



Whenuapai Redhills: Package 1 Project

Traffic Impact Assessment Report

Prepared for Watercare Services Ltd
Prepared by Beca Limited

12 September 2022



Contents

1 Introduction 1

1.1 Background and Purpose 1

1.2 Report Structure 1

1.3 Project Description..... 1

2 Existing Transport Network..... 3

2.1 Surrounding Land Uses 3

2.2 Surrounding Road Network 3

2.3 Existing Site Traffic Generation 6

2.4 Crash History 7

2.5 Pedestrian and Cycle Facilities 7

2.6 Public Transport..... 8

2.7 Freight Routes 8

3 Proposed Site Activity..... 9

3.1 Construction Phase 11

3.2 Construction Traffic Generation..... 13

3.3 Operational Phase Traffic Generation 15

3.4 Operational Phase Access Arrangement 15

4 Assessment of Transport Effects 17

4.1 Construction Phase – Visibility 17

4.2 Construction Phase – Vehicle Tracking..... 20

4.3 Construction Phase – Road Capacity..... 26

4.4 Construction Phase – Other Impacts..... 30

4.5 Operational Phase 31

5 Construction Traffic Management Plan..... 32

6 Summary and Conclusion 34

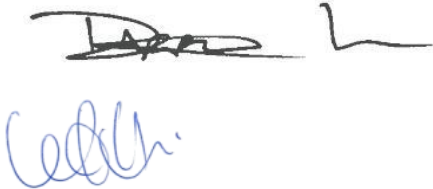
Appendices

- APPENDIX A – Crash Data Map
- APPENDIX B – SIDRA Results for One-lane Two-way Operation
- APPENDIX C – Vehicle Tracking

Revision History

Revision N°	Prepared By	Description	Date
0.1	Ben McKibbin	Draft for client	25/03/2022
0.2	Ben McKibbin	Client comments	12/09/2022

Document Acceptance

Action	Name	Signed	Date
Prepared by	Ben McKibbin		12/09/2022
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on behalf of	Beca Limited		

1 Introduction

1.1 Background and Purpose

Watercare proposes to construct a new wastewater pump station and pipeline to service Whenuapai and to accommodate the anticipated future growth in the Whenuapai area. The project will construct a new pump station, rising main and gravity main pipeline (**Package 1**).

This Traffic Impact Assessment (TIA) report has been prepared by Beca Ltd (Beca) on behalf of Watercare Services to support the Resource Consent Application (RCA). The purpose of this report is to provide a traffic assessment focusing on the traffic impact from the work sites on the surrounding road network during the construction phase and the impact of the maintenance access during the operational phase. The road capacities and safety at the site accesses including visibility and vehicle tracking are assessed. The assessment also includes the potential traffic impact to the existing road users, residents, and businesses. Moreover, this report provides recommended mitigation, minimisation and management measures for the construction traffic impacts, which can be adopted in a Construction Traffic Management Plan (CTMP).

1.2 Report Structure

- Section 1 – Describes the background information and purpose of the project
- Section 2 – Presents the existing transport network surrounding the construction and operation area
- Section 3 – Describes the proposed site activities
- Section 4 – Presents the assessment of the transport effects of the proposed activity
- Section 5 – Provides recommendations for the Construction Traffic Management Plan
- Section 6 – Provides the summary and conclusion of the report

1.3 Project Description

The Whenuapai Redhills: Package 1 Project (the Project) aims to provide wastewater servicing capacity for approximately 10,240 dwellings, or 30,720 people, in the Whenuapai catchment. This growth is projected to occur by 2041. The Project includes the following five key components (see Figure 1-1):

1. A **Pump Station** at a point where the Whenuapai and Redhills Catchments meet at 23-27 Brigham Creek Road, with an emergency overflow outfall to Sinton Stream
2. A **Gravity Main Pipeline** (approximately 700m long and 375 – 475 mm in diameter) between Whenuapai Village Pump Station on Tamiro Road and the new pump station
3. A **Rising Main** (approximately 1.4km long and 500 mm in diameter) between the Pump Station and a proposed new break pressure chamber on Mamari Road (the boundary of Package 2)¹.
4. A **Culvert** (approximately 63m long including wing wall and rip rap) to provide access for the rising main across Sinton Stream.
5. A **Break Pressure Chamber** which connects to the Massey Connector rising main (proposed under Package 2).

¹ An extension of the rising main is part of 'Package 2' and will be designed to connect to the planned Northern Interceptor Phase 2 tunnel and deliver flows from the Whenuapai Catchment to the Rosedale Wastewater Treatment Plant for treatment. Package 2 is subject to a separate consent application.

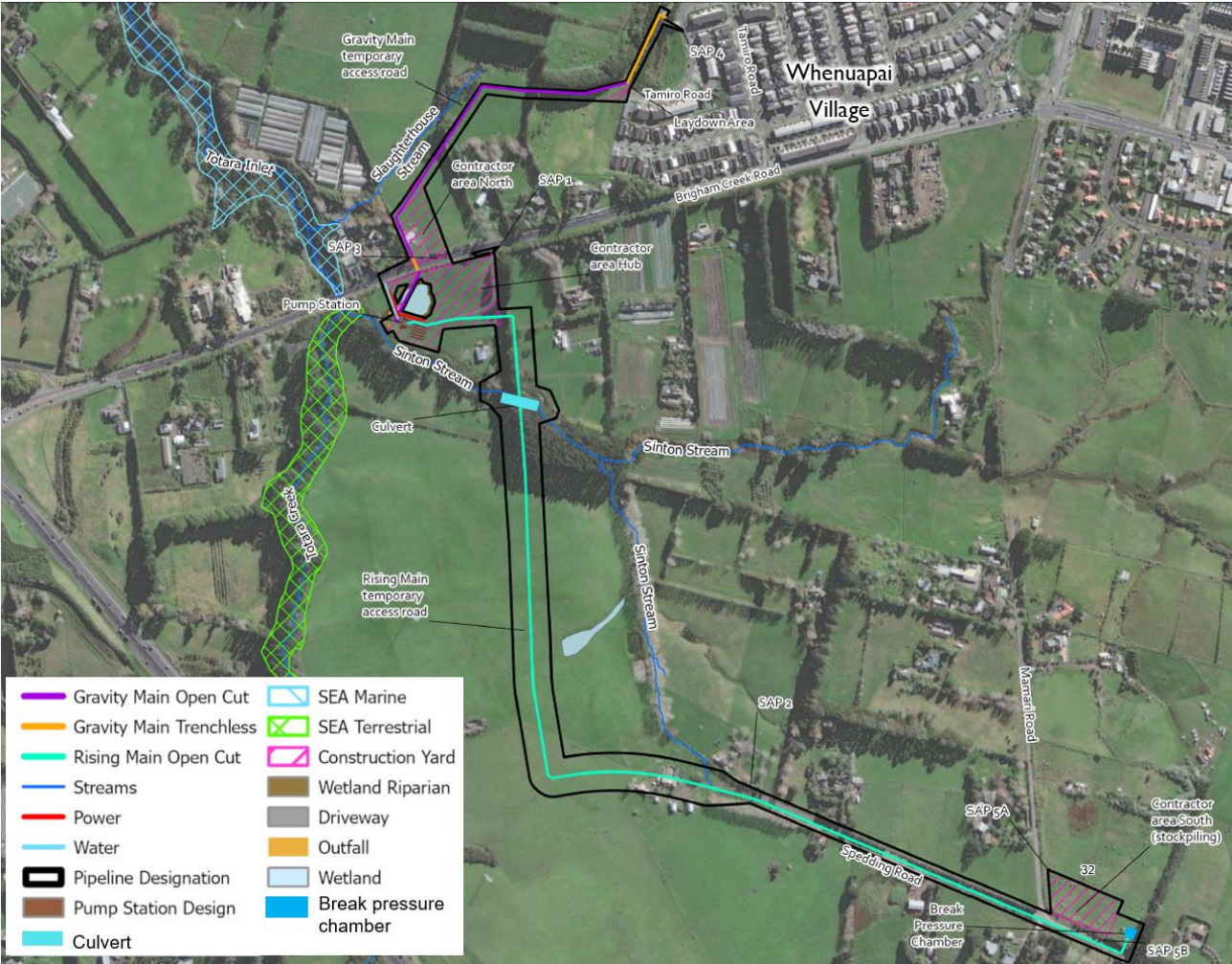


Figure 1-1: Proposed Works

The Project extends from the existing Whenuapai Village pump station site in Tamiro Road in the north, across Brigham Creek Road, to Spedding Road in the south.

Proposed Site Access Point locations and Contractor Areas are Discussed further in Section 3.

2 Existing Transport Network

2.1 Surrounding Land Uses

Land surrounding the project is zoned Future Urban Zone, Residential – Mixed Housing Urban Zone and Town Centre in the Auckland Unitary Plan (Operative in Part) (AUP:OP) (see Figure 2-1: Land Use Zoning Surrounding Site Access Points and Contractor Area Hubs)

Along Brigham Creek Road, to the east of the project area is Whenuapai Town Centre and an existing residential area. Whenuapai School and Whenuapai Kindergarten are located on Airport Road, and there is also Timatanga Community School along Mamari Road.

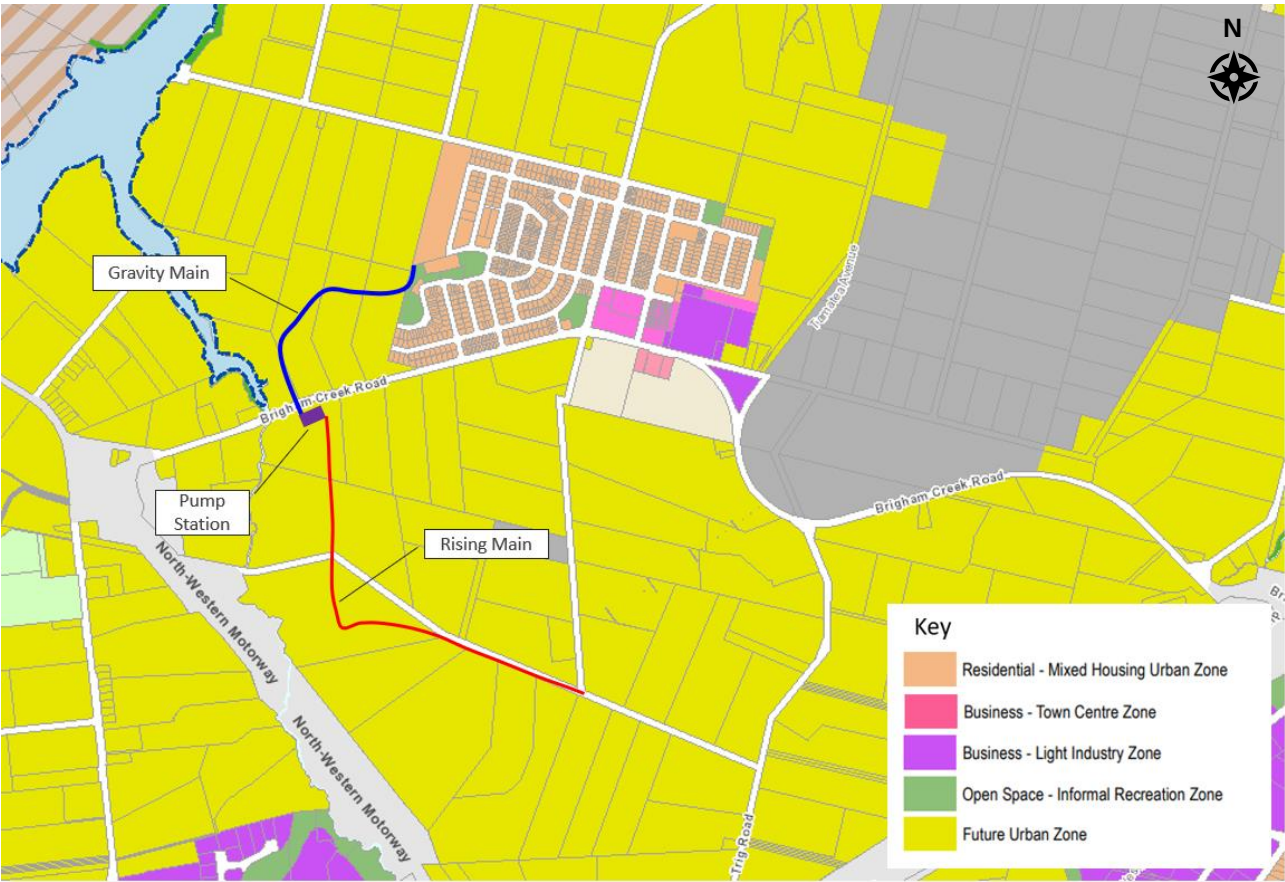


Figure 2-1: Land Use Zoning Surrounding Site Access Points and Contractor Area Hubs

2.2 Surrounding Road Network

A site visit was undertaken on Wednesday 9th February 2022 during 7am - 9am and 2pm - 5pm to understand the traffic conditions of the road network surrounding the site.

It should be noted that the Covid-19 Alert Level for Auckland at the time of the site visit was at Red Light setting (for the Auckland region) from Sunday 23rd January 2022. It is expected that the traffic volumes have increased since the lockdown period in 2021 (from August to November 2021) but are still expected to be lower than a pre-covid period by comparing the traffic data. The site visit focused on checking traffic patterns, traffic volumes, queuing, road layout, road width measurements and sightline checks.

