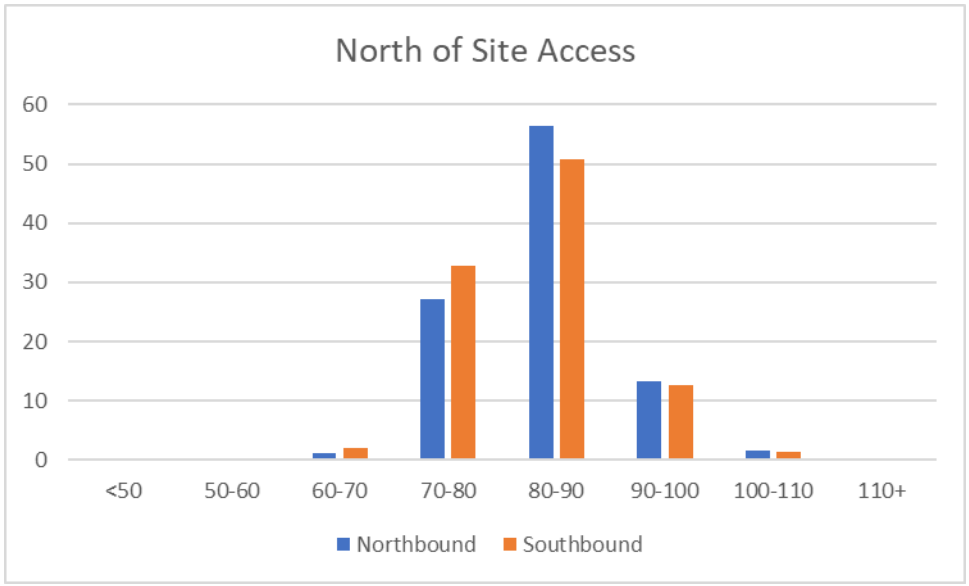

Figure 6-4: Vehicle Speeds North of Proposed Access Location

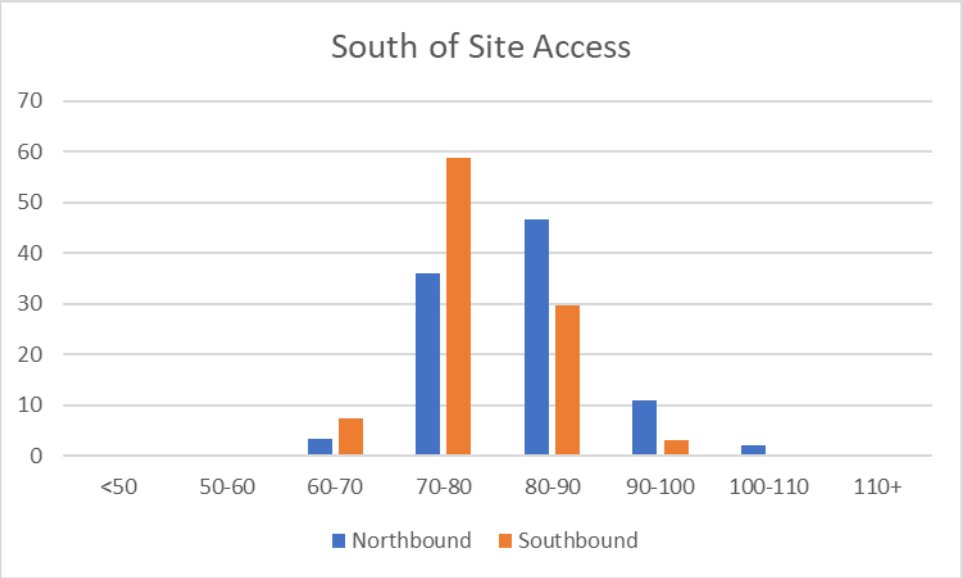

Figure 6-5: Vehicle Speeds South of Proposed Access Location

Table 6-6: Speed Survey Results Summary

Direction	Location	Observations	Average Speed (km/h)	85th Percentile Speed (km/h)
Northbound	North of Site Access	45,523	83.7	90.1
	South of Site Access	46,197	82.2	89.3
Southbound	North of Site Access	46,023	82.9	89.7
	South of Site Access	46,859	77.9	83.8

The speed distribution of the tube counts is similar to the free speeds recorded using the radar gun surveys. Speeds along the current SH1 alignment were generally found to be slower south of the access, particularly for the southbound direction, which can be attributed to the horizontal curve approximately 300m south of the proposed access location.

These factors and patterns of current road user behaviour have informed the NZTA's safety improvement improvements which are soon to be constructed, and upon which the assessment of the ARL's construction and operational traffic effects will be based.

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