Figure 2-2: Key Roads around the Site for Construction Vehicle Movements highlights the surrounding road network that will be used by vehicles to access the sites.

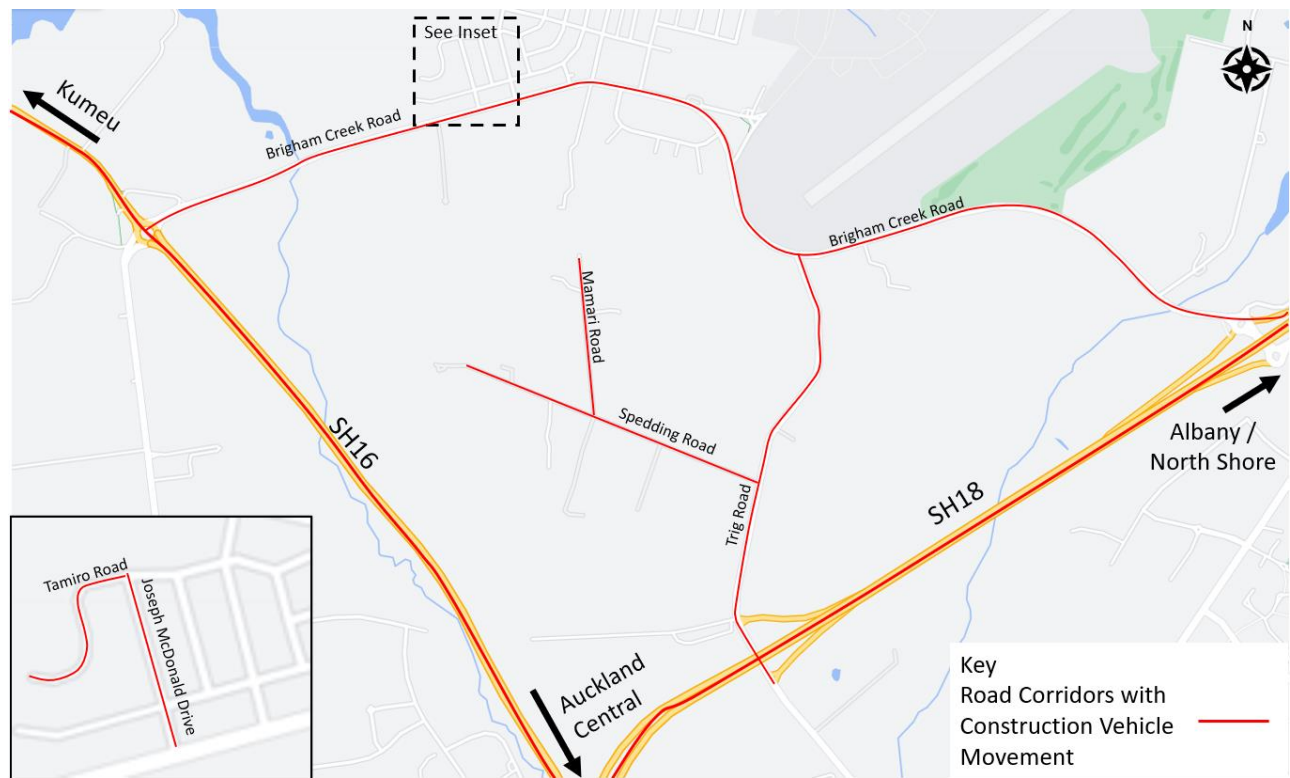


Figure 2-2: Key Roads around the Site for Construction Vehicle Movements

Table 2-1: Features of the Surrounding Roads shows the key features of each of the roads surrounding the site. The annual average daily traffic (AADT) and peak hour traffic volumes in both directions are based on information available on the traffic counts conducted by Auckland Transport (AT). The Sydney Coordinated Adaptive Traffic Systems (SCATS) traffic count data from the signalised intersection was also obtained and compared with the AT traffic counts for pre-covid period. It was found that the pre-covid traffic data is higher, therefore the AT traffic counts were adopted for assessment as a conservative approach. Traffic data is not available for Tamiro Road and Joseph McDonald Drive as these are newly built roads. From the site observation, these three roads should be access roads serving the residents and should not have more than 50 veh/hr. The road classification is retrieved from the One Network Road Classification (ONRC).

Table 2-1: Features of the Surrounding Roads

Road Name	Road Classification	No. of Lanes	Speed Limit (km/h)	AADT (5 days)	2-way Peak Flows (vehicles/hr)	HCV %	Year of Data
Brigham Creek Road	Arterial	2	50/80	12,000	1,200	4%	2018
Trig Road	Arterial	2	80	4,200	600	8%	2018
Spedding Road	Primary Collector	Undivided	80	300	40	6%	2018
Mamari Road	Low Volume	Undivided	80	100	30	4%	2020
Tamiro Road	Not Classified	2	50	N/A	N/A	N/A	N/A
Joseph McDonald Drive	Not Classified	2	50	N/A	N/A	N/A	N/A

2.2.1 Brigham Creek Road

Brigham Creek Road is classified as an arterial road connecting Whenuapai to SH16 and SH18 with broader access to Auckland Central and the North Shore. Brigham Creek Road also connects to Hobsonville Road providing access to Hobsonville and to Fred Taylor Drive providing access to Westgate shopping area. Brigham Creek Road serves Whenuapai town centre and the residential area surrounding the town centre. It also serves as a connection to people travelling between SH16 from the north and SH18 from the east as there is no motorway to motorway connection for this.

A steady flow of traffic along Brigham Creek Road for both directions was observed in the AM peak and in the eastbound direction in the PM peak. A long queue was observed in the westbound direction from the roundabout with SH16 back to Joseph McDonald Drive during the PM peak, i.e. 16:30 – 17:30. The long queue of vehicles wanting to turn right from Brigham Creek Road onto SH16 is due to high traffic volume on SH16 northbound in the PM peak. There is merging from 2 lanes to 1 lane on the northern exit arm of the roundabout which is insufficient to cater for the demand. Therefore, traffic from Brigham Creek Road westbound approach is not able to travel through the roundabout resulting in long queues during the PM peak.

Heavy vehicles heading to and from the residential area through the signalised intersection were also observed, those vehicles are related to the new development at the northern part of the residential area. There was also a higher flow of traffic around Whenuapai School before and after school hours related to pick-up and drop-off activities. Pick-up and drop-off vehicles mainly parked on Airport Road fronting the school and inside the lane owned by the Air Force which permits parking between 08:15 – 09:15 and 14:30 – 15:30. The school traffic is fairly contained in the area fronting the school, i.e. Airport Road, Tamatea Avenue and the Air Force’s land, with minimal impact on the traffic on Brigham Creek Road.

There is a steep downhill grade from the residential area past SAP 1 and SAP 3 to SH16 roundabout and it was observed that the westbound traffic was travelling fast. There is a crest near the 80/50 speed limit sign which is around 200m to the west of Joseph McDonald Drive, the crest impedes the sightline to the surrounding property driveways.

The speed limit along Brigham Creek Road is currently 80km/h in areas where there are few properties and 50km/h near the residential development and town centre. It is noted that, under AT’s Proposed Speed Limit Changes – Phase Three, the speed limits on several roads in Whenuapai area are proposed to be reduced as shown in **Figure 2-3**. The section of Brigham Creek Road currently with a speed limit of 80km/h is proposed to reduce to 60km/h. Consultation is currently in progress for getting the feedback on the proposed speed limit changes. If approved, the changes will come into force in November/ December 2022.

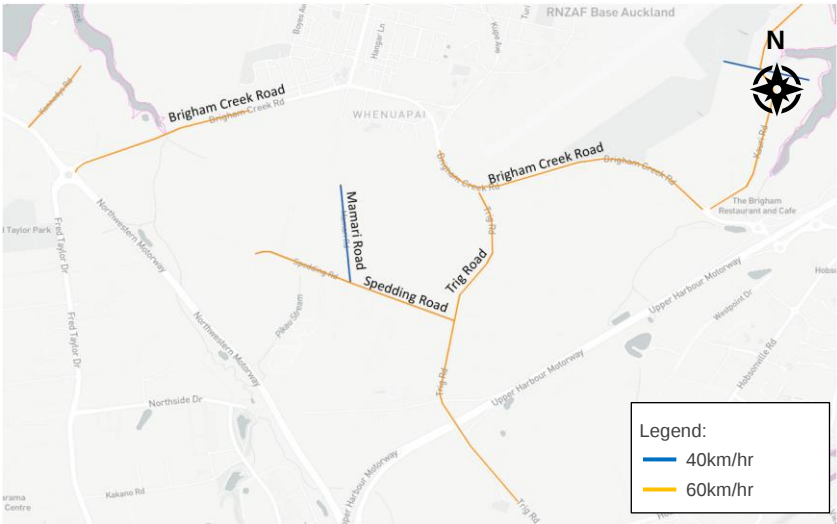


Figure 2-3: AT’s Proposed Speed Limit Changes around Whenuapai

2.2.2 Trig Road

Trig Road is classified as an arterial road and provides an additional connection between Whenuapai and SH18, providing access towards the North Shore. Trig Road also connects Whenuapai to West Harbour and Hobsonville. We observed a steady flow of vehicles along Trig Road with a small volume of heavy commercial vehicles. The speed limit along Trig Road is 80km/h currently, AT is proposing to change the speed limit to 60km/h (as shown in **Figure 2-3**).

2.2.3 Spedding Road

Spedding Road is classified as a primary collector between Mamari Road and Trig Road and a low volume road west of Mamari Road. Spedding Road is sealed up to Mamari Road and then turns into an unsealed road for its western section. We observed very little traffic along Spedding Road. We observed some heavy vehicle movements along the sealed section of Spedding Road. The speed limit along Spedding Road is 80km/h currently, AT is proposing to change the speed limit to 60km/h (as shown in **Figure 2-3**).

Spedding Road is an undivided road with various road widths. The widths were measured from edge to edge of the unsealed surface during the site visit and are summarised in Table 2-2: Measured Road Widths on Spedding Road.

Table 2-2: Measured Road Widths on Spedding Road

Section	Measured Road Width
Between Trig Road and Mamari Road	5.5m
Between Mamari Road and driveway of 12 Spedding Road	4.8m
Between driveway of 12 Spedding Road and western end	3.6m

2.2.4 Mamari Road

Mamari Road is classified as a low volume road. The section of Mamari Road north of Spedding Road is a gravel road. We observed very low traffic volumes along Mamari Road. Timatanga Community School is located at the northern end of the road, it was observed that the scale of the school is relatively smaller compared to Whenuapai School. The cars associated with the school are less than 10 vehicles before and after school hours.

It is an undivided road with measured road width of 5m near the intersection with Spedding Road. The speed limit along Mamari Road is 80km/h currently, AT is proposing to change the speed limit to 40km/h (as shown in **Figure 2-3**).

2.2.5 Tamiro Road

Tamiro Road currently has no classification due to the recent completion of the road. There is now residential development along the road. Our site visit observed low traffic volumes.

2.2.6 Joseph McDonald Drive

Joseph McDonald Drive currently has no classification due to the recent completion of the road. There is now residential development along the road. Our site visit observed low traffic volumes.

2.3 Existing Site Traffic Generation

During our site visit, no vehicle movements were observed from the properties that are proposed work sites. This was expected as these sites have not been developed and are currently paddocks.

2.4 Crash History

The crash history was obtained from Waka Kotahi New Zealand Transport Agency’s (NZTA) Crash Analysis System (CAS) for five years, from 2017 to 2021 (inclusive). The crash history includes all the relevant roads and intersections the site is on and around, as shown in Figure 2-2: Key Roads around the Site for Construction Vehicle Movements.

The number of crashes and their severity have been summarised in Table 2-3: Crashes in the area between 2017-2021.

Table 2-3: Crashes in the area between 2017-2021

Severity	2017	2018	2019	2020	2021	Total
Fatal	1	0	0	0	2	3
Serious	0	0	1	0	0	1
Minor	8	4	5	1	9	27
Non-Injury	13	8	12	14	7	54
Total	22	12	18	15	18	85

The crash history showed there were a total of 85 crashes between 2017 and 2021. The crashes included three fatal crashes, one serious crash, 27 minor crashes, and 54 non-injury crashes. These crashes occurred on Brigham Creek Road, Trig Road and Spedding Road as shown in **Appendix A**. There were no crashes along Mamari Road, Tamiro Road and Joseph McDonald Drive.

The details of fatal and serious crashes are presented below:

- The 2017 fatal crash was a head on crash along a straight section of Brigham Creek Road. The crash was between a car and truck outside 28 Brigham Creek Road. This crash was due to the car driver crossing the centre line. The driver of the car had drugs in their system which may have resulted in an impairment in their ability to drive safely.
- The 2019 serious crash was a vehicle that clipped a pedestrian who was on the carriageway engaged in conversation with a truck driver on Spedding Road. The crash occurred at the intersection of Trig Road and Spedding Road.
- The first 2021 fatal crash was along a straight section of Brigham Creek Road. This crash was between a car and a truck outside 18 Brigham Creek Road. The crash occurred when the truck hit the car on the driver’s side while the car was undertaking a U-turn. The crash was due to the driver of the car not checking for traffic before conducting the U-turn manoeuvre.
- The second 2021 fatal crash was a side on crash with a vehicle making a turn into a driveway from Trig Road. The crash occurred between a car and a motorcycle as the car entered a driveway. The crash occurred outside 86/88 Trig Road. Speed was a contributing factor to this crash.

The majority of crashes in the area involved two vehicles and the movements were generally turning movements, stopped or slowing down for a queue or overtaking movements. The majority of these resulted in non-injury and minor crash outcomes.

2.5 Pedestrian and Cycle Facilities

There are cycling facilities along Brigham Creek Road in the residential area and town centre, further east towards Trig Road and towards the west connecting Brigham Creek Road to SH16. This is in the form of a single cycleway on the northern side of the road through the residential area and town centre and a shared path on the section of Brigham Creek Road near Trig Road and the section between Brigham Creek Road and SH16. Brigham Creek Road is also part of the current and 10-year strategic cycle network as a major route as part of Future Connect.

There are pedestrian facilities along Brigham Creek Road from the residential area to the roundabout on ramp and off ramps for SH18, Tamiro Road and Joseph McDonald Drive. The majority of Brigham Creek Road west of the residential area does not have any pedestrian facilities. Along Joseph McDonald Drive there are pedestrian facilities on both sides of the road. Tamiro Road has facilities on one side of the road.

2.6 Public Transport

Based on the current bus network for West Auckland (implemented in March 2017) there is one route that runs around the Whenuapai area. This service is the 114 that runs between Hobsonville and Westgate through the Whenuapai area. This bus route runs along a section of Brigham Creek Road through the town centre and Trig Road. The frequency of buses along this route is at least every 60 minutes 7 days a week with lower frequencies early in the morning and in the evening.

2.7 Freight Routes

Based on AT’s Future Connect Mapping Portal only Brigham Creek Road is on the strategic freight network as a Level 1B route. Both Brigham Creek Road and Trig Road are classed as overweight routes. The AT Future Connect freight network for both the current and first decade timeframe in the surrounding area of the site is shown in **Figure 2-4**.

There are no major facilities, apart from freight vehicles towards to the Air Force Base, in the area for freight thus we do not expect any notable freight movements taking place in the area.

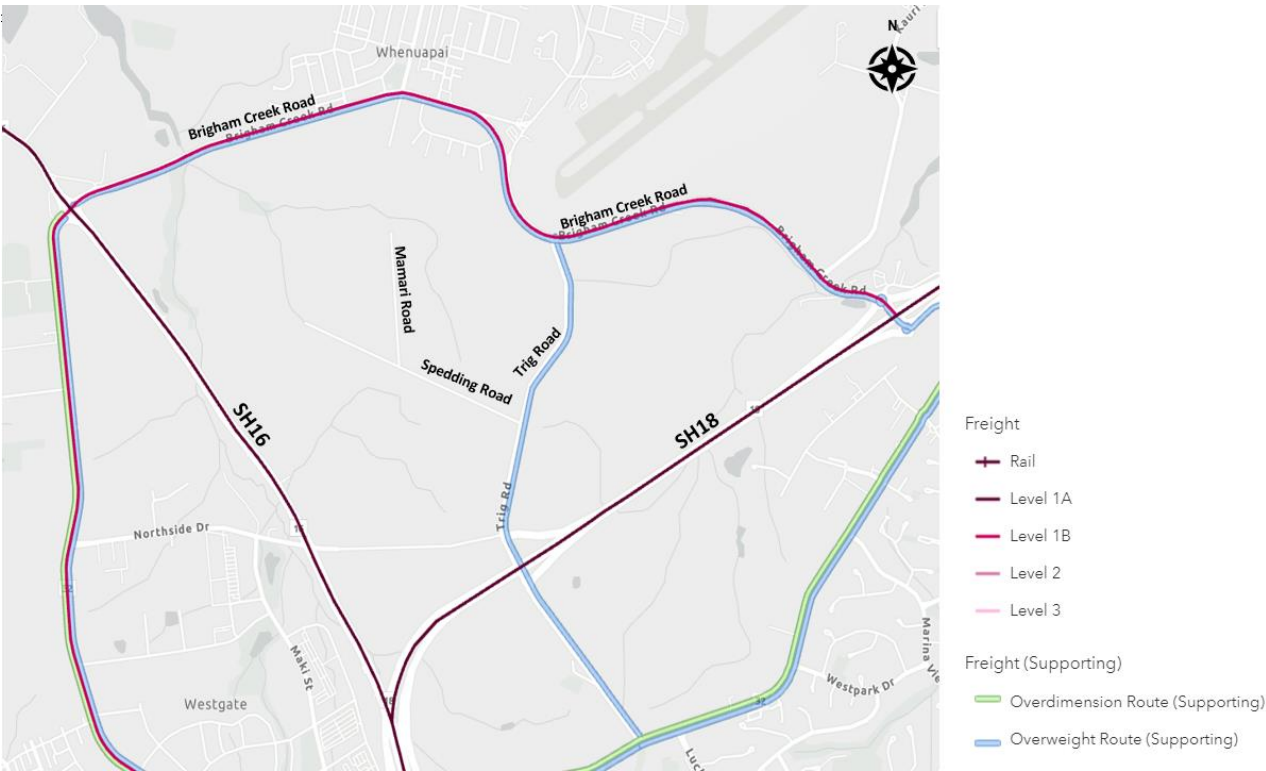


Figure 2-4: Current and First Decade Freight Network

3 Proposed Site Activity

Three large contractor areas are proposed on Brigham Creek Road and Spedding Road. A total of six Site Access Points (SAP) leading to the work sites. The locations of SAPs and contractor areas are shown in Figure 3-1: Contractor Areas and SAPs.



Figure 3-1: Contractor Areas and SAPs

Contractor Areas

A description of the five potential contractor areas is provided below.

- **Contractor Area Hub (Figure 3-2)** – Located at 23-27 Brigham Creek Road, including site office, workshop facilities, light vehicle parking, spoil stockpiling area and materials storage yard space



- Figure 3-3: Contractor Area North Layout

- **Contractor Area South (Figure 3-4)** – Located on the corner of Spedding Road and Mamari Road, including stockpiling area, materials storage, light vehicle parking and amenities

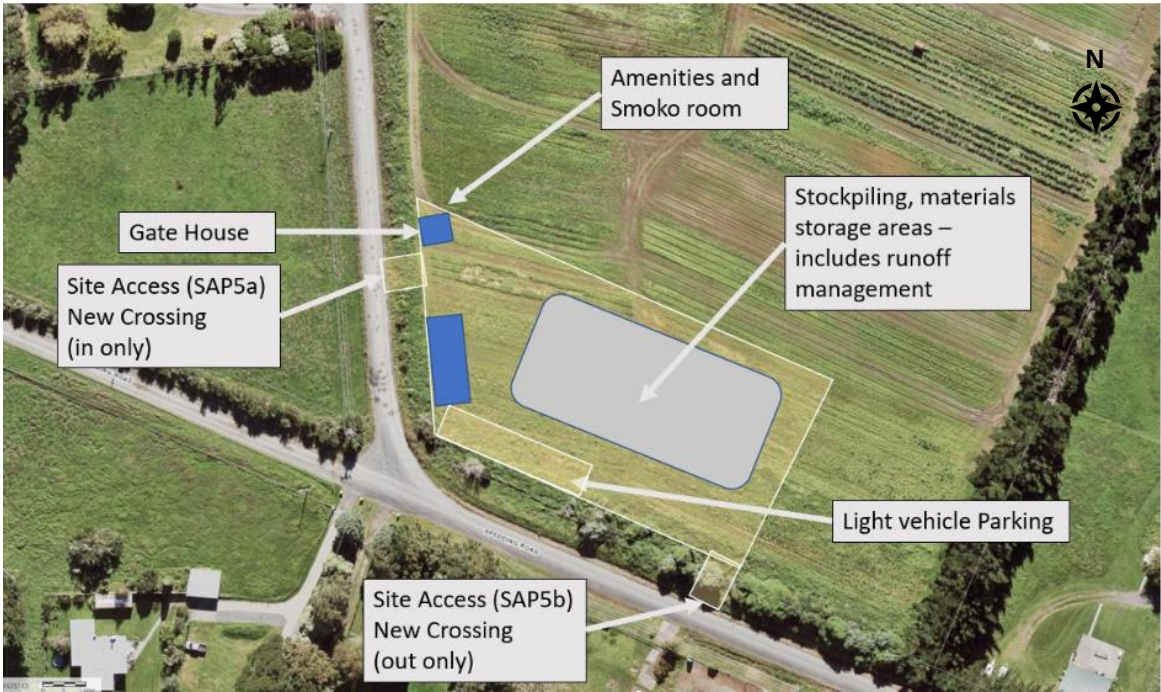


Figure 3-4: Contractor Area South Layout

SAPs

A description of the location of each SAP is provided below.

- **SAP 1** – Site access point to the Contractor Area Hub, which is located at 23-27 Brigham Creek Road
- **SAP 2** – Site access point to rising main, which is located at 13 Spedding Road
- **SAP 3** – Site access point to Contractor Area North, which is located at 20 Brigham Creek Road.
- **SAP 4** – Site access point to gravity pipeline, which is opposite to 30 Joseph McDonald Drive and 2 Tamiro Road.
- **SAP 5A** – Site ingress (inbound movement only) to Contractor Area South, which is located at 32 Mamari Road fronting Mamari Road
- **SAP 5B** – Site egress (outbound movement only) to Contractor Area South, which is located at 32 Mamari Road fronting Spedding Road

3.1 Construction Phase

The project consists of the following three phases:

- Pump Station construction
- Rising Main pipeline construction
- Gravity Main pipeline construction

3.1.1 Pump Station

The proposed Slaughterhouse Pump Station site is in a greenfield area adjacent to Brigham Creek Road. The pump station site is situated between the Sinton Stream to the southwest and a wetland area to the north.

The key construction activities include excavating a deep inlet, concrete pouring, excavating tank excavation and backfill around tanks.

3.1.2 Rising Main

The alignment of rising main is shown in **Figure 3-5**. There construction method of the rising main will be open trenching.

The key construction activities for this pipeline include bulk earthworks, installation of the temporary road bed, pipeline installation, removal of the temporary road bed and remediating the stockpile.

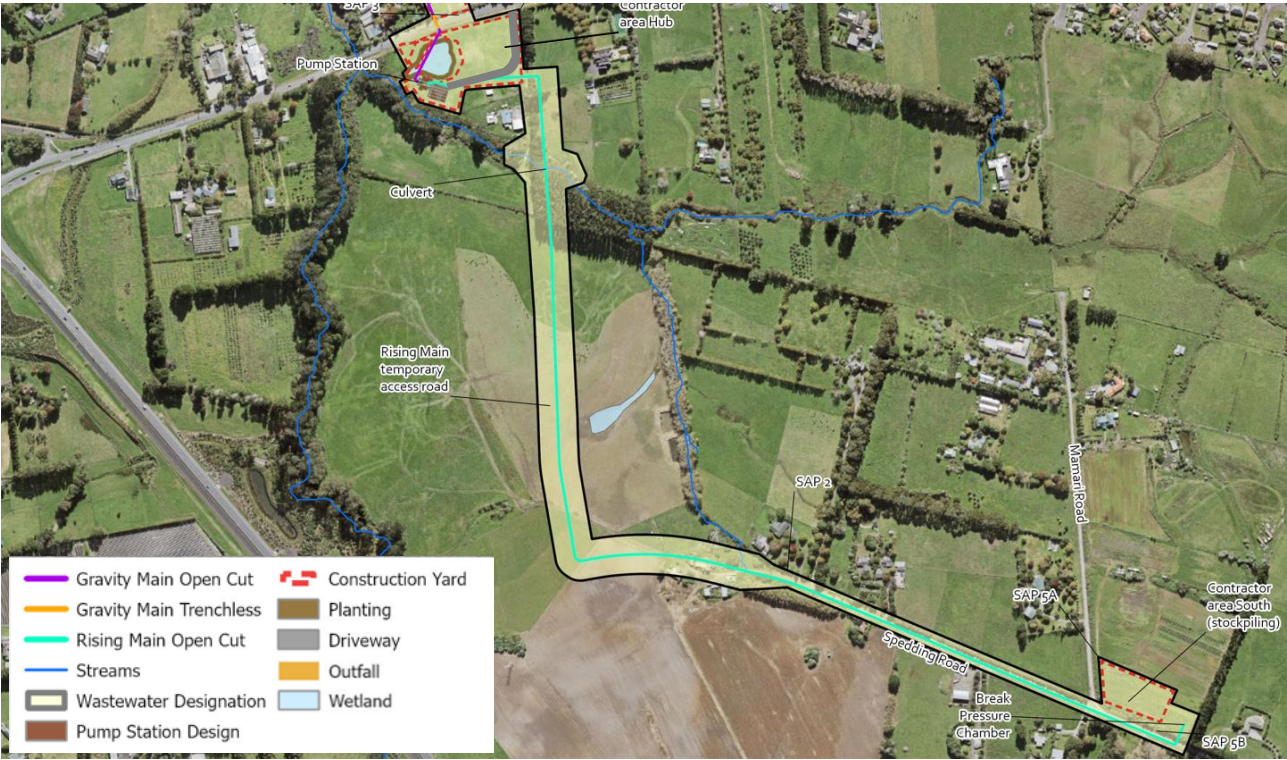


Figure 3-5: Rising Main Alignment

3.1.3 Gravity Main

The gravity main will require a construction access road along the full alignment. The topography of the gravity main alignment is generally much flatter than the rising main alignment, which means that the volume of earthworks required for the temporary access will be significantly less than that required for the rising main. The alignment of rising main is shown in **Figure 3-6**.

The key construction activities include topsoil strip to stockpile, installing temporary road bed, installing drive pits, excavating and installing pipeline, removing the temporary access road and remediating the stockpile.

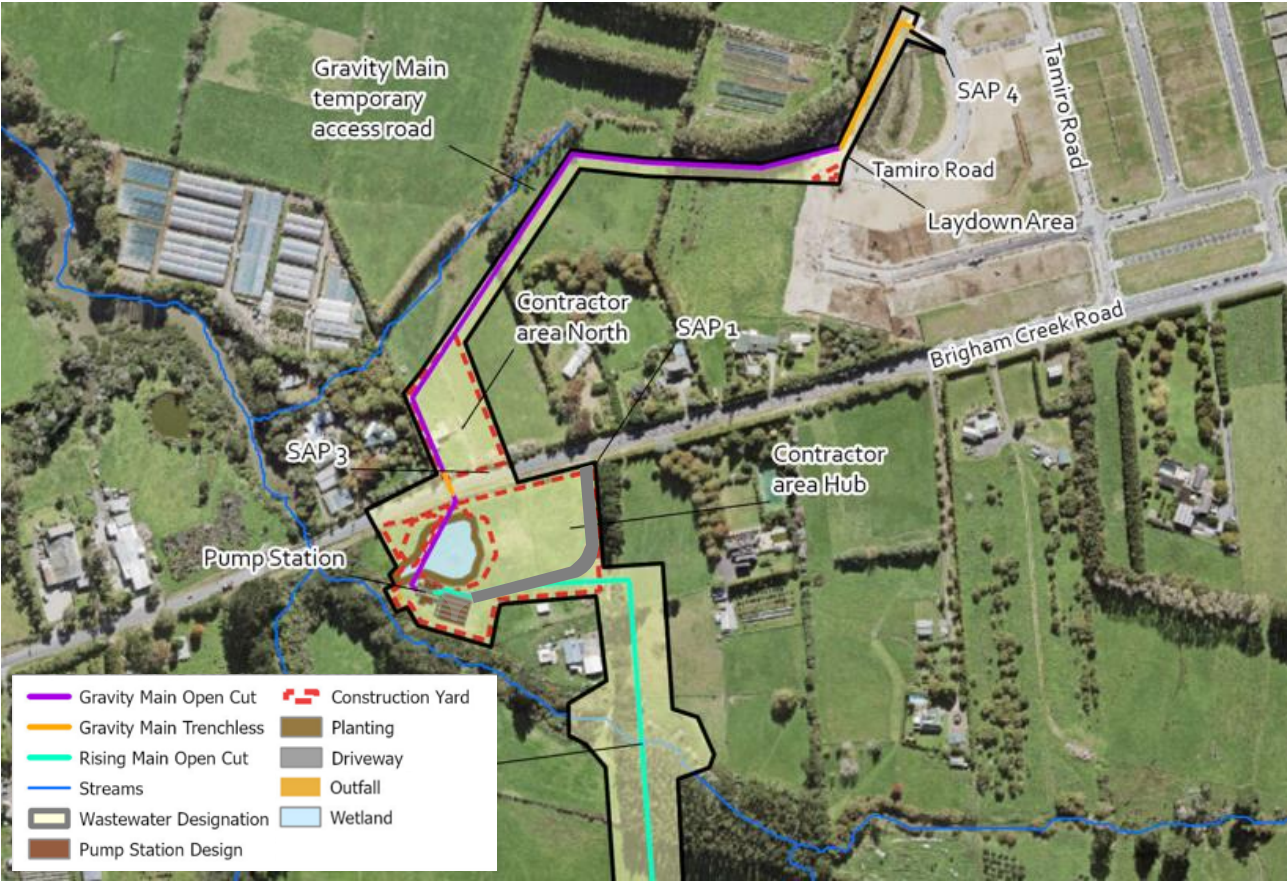


Figure 3-6: Gravity Main Alignment

3.1.4 Brigham Creek Road Crossing

There are two methods to construct the gravity main pipe across Brigham Creek Road:

- **Trenchless Option (Preferred)** - This is the preferred option; however, the ground conditions do present some risk as fibrous organics and wood were identified in the geotechnical borehole logs. This method will not affect the traffic flow on Brigham Creek Road.
- **Open Trenching Option** – This option will only be used if the trenchless option failed due to poor ground conditions or underground obstructions. Where the pipe needed to be opencut through Brigham Creek Road the work will be proposed to be completed in half of the road at a time. Therefore, 1-lane 2-way operation on a section of Brigham Creek Road will be required.

3.2 Construction Traffic Generation

The origins and destinations of the trucks generated from the each of the key construction activities as well as the associated truck types and sizes are summarised in **Table 3-1**. It should be noted that the vehicle lengths are based on the standards stated in AT’s Transport Design Manual (TDM).

Table 3-1: Truck Origins/ Destinations, Type and Sizes

Construction Activity	Truck Origin / Destination	Truck Type	Truck Size
Aggregate supply	Winstone Hunua Quarry - Drury	Truck and trailer	23m
	Atlas Recycled Concrete - Albany or Kumeu		
Concrete supply	Firth - Albany	Concrete truck	10m
Cleanfill disposal	Kumeu	Truck and trailer	23m
Large machinery delivery	Fletchers Plant Yard - Drury	Semi-trailer	19.5m

According to the construction methodology advised by the contractor, some SAPs are operating in 1-way direction (either in or out) whereas the others are in 2-way. All SAPs will allow for access by construction trucks except that SAP 4 is to be used by staff vehicles (i.e. cars and vans) only. The details of each of the SAPs are presented in **Table 3-2**.

Table 3-2: Details of SAPs

SAP	1-way / 2-way	Vehicle Type
SAP 1	2-way	Trucks and staff vehicles
SAP 2	1-way (Out)	Trucks and staff vehicles
SAP 3	2-way	Trucks and staff vehicles
SAP 4	2-way	Staff vehicles only
SAP 5A	1-way (In)	Trucks and staff vehicles
SAP 5B	1-way (Out)	Trucks and staff vehicles

The key construction activities that will generate the high number of trucks include excavation (spoil disposal), aggregate import, concrete pouring and backfill. With reference to the indicative construction programme, most of these key activities will take place during May - November 2023 as presented in **Table 3-3**.

Table 3-3: Construction Activities and Associated Construction Periods

Location	Construction Activity	Construction Period	
		Start	End
Rising Main Construction	Excavation	8 May 2023	4 Jul 2023
	Aggregates Import	29 May 2023	20 Jul 2023
Pump Station Construction	Excavation	26 May 2023	4 Aug 2023
	Concrete pouring	7 Aug 2023	1 Sep 2023
	Aggregates Import	4 Sep 2023	13 Oct 2023
	Backfill	16 Oct 2023	10 Nov 2023
Gravity Main Construction	Excavation	29 May 2023	24 Jul 2023
	Aggregates Import	12 Jun 2023	21 Jul 2023

The numbers of trucks associated with the key construction activities were estimated by the quantities of materials, volume of each truck and number of working days, which are shown in **Figure 3-7**. The total daily and hourly trucks generated by the activities are summarized in **Table 3-4**, and the highest truck generation will occur in June and July 2023, which account for 72 trucks / day (1-way), or 12 trucks / hour (1-way).

Location	Type of Activities	2023							Number of Working Days	Quantities of Materials (m³)	Volume of Each Truck (m³)	Total Number of Trucks	Truck/Day (1-way)	Truck/Hour (1-way)
		May	Jun	Jul	Aug	Sep	Oct	Nov						
Rising Main Construction	Excavation								42	14,774	14	1,055	25	4
	Aggregates Import								38	7,474	14	534	14	2
Pump Station Construction	Excavation								51	8,500	14	607	12	2
	Concrete pouring								20	60	7.4	8	1	1
	Aggregates Import								30	7,500	14	536	18	3
	Backfill from stockpile								18	7,300	14	521	29	4
Gravity Main Construction	Excavation								22	3,500	14	250	12	2
	Aggregates Import								30	3,600	14	257	9	2

Figure 3-7: Programme of Key Construction Activities and Associated Number of Trucks

Table 3-4: Monthly Variation of Daily and Hourly Number of Trucks

Month	Trucks Per Day (1-way)	Trucks Per Hour (1-way)
May 2023	63	10
June 2023	72	12
July 2023	72	12
August 2023	1	1
September 2023	18	3
October 2023	29	4
November 2023	29	4

3.3 Operational Phase Traffic Generation

The operation of the pump station will require minimal vehicle movements as there will only be vehicles entering the site for maintenance and inspection activities. It is assumed to be one vehicle per week (one in and one out).

3.4 Operational Phase Access Arrangement

The access to the pump station site will be maintained through the same access as the construction phase access to SAP 1. The access at SAP 1 is located at 23 Brigham Creek Road. **Figure 3-8** shows the operational layout of the pump station site once the construction is complete.

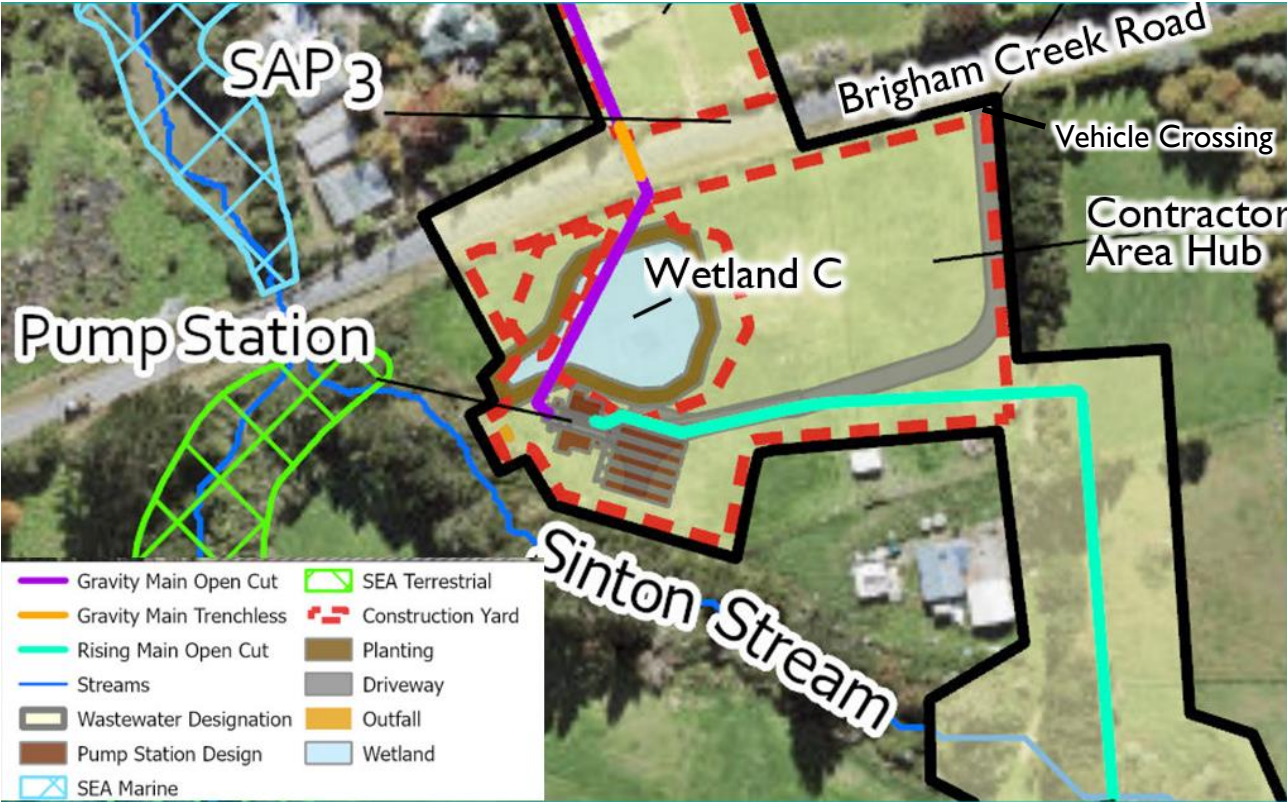


Figure 3-8: Operational Layout at the Pump Station

4 Assessment of Transport Effects

The following section covers the assessment of transport effects for both the construction phase and operational phase. The topics of visibility, vehicle tracking, and road capacity are covered for both the construction and operational phases.

4.1 Construction Phase – Visibility

The visibility at all the SAPs, and intersections in the rural area that potentially have visibility issues, were checked against the requirements in the Transport Design Manual (TDM) and Austroads Guide to Road Design Part 4A - Unsignalised and Signalised Intersections. These require that approach sight distance (ASD), safe intersection sight distance (SISD), and minimum gap sight distance (MGSD) are achieved. Among the three requirements, SISD requires the longest distances, therefore ASD and MGSD can normally be achieved if SISD is achieved.

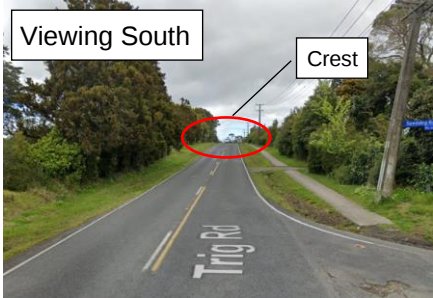
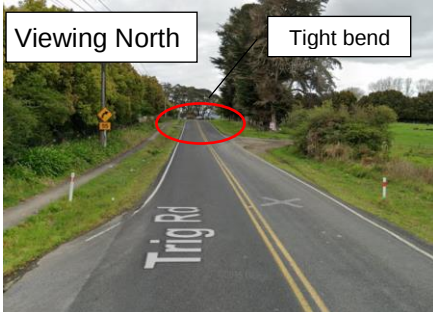
SISD is calculated from the operating speed on the road fronting the SAPs (for site access points) or the operating speed on the main road (for intersection). The operating speed is normally estimated by speed limit plus 10km/h. The speed limit of Brigham Creek Road is 80km/h outside of the town centre and residential area and 50km/h in these areas. Due to the location of SAP 1 and SAP 3 being in the 80km/h area of Brigham Creek Road an operating speed of 90km/h was adopted for the sight distance checks. The speed limit of Trig Road, Spedding Road and Mamari Road is 80km/h and an operating speed of 90km/h was adopted for sight distance checks. The SISD also takes into account the gradient of the road, therefore the required SISD viewing left and right from the SAPs or the minor intersection approach will be different if the fronting road / main road is steep in grade. The assessment is based on the current speed limit as AT's proposed speed limit changes are not yet approved.

Table 4-1: Required and Available Sight Distance shows the required and measured SISD distances for each of the SAPs and critical intersections that will be used by vehicles during the construction phases.

Table 4-1: Required and Available Sight Distance

SAP / Intersection	Fronting Road / Main Road at Intersection	Operating Speed	Required SISD	Available SISD	Findings
SAP 1	Brigham Creek Road	90km/h	228m (East) 203m (West)	220m (East) >300m (West)	The sight distance towards the west meets the requirement. The sight distance towards the east cannot meet the requirement (shortfall of 8m) as there is a crest on the road to the east of the SAP that impedes the sightline (shown below). Mitigation measures may be required. 
SAP 2	Spedding Road	90km/h	243m	>300m	Meets the requirement

SAP / Intersection	Fronting Road / Main Road at Intersection	Operating Speed	Required SIRD	Available SIRD	Findings
SAP 3	Brigham Creek Road	90km/h	228m (East) 203m (West)	300m (East) >300m (West)	Meets the requirement
SAP 4	Tamiro Road	60km/h	123m	>300m	Meets the requirement
SAP 5A	Mamari Road	90km/h	243m	>300m	Meets the requirement
SAP 5B	Spedding Road	90km/h	214m	>300m	Meets the requirement
Mamari Road (Spedding Road)	Spedding Road	90km/h	243 (West) 214 (East)	26m (West) >300m (East)	It should be noted that there are no additional trucks coming out from Mamari Rd as SAP 5A just allows incoming movement, checking of SIRD should not be required. However, as there will be additional trucks on Spedding Road, it would still be good to improve the safety for other vehicles coming out from Mamari Road. The sight distance towards the east meets the requirement. The sight distance towards the west cannot meet the requirement as there are trees at the corner that impede the sightline (shown below). Mitigation measure(s) will be needed to improve safety. 

SAP / Intersection	Fronting Road / Main Road at Intersection	Operating Speed	Required SISD	Available SISD	Findings
Spedding Road (Trig Road)	Trig Road	90km/h (South) 60km/h (North)	225 (South) 123 (North)	202m (South) 160m (North)	The sight distance towards the south cannot meet the requirements (shortfall of 23m) due to the road crest as shown below. Mitigation measure(s) may be required. Viewing South  Crest The operating speed on the northern section will be difficult to reach 90km/h due to the tight bend. The advisory speed of 55km/h for the radius of the bend suggests that an operating speed, of 60km/h would be more appropriate. As such, the sight distance towards the north can meet the requirement. Viewing North  Tight bend

To summarise, the visibility requirements are met at SAP 2, SAP 3, SAP 4, SAP 5A, SAP 5B; while the visibility requirements are not met at SAP 1, Spedding Road / Mamari Road intersection and Trig Road / Spedding Road intersection. **Table 4-2** outlines the recommended mitigation for the SAP and intersections that do not meet the required SISD distances.

Table 4-2: Visibility Recommendation / Mitigation Measures

Access Point / Intersection	Recommendations
SAP 1	The shortfall of sight distance is 8m, which is not significant compared to the required 228m. Using lower temporary speed limit on Brigham Creek Road could be adopted to meet the SISD requirement but may unnecessarily affect the other road users. With such small shortfall, it is recommended that the traffic movements and condition near SAP 1 to be monitored during the construction period. If any near misses or potential safety issues are observed, then a temporary speed limit (e.g. 50km/h) may need to be introduced on Brigham Creek Road near SAP 1 so it meets the required SISD (129m for speed of 50km/h).

Access Point / Intersection	Recommendations
	If AT's proposed speed limit change on Brigham Creek Road, i.e. reduced to 60km/h, is approved and implemented in November/ December 2022 which is before the commencement of the construction works, then the required SISD would be reduced to 159m. In such case, the available sight distance towards the east will meet the requirement.
Spedding Road/ Mamari Road Intersection	As there will not be additional trucks coming out of Mamari Road, suggestion for this intersection is mainly to enhance the visibility for other road users. It is recommended to remove or trim the trees along the southern fence line of 17 Mamari Road to improve sight distance towards the west from Mamari Road.
Trig Road/ Spedding Road Intersection	The shortfall of sight distance is 23m, which is not significant compared to the required 225m. Similar to SAP 1, using lower temporary speed limit may unnecessarily affect the other road users on. Therefore, it is recommended that the traffic movements and condition near the Trig Road / Spedding Road intersection be monitored during the construction period. If any near misses or potential safety issues are observed, then a temporary speed limit (e.g.50km/h) may need to be introduced on Trig Road near Spedding Road to meet the required SISD (128m for speed of 50km/h). if AT's proposed speed limit change on Trig Road, i.e. reduced to 60km/h, is approved the required SISD would be reduced to 158m. The SISD requirement would be met.

4.2 Construction Phase – Vehicle Tracking

Vehicle tracking analysis was conducted for the truck movements in and out of the SAPs and some critical intersections along the truck delivery routings. The intersections in the rural area are normally not designed to cater for turning of long vehicles. Therefore, vehicle tracking analysis was also undertaken at the intersections within the rural area along the truck delivery routes, such as Spedding Road/ Mamari Road and Spedding Road/ Trig Road. SAP 4 is for staff vehicles only, vehicle tracking for trucks along the routing to SAP 4 in the residential area is not required.

4.2.1 Delivery Routes

The turning movements identified for vehicle tracking were based on the truck delivery routings, which was derived by considering the truck origins and destinations as well as the operating directions of the SAPs as mentioned in Section 3. Among all the routings, the routings of (i) spoil disposal / internal stockpiling for the excavation (by truck and trailers) as shown in **Figure 4-1** and (ii) equipment delivery during site mobilisation / demobilisation and pipeline delivery (by semi-trailers) as shown in **Figure 4-2** are of the most concerns in terms of vehicles tracking due to the large truck sizes.

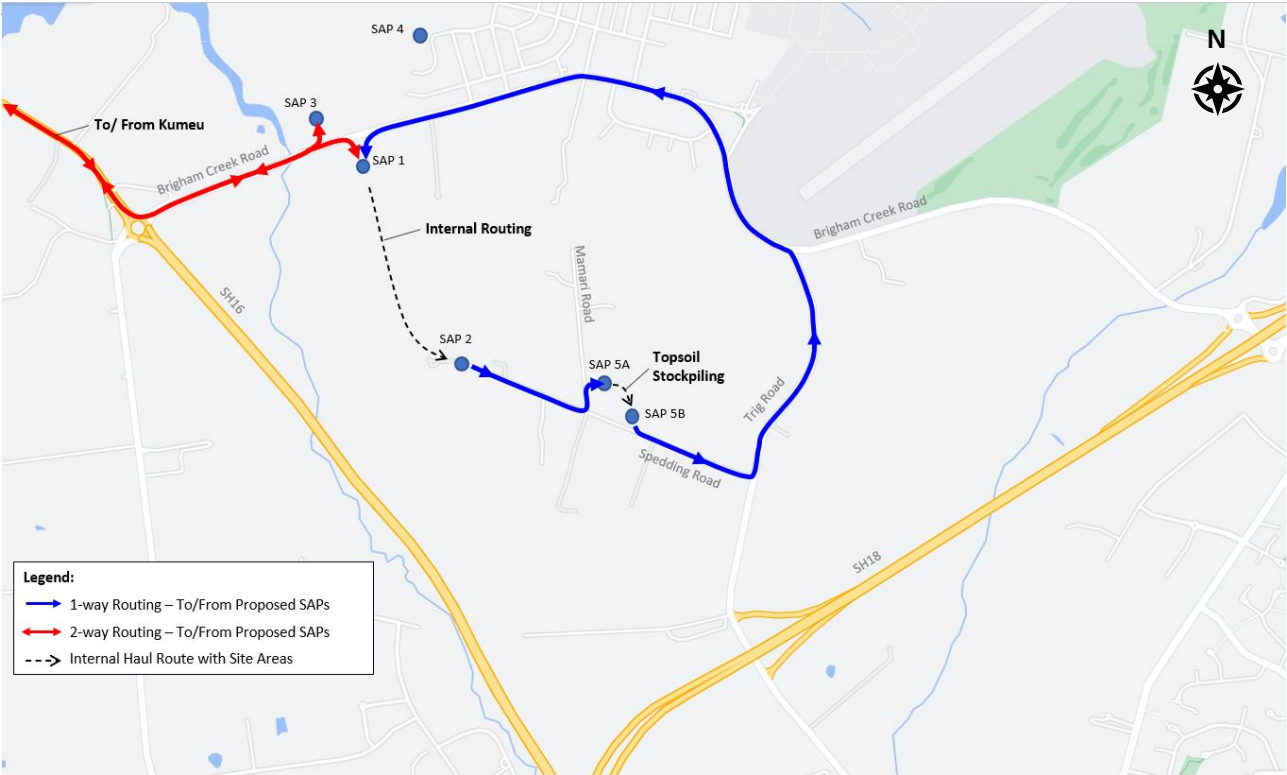


Figure 4-1: Original Routings for Truck and Trailers



Figure 4-2: Original Routings for Semi-trailers

4.2.2 Proposed Banned Movements at SAP 1 and SAP 3

It was observed that the traffic volume on Brigham Creek Road is high and the vehicles are travelling fast in the westbound direction. This will increase the difficulty for construction trucks to turn right into / out of SAP 1 and SAP 3. Therefore, it is recommended that the right-turning movements are banned to and from SAP 1 and SAP 3 to improve safety. The banned right turn movements will be diverted to the roundabout intersections at SH16 and SH18 as presented in **Table 4-3**.

Table 4-3: Diversion Route for the Proposed Banned Turning Movements

From	To	Diversion Route
Brigham Creek Road (westbound)	SAP 3	Brigham Creek Road (westbound) → turn around at SH16 roundabout → Brigham Creek Road (eastbound) → left turn to SAP 3
SAP 3	Brigham Creek Road (westbound)	Left turn from SAP 3 → Brigham Creek Road (eastbound) → turn around at SH18 roundabout → Brigham Creek Road (westbound)
Brigham Creek Road (eastbound)	SAP 1	Brigham Creek Road (eastbound) → turn around at SH18 roundabout → Brigham Creek Road (westbound) → left turn to SAP 1
SAP 1	Brigham Creek Road (eastbound)	Left turn from SAP 1 → Brigham Creek Road (westbound) → turn around at SH16 roundabout → Brigham Creek Road (eastbound)

The diversion route through SH16 roundabout means an additional travelling distance of around 1.6km (or approximately 2 mins travelling time). For the trucks to be diverted through SH18 roundabout, there will be around 7km additional travelling distance (or approximately 7mins travelling time). Apart from diverting through SH18 roundabout, other shorter routings through Ngahue Crescent or Airport Road-Tamatea Avenue route were also investigated; however, these routes were found not feasible due to insufficient turning space for the trucks.

The diversion will mainly impact the truck and trailers for spoil disposal to / from the west (i.e. via SH16 to Kumeu) and concrete trucks to / from the east (i.e. via SH18 to Albany). There is relatively little impact on aggregate supply by truck and trailer and machinery delivery by semi-trailers to / from the south as these can choose to use either SH16 or SH18 to access SAP 1 and SAP 3. The revised routings for truck and trailer and semi-trailer incorporating the proposed right-turn restrictions at SAP 1 and SAP 3 are shown in **Figure 4-3** and **Figure 4-4**.

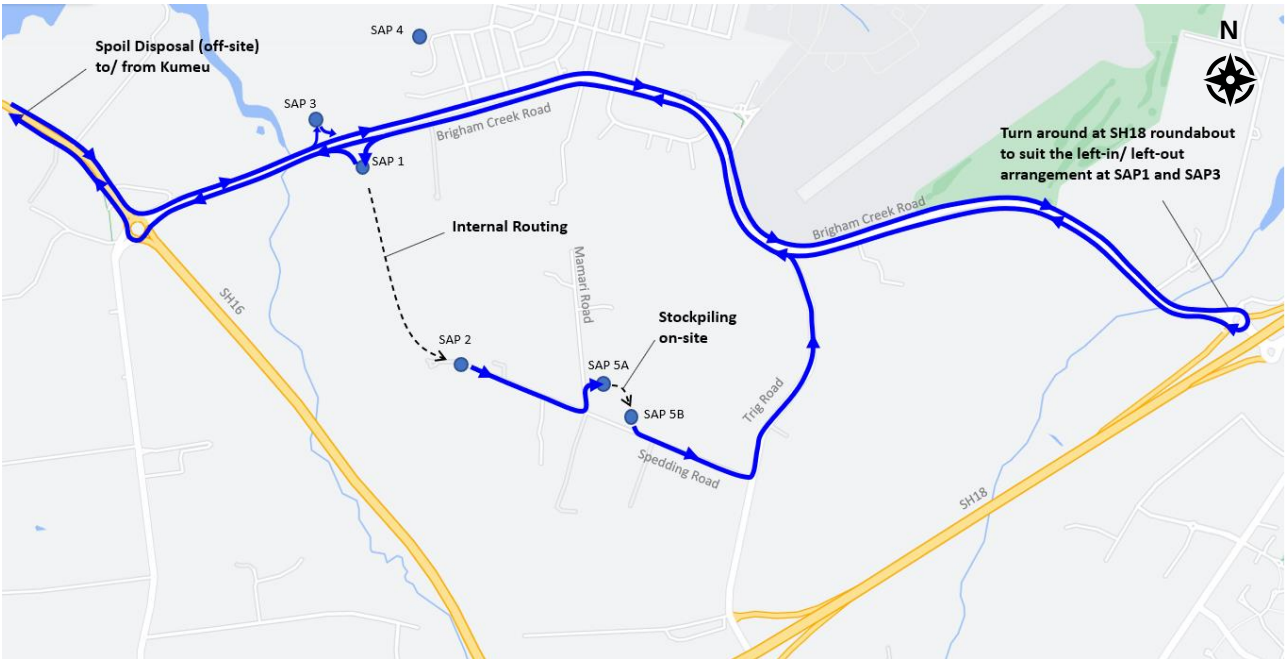


Figure 4-3: Revised Routings for Truck and Trailers



Figure 4-4: Revised Routings for Semi-trailers

All the sites will also require vehicle access for smaller staff vehicles like cars and vans. No banned turning movements for small vehicles for SAP 1 and SAP 3 are proposed due to the reduced time it takes for small vehicles to complete a right turn movement compared to the long trucks. It is recommended to monitor the turning movements at the SAPs during the construction period, the necessity of banning right-turning movement for small vehicles should be reviewed if near misses or other conflicts are observed.

4.2.3 Vehicle Tracking

The critical truck turning movements included in the vehicle tracking analysis (as shown in **Figure 4-5**) were identified based on the delivery routes and the proposed banned turning movements at SAP 1 and SAP 3 as mentioned in previous sections.

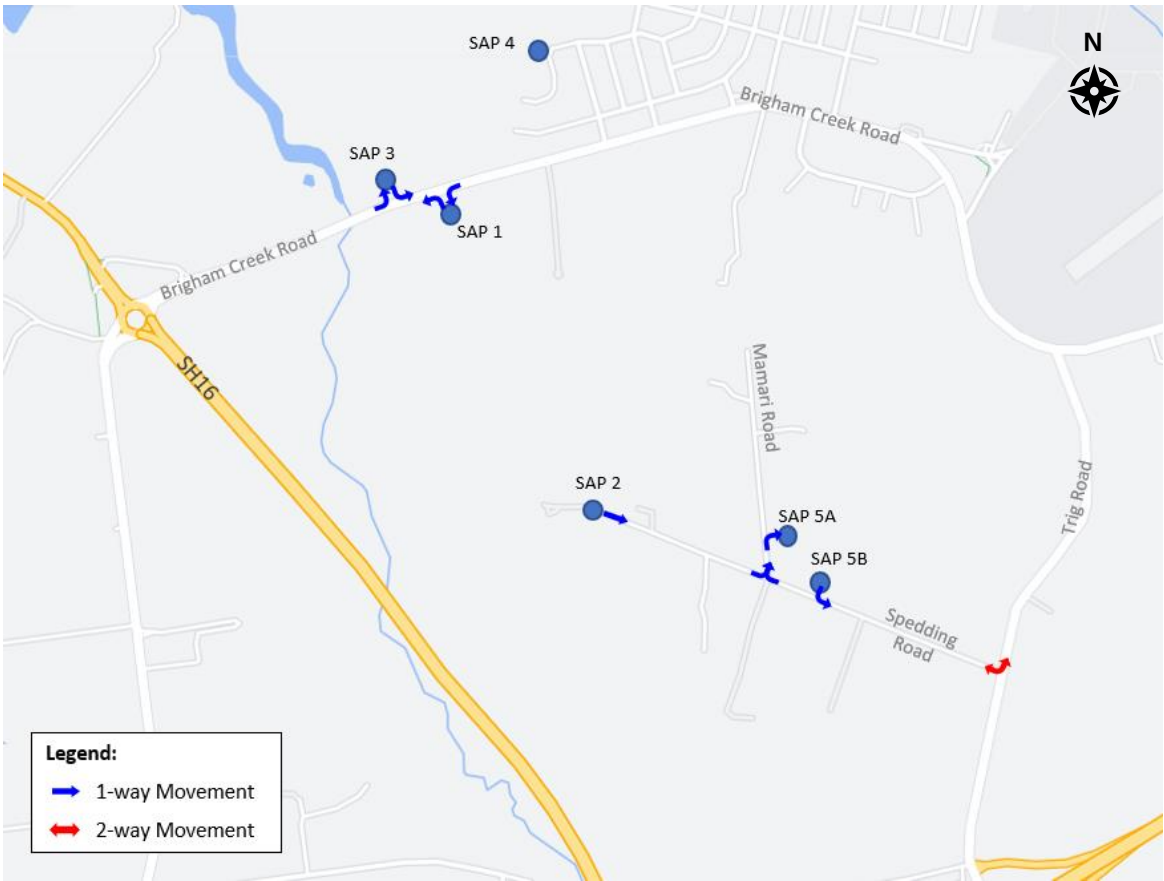


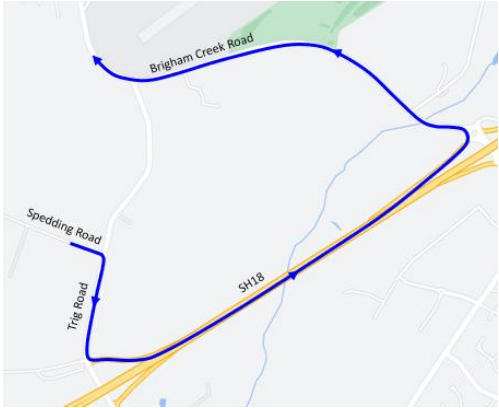
Figure 4-5: Truck Movements at SAPs and Critical Intersections

Table 4-4 summarises the vehicle tracking results and whether the location meets the tracking requirement. **Appendix C** shows all of the critical swept paths at each of the SAPs and intersections where issues may arise or there is possible conflict between vehicles. It should be noted that the turning space required for truck and trailer and semi-trailer are similar, most of the time truck and trailers will need slightly more space which is more critical.

Table 4-4: Vehicle Tracking Summary

SAP / Intersection	Results	Recommendations
SAP 1	If suitable driveway width is provided, there should be no issues with movements in and out of the SAP.	15m wide driveway at boundary is proposed. - As mentioned previously, it is proposed to restrict the truck movements to be left in and left out only as the traffic volumes on Brigham Creek Road are high and the operating speeds are high. - A deceleration lane to the immediate east of SAP 1 would be ideal to allow safe turning of long vehicle without blocking the traffic on Brigham Creek Road; however it may require extensive work and a significant cost. - Alternatives to this include a speed reduction around the SAP or advanced warning systems of turning vehicles.
SAP 2	There should be no issue with trucks exiting this site as the road is straight from the SAP.	Propose typical 6m wide driveway

SAP / Intersection	Results	Recommendations
SAP 3	If suitable driveway width is provided, there should be no issues with movements in and out of the SAP.	15m wide driveway at boundary is proposed. - Same as SAP 1, it is proposed to restrict the truck movements to be left in and left out only as the traffic volume on Brigham Creek Road is high and the vehicles are travelling fast. - An acceleration lane to the immediate east of SAP 3 would be ideal to allow safe merging to Brigham Creek Road; however it may require extensive work and a significant cost. - Alternatives to this include a speed reduction around the SAP or advanced warning systems of turning vehicles.
SAP 4	There will only be small vehicles and vans entering the site through this access, which should have sufficient space.	Existing driveway layout to be maintained
SAP 5A	If suitable driveway width is provided, there should be no issues with right-in to the SAP.	7m wide driveway at property boundary is proposed.
SAP 5B	If suitable driveway width is provided, there should be no issues with left-out movement from the SAP.	6m wide driveway at property boundary is proposed
Spedding Road / Mamari Road Intersection	- Truck & trailer turning left from Spedding Road onto Mamari Road will slightly encroach onto the berm at the inner corner, mitigation measures will be required. - There should be no issues for semi-trailer turning right from Spedding Road onto Mamari Road.	- Minor widening at the intersection to allow sufficient turning space is recommended. - If the widening requires extensive work and significant cost, 6-wheel truck (without the trailer) instead of truck and trailer could be considered for delivery of spoil. This will double the truck volume around this area, which will have greater impact on road capacity compared with using truck and trailers. However, the impact on the road capacity will probably still be acceptable. (detailed assessment refers to Section 4.1.3).
Trig Road / Spedding Road Intersection	- Both semi-trailer and truck & trailer turning left from Spedding Road onto Trig Road will either cut across the inside corner or encroach onto the opposing lane on Trig Road based on the existing road layout, and mitigation measures will be required. - There should be no issues for both vehicle types turning right from Trig Road onto Spedding Road.	- It is noted that semi-trailer is used for delivery of large machinery and equipment during site mobilisation / demobilisation and delivery of pipeline materials, which is not frequently used and could work outside the peak times. For such infrequent use, appropriate traffic management plan with escort vehicles could be adopted to allow semi-trailer to turn around the intersection safely and without conflict with other vehicles. - To allow safe turning for the more frequently used truck and trailers, one of the options is to widen the Spedding Road approach to allow sufficient turning space to left turn out of Spedding Road without encroaching onto the opposite lane on Trig Road. However, the distance of pedestrian crossing

SAP / Intersection	Results	Recommendations
		across Spedding Road will be increased, and it may require extensive work and significant costs. - Two other options not requiring physical modification of the intersection were explored: Re-routing: If trucks are re-routed to turn right out of Spedding Road onto Trig Road, via SH18 and back to Brigham Creek Road, the turning space for the right-turn trucks at the Spedding Road / Trig Road intersection should be sufficient.  Using 6-wheeler only: There is sufficient turning space for a 6-wheel truck (without the trailer) to turn left out of Spedding Road. This will double the truck volume around this area, which will have greater impact on road capacity compared with using truck and trailers. However, the impact on the road capacity will probably still be acceptable (detailed assessment refers to Section 4.1.3).

4.3 Construction Phase – Road Capacity

The impact of trucks and staff vehicles travelling on the surrounding road network was assessed. The routings of the vehicles generated from the sites were identified, the estimated numbers of trucks and staff vehicles were then distributed on each of the surrounding roads. The assessment reviewed whether the surrounding roads would still have sufficient capacities to cater for the additional traffic flows.

As discussed in the previous section, the open trenching method for the Brigham Creek Road Crossing will require closing 1 traffic lane on Brigham Creek Road, and temporary 1-lane 2-way operation will be adopted to control the traffic. The associated impact on the road traffic such as queue lengths and delay time is assessed below.

The narrow sections on Spedding Road and Mamari Road were also reviewed and mitigation measures are proposed to allow opposite vehicles to pass each other safely.

4.3.1 Impact of Truck Generation

The worst-case scenario for the number of trucks generated from all the sites during the construction period has been considered. As presented in **Table 3-4**, the highest truck generation will occur in June and July

2023, which account for 72 trucks / day (1-way), or 12 trucks / hour (1-way). The construction activities and the associated 1-way truck generation during this peak period were identified as follows:

- **Rising Main Construction:** Excavation (4 trucks/hr), Aggregates import (2 trucks/hr)
- **Pump Station Construction:** Excavation (2 trucks/hr)
- **Gravity Main Construction:** Excavation (2 trucks/hr), Aggregates import (2 trucks/hr)

Part of the spoil from the excavation will be disposed to the cleanfill at Kumeu, while the topsoil (around 1/4 of the total excavated volume) will be stockpiled on-site. The off-site spoil disposal will be transported by truck and trailer via Brigham Creek Road and SH16 to Kumeu. The aggregates will be delivered from the Hunua quarry to the sites by truck and trailer via either SH16 or SH18, depending on which SAP they are delivering to. The forecasted truck numbers on each road section along the delivery routes are shown in **Figure 4-6**. It should be noted that a recommendation for mitigating the insufficient turning space at the intersection of Spedding Road / Trig Road, i.e. turning right from Spedding Road to Trig Road, is adopted.

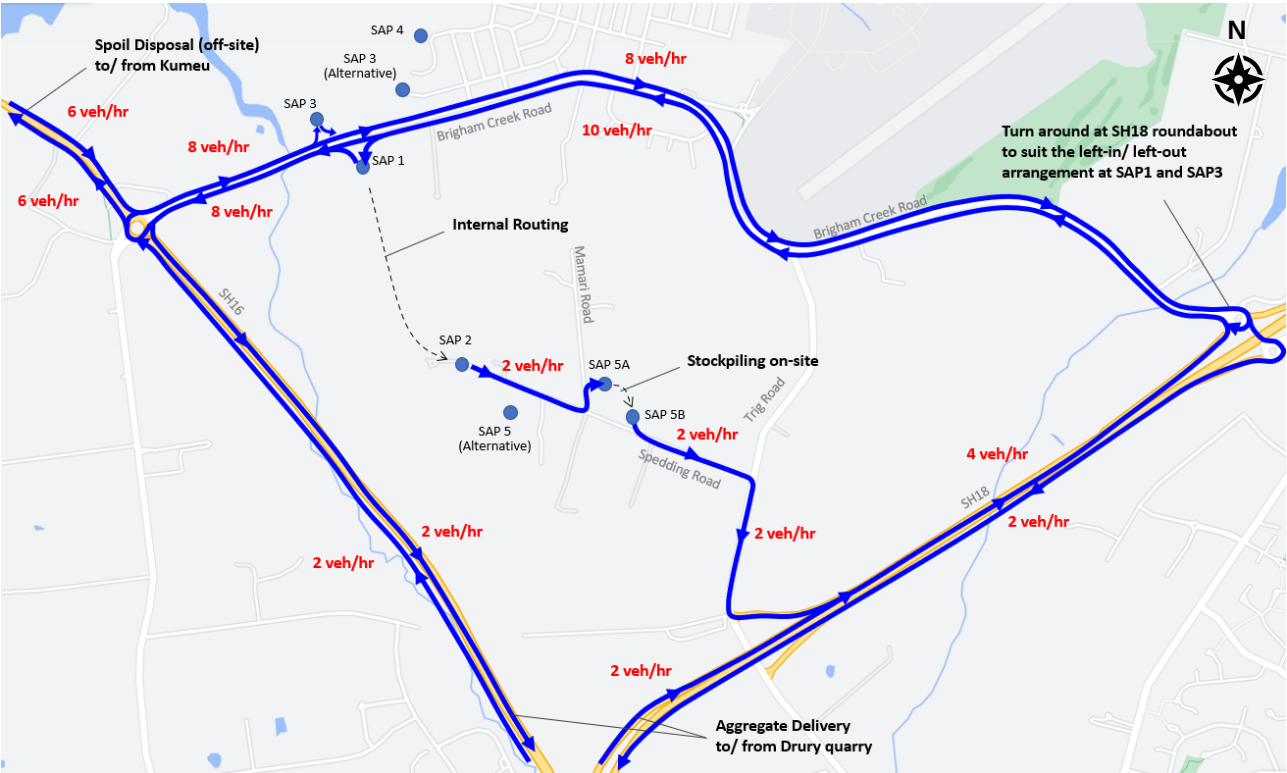


Figure 4-6: Hourly Volume for Truck Movements in the Peak Month

The number of trucks on Brigham Creek Road travelling in a westbound between SAP 1 and SH18 (10 trucks/hr) is the highest among all the roads in the area. As discussed in Section 2, the pre-covid traffic volume on Brigham Creek Road is adopted for the assessment as a conservative approach. The 2-way traffic flow Brigham Creek Road is approximately 1,200 vehicles per hour, of which 750 veh/hr travelling westbound and 450 veh/hr travelling eastbound. The road capacity for each of the roads generally ranges from 1,000 to 1,500 vehicles per lane per hour subject to the road hierarchy, speed limit and whether there are kerbside activities such as car parking. With the additional 10 trucks/hr, the impact on the capacity of Brigham Creek Road should be insignificant even though the lowest capacity of only 1,000 veh/hr is adopted. The number of trucks on the other roads are less than 10 trucks/hr which should also have insignificant impact on the road capacities. If 6-wheel trucks (no trailer at the back) are used instead of truck and trailer for spoil disposal and aggregate import, the hourly number of trucks will be doubled to around 20 trucks/hr. The impact on the road capacities due to this number of trucks is still minimal compared with the road capacity.

However, during the PM peak (16:30 – 17:30) there is a long queue that forms on the westbound lane of Brigham Creek Road from the roundabout with SH16, tailing back to the residential area. Adding any trucks to that traffic will worsen the queuing situation, therefore it is recommended not to generate trucks on Brigham Creek Road heading to SH16 between 16:30 and 17:30 on weekdays.

4.3.2 Impact of Staff Vehicles

There will be approximately 70 staff vehicles accessing the sites each day. There will be 40 vehicles heading to Contractor Area Hub, and 15 vehicles heading to the Contractor Area North and South. It is expected that the majority of the vehicles are coming from the area south of Whenuapai via SH16, the remaining from the North Shore via SH18. The vehicles will arrive at the sites during the morning peak and leave during the afternoon peak. The routing and the number of vehicles on each of the roads are shown in **Figure 4-7**.

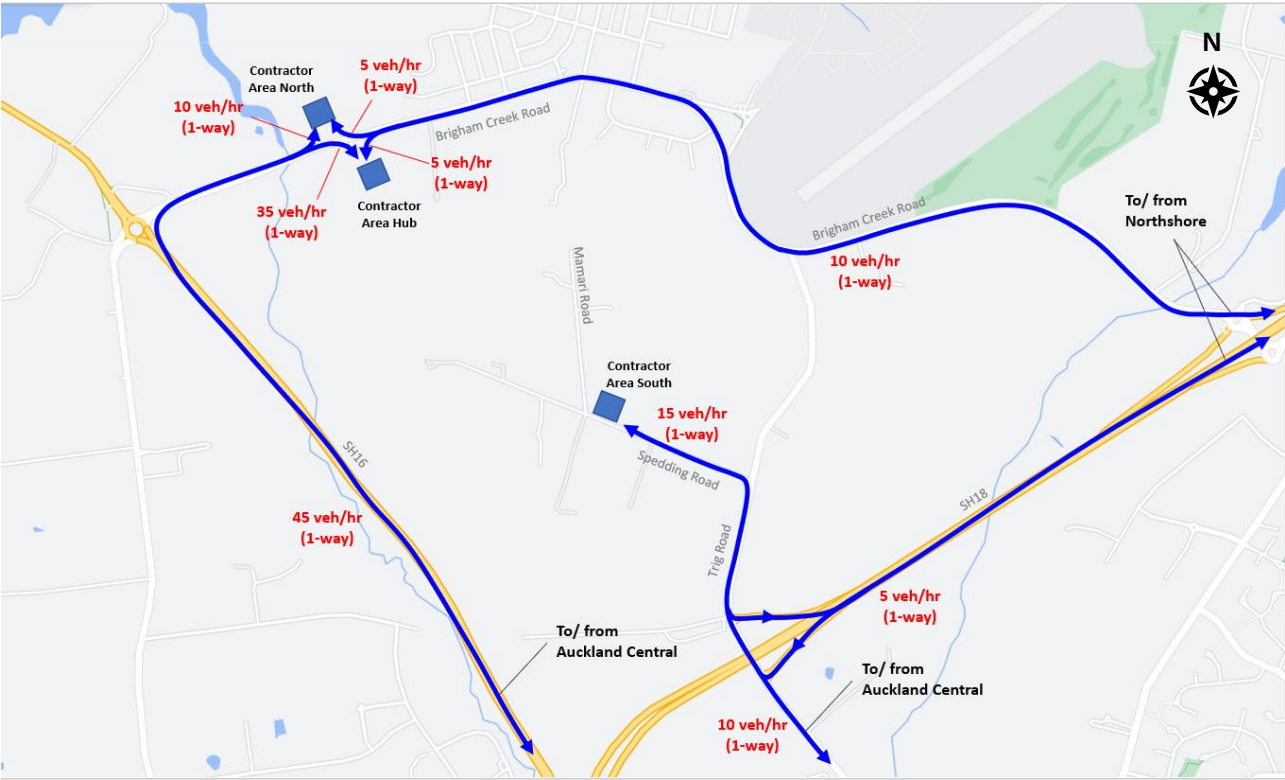


Figure 4-7: Hourly Volume for Staff Vehicle Movements

In the AM peak, Brigham Creek Road will have the most staff vehicles travelling through with 45 veh/hr, of which 10 vehicles are turning left to Constructor Area North and 35 vehicles are turning right to Constructor Area Hub. The additional number of staff vehicles will likely have a minimal impact on the capacity of Brigham Creek Road. However, it is expected the vehicles will probably come to the sites in the half an hour before starting, the right turning vehicles to Contractor Area Hub may be of concern as it may block the traffic on the eastbound lane of Brigham Creek Road in the AM peak. This should be monitored and if any issues arise then it may be necessary to make SAP 1 left-in / left-out for small vehicles as well as long trucks.

Similar to the recommendation for truck generation in the PM peak, it is suggested the staff vehicles do not use the westbound lane of Brigham Creek Road in the PM due to the long queue. The staff heading back to the south should travel along Brigham Creek Road eastbound, via SH18 to SH16. Overall, the additional staff vehicles will have a low impact on the capacities of the surrounding roads.

4.3.3 1-lane 2-way Operation on Brigham Creek Road

If the trenched option is selected for constructing the Brigham Creek Road Crossing instead of the trenchless option, 1-lane 2-way operation controlled by Go/Stop signs or temporary traffic signals will be required on Brigham Creek Road. This work will be carried out to ensure that one lane is open the entire time while the work is being conducted.

The 1-lane 2-way operation was simulated by SIDRA modelling programme to understand the potential queue lengths and delay time. **Figure 4-8** shows the site layout setup in SIDRA. It was assumed that the length of road 1-lane section is 100m long. The weekday peak hour traffic flows were modelled. The results show that the queue will be around 300m and an average delay time is around 60 seconds. The detailed analysis result is shown in **Appendix B**. The result from the simple model does not take into account the downstream effect, i.e. queues tailing back from the downstream intersection. During the PM peak, the 1-lane 2-way operation will seriously worsen the queuing on Brigham Creek Road to beyond the signalised intersection with Totara Road. Therefore, it is considered not acceptable to implement the 1-lane 2-way operation on a weekday.

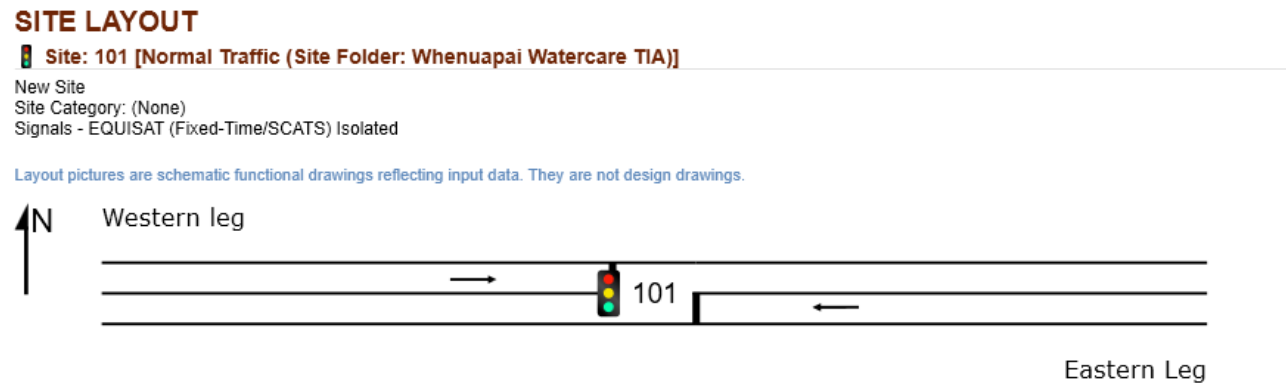


Figure 4-8: Site Layout of 1-lane 2-way Operation on Brigham Creek Road

With reference to the SCATS data for the signalised intersection of Brigham Creek Road and Totara Road and the traffic data from the Traffic Monitoring System (TMS) for the State Highways, the peak hour traffic volumes on the roads during Christmas Holiday will be around 20% to 30% less than the normal volumes. It is expected that the long queue on Brigham Creek Road westbound will not occur in the Christmas period, therefore will not affect the 1-lane 2-way operation at the Brigham Creek Road Crossing. The SIDRA model shows that queue length of around 160m and an average delay time of 45 seconds. The result is considered acceptable as the queue will not extend to the upstream intersection and therefore will not affect the wider road network.

4.3.4 Spedding Road (West of Mamari Road)

Most of the roads to be used by trucks and staff vehicles have two traffic lanes, except the section of Spedding Road and Mamari Road that is undivided with road widths less than 5.5m as shown in **Table 4-5**. A road width of 5.5m is the minimum requirement for two vehicles to pass each other safely. According to AUP:OP, passing bays should be provided at 100m intervals for a road narrower than 5.5m in rural area.

Table 4-5: Measured Road widths on Spedding Road and Mamari Road

Road	Section	Approximate Length	Measured Road Width
Spedding Road	Between Mamari Road and driveway of 12 Spedding Road	380m	4.8m
	Between driveway of 12 Spedding Road and SAP 2	60m	3.6m
Mamari Road	Between Spedding Road and SAP 5A	70m	5.0m

The narrow section of Spedding Road (to the west Mamari Road) serves around 8 properties only and the existing traffic volume is very low (as observed on site). According to the truck routing, the trucks will only travel on Spedding Road eastbound from SAP 2 to SAP 5A, which is around 2 trucks/hr. Thus, the chance of having two vehicles travelling on that narrow section in opposite directions will be quite low. Moreover, the berm adjacent to the road is flat. In case there are two vehicles travelling in opposite direction, one of the vehicles could slightly pull over to the berm to let the opposite vehicle pass. It is recommended to monitor the situation during the construction period and provide the passing bays if conflict between vehicles arise.

More vehicles are found on Mamari Road than the western section of Spedding Road especially before and after the school hours due to movements to and from Timatanga Community School. The section of Mamari Road between Spedding Road and SAP 5A is 70m, and the alignment is fairly straight. Vehicles travelling in opposite directions are able see each other outside this section, therefore a passing bay is not required for this road section.

4.4 Construction Phase – Other Impacts

4.4.1 Surrounding Properties

Construction will impact the local residents who will have their property access close to the proposed SAPs. These include the properties at:

- 20 Brigham Creek Road
- 23-27 Brigham Creek Road
- 16 Spedding Road

During the entire construction process there will be an increase in vehicle movements on the surrounding road network, however, the impact on the local residents and businesses and users of this road network will be low. As a courtesy, it is recommended that the local residents, businesses and stakeholders be kept informed of the construction times and progress.

4.4.2 Cycling / Pedestrian

There are limited cycling and walking facilities in the areas around each SAP. Cycling and pedestrian movements were observed during a site visit however these were away from any SAP and in the residential and business area of Whenuapai along Brigham Creek Road. There was a large amount of pedestrian and cyclist movement along Brigham Creek Road toward Whenuapai School and Whenuapai Kindergarten. There was also pedestrian and cycling movement along the Brigham Creek Road shared path between Tamatea Avenue and Kauri Road.

There are footpaths on Tamiro Road and Joseph McDonald Drive where vehicles will operate when travelling to and from SAP 3 Alternative and SAP 4. Whilst the number of movements will generally be low, construction vehicles and staff will need to be made aware of the surrounding environment and drive according to the conditions.

4.5 Operational Phase

4.5.1 Traffic Impact on Road Capacity

There will normally be one ute per week for the operations personnel to attend the site and could be up to 1 vehicle per 1-2 day(s). The additional vehicle movements will have a low impact on the road capacity of Brigham Creek Road.

4.5.2 Visibility

The access point during the operational phase will be at the same location as SAP 1 in the construction phase so the visibility assessment result is the same (i.e. the visibility requirements are not met). There is shortfall of 8m for the sight distance towards the east. Given that the vehicle generation is likely very low for the operational phase and that vehicles could access the site during the off-peak period, it is recommended to include the issue of visibility in the operational health and safety plan so that operations personnel are properly briefed.

If the speed limit changes on Brigham Creek Road (from 80km/h to 60km/h) are approved, the visibility requirements for the operational phase will be met.

4.5.3 Vehicle Tracking

Ute or Hi-abs will be used to access the site. The vehicle tracking has been undertaken for an 11.5m rigid truck for the permanent access to the pump access, there should be no issue turning if the width of the access is 7m wide.

4.5.4 Pedestrian and Cycling

Impact on pedestrians and cyclists will be negligible.

5 Construction Traffic Management Plan

The objective of the Construction Traffic Management Plan (CTMP) is to enable the safe and efficient movement of local traffic throughout the construction period of the pump station and pipeline. It will also serve the purpose of identifying how disruption to road users and adjacent residential properties and local activities is minimised.

The CTMP will include the procedures and requirements designed to manage the traffic effects during the construction phase, so that the above objectives are achieved. The CTMP will be prepared by the contractor, once appointed. The following outlines matters for particular consideration based on the assessed effects:

- The recommended measures at the SAPs and other specific locations are presented in **Table 5-1** for consideration by the contractor.
- Identify appropriate transportation routes to and from the SAPs with consideration of the type of materials to be delivered and transported away.
- Specific measures for construction traffic during the busiest construction period, including safety induction material to inform the associated risks with turning in and out of the site
- Identify the arrangements for contractor parking with the site
- Identify appropriate temporary advance warning signs and other Temporary Traffic Management measures to alert drivers to the SAPs and the truck movements / crossing on surrounding roads.
- Identify appropriate arrangements and procedures to enable effective two-way communication with local stakeholders
- Coordination with the Road Controlling Authority and / or maintenance contractors for adjacent Temporary Traffic Management and any Corridor Access Requests.

Table 5-1: Recommended Measures

Item / Location	Recommendations for CTMP
Truck Generation	• It is recommended not to generate trucks on Brigham Creek Road heading to SH16 during PM peak (16:30 – 17:30) Monday-Friday.
Staff Vehicles	• it is suggested the staff vehicles not to use the Brigham Creek Road westbound in the PM due to the long queue. The staff heading back to the south should travel through Brigham Creek Road eastbound, via SH18 to SH16
SAP 1	• Regarding the shortfall of 8m for the sight distance requirement, traffic movements and condition near SAP 1 have to be monitored during the construction period. If any near misses or potential safety issues are observed, then a temporary speed limit (e.g.50km/h) may need to be introduced on Brigham Creek Road near SAP 1 so as to meet the required SISD. • If AT's proposed speed limit change on Brigham Creek Road, i.e. reduced to 60km/h, is approved and implemented in November / December 2022, sight distance requirement will be met and the point above will not be needed. • It is recommended to ban the right-turning movements to and from SAP 1 to improve safety as traffic volumes on Brigham Creek Road are high and the operating speeds are fast. • 15m wide driveway at boundary is proposed. • A deceleration lane to the immediate east of SAP 1 would be ideal to allow safe turning of long vehicle without blocking the traffic on Brigham Creek Road; however it may require extensive work and a significant cost. • Alternatives to this include a speed reduction around the SAP or advanced warning systems of turning vehicles.

Item / Location	Recommendations for CTMP
	The right-turning of staff vehicles from Brigham Creek Road eastbound to SAP 1 should be monitored. If any issues arise then it may need to make SAP 1 left-in / left-out for small vehicles.
SAP 2	Propose typical 6m wide driveway
SAP 3	- It is recommended to ban the right-turning movements to and from SAP 3 to support improved safety on Brigham Creek Road 15m wide driveway at boundary is proposed. - It is proposed to restrict the truck movements to be left in and left out only as the traffic volume on Brigham Creek Road is high and the vehicles are travelling fast. - An acceleration lane to the immediate east of SAP 3 would be ideal to allow safe merging to Brigham Creek Road; however it may require extensive work and a significant cost. - Alternatives to this include a speed reduction around the SAP or advanced warning systems of turning vehicles.
SAP 4	No specific recommendation
SAP 5A	Typical 6m wide driveway at boundary is proposed.
SAP 5B	Typical 6m wide driveway at boundary is proposed
Trig Road / Spedding Road	- Regarding the shortfall of 23m for the sight distance requirement, traffic movements and condition near the intersection have to be monitored during the construction period. If any near misses or potential safety issues are observed, then a temporary speed limit (e.g. 50km/h) may need to be introduced on Trig Road near Spedding Road so as to meet the required SISD - If AT's proposed speed limit change on Trig Road, i.e. reduced to 60km/h, is approved and implemented in November / December 2022, sight distance requirement will be met and the point above will not be needed. - For infrequent deliveries by semi-trailer, appropriate traffic management plan with escort vehicles is recommended to allow semi-trailer to turn around the intersection safely and without conflict with other vehicles. - For frequent truck and trailer movement, three options are available to mitigate the insufficient turning spaces for left-turning truck and trailer: - Widen Spedding Road: Allow more turning space, but length of pedestrian crossing across Spedding Road will be increased, and it may require extensive work and a significant cost. - Re-routing (Preferred): Re-route to turn right from Spedding Road to Trig Road, via SH18 and back to Brigham Creek Road. Longer travelling distance but removes need for physical works. - Using 6-wheel truck: Able to turn left, it will double the number of trucks but the impact of the road capacity will still be minimal.
Spedding Road / Mamari Road	- It is recommended to remove or trim the trees along the southern fence line of 17 Mamari Road to improve sight distance towards the west from Mamari Road. - Minor widening at the intersection to allow sufficient turning space is recommended. - If the widening requires extensive work and significant cost, 6-wheel truck (without the trailer) instead of truck and trailer could be considered for delivery of spoil. The impact of the road capacity will still be minimal.
Spedding Road	For the narrow section to the west of Mamari Road, it is suggested to monitor the situation to understand whether there is issue / conflict for opposite vehicles passing each other, it may need to provide the passing bays if conflict between vehicles arise.
Brigham Creek Road Crossing	If open trenching method is used, it is recommended to construct in Christmas Holiday with 1-lane 2-way operation on Brigham Creek Road

6 Summary and Conclusion

The traffic assessment has considered the potential traffic-related impacts associated with the construction of the rising main, pump station and gravity main as well as the operation of the pump station.

The visibility and vehicle tracking were checked for all the SAPs and key intersections, and the road capacities of the surrounding roads along the routings leading to the sites were also assessed. The detailed recommended measures to address the issues identified in the assessments are summarised in Section 5.

According to the indicative programme and the information provided by the contractor, the construction of the pipelines and pump station will result in an additional maximum 10 trucks per hour (1-way) on the roads during the busiest period of the construction. It is estimated that maximum of 45 staff vehicles per hour (1-way) would be added on the roads during the peak periods. The impact of the additional number of trucks or staff vehicles on the road capacities would be minimal. However, due to the long queue on Brigham Creek Road westbound in the PM peak, it was recommended to avoid generating vehicles or using that road section during PM peak.

If open trenching method is adopted for the Brigham Creek Road Crossing, 1-lane 2-way operation would be needed. Implementation of such operation on a weekday is not recommended due to the existing long queue on Brigham Creek Road in the PM peak. If the work is conducted during the Christmas Holiday period, the queue length and delay times were considered acceptable.

At the narrow section on Spedding Road, it is recommended that the CTMP include provisions to closely monitor the condition of opposite vehicles passing each other. Passing bays may be considered if safety issues arise.

Sight distances at most of the SAPs and intersections could meet the requirements. At the locations where the requirements could not be met, the shortfalls of the requirements were considered minor and close monitoring of the turning movements were recommended. Mitigation measures as recommended in Section 5 should be considered if any safety issues arise. It should be noted that AT proposed to change the speed limits on some of the roads in Whenuapai area. If it is approved and implemented in late 2022 as planned, the sight distance requirements for some locations could be met by then.

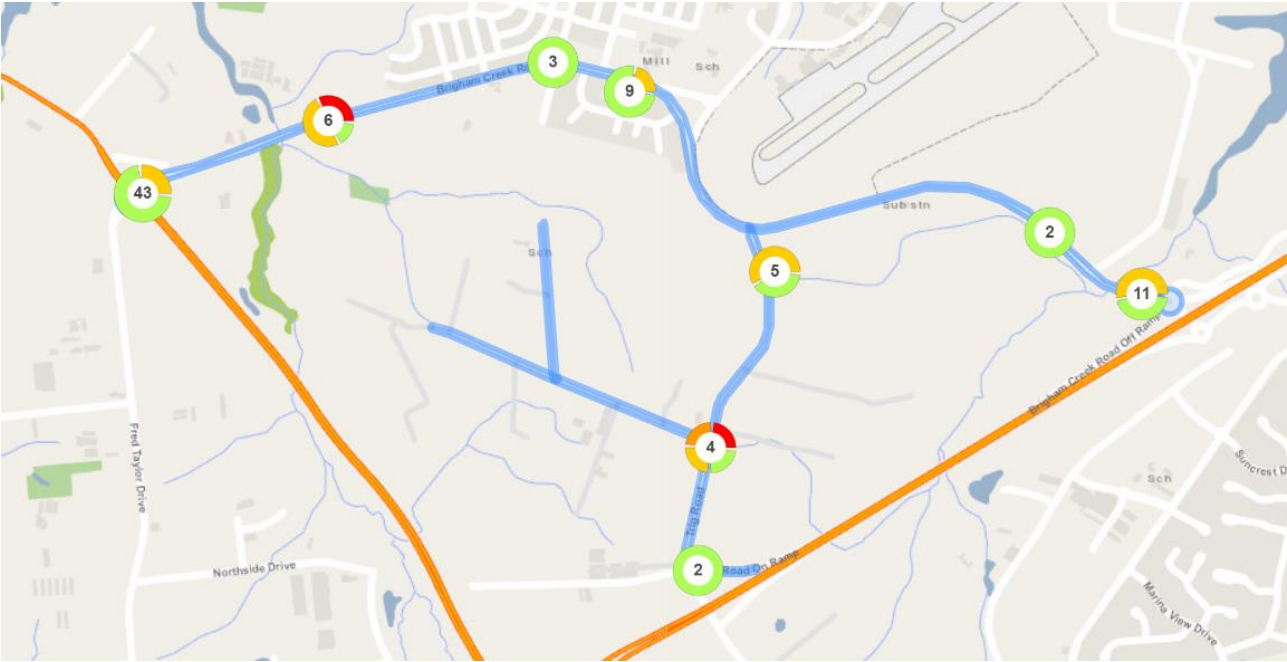
Semi-trailers as well as truck and trailers would be the longest vehicle types used during the construction. The required widths of the driveways at the SAPs and other mitigation measures were recommended in Section 5 to allow sufficient turning spaces of the trucks. In particular, it was recommended to ban the right-turning movements to and from SAP 1 and SAP 3 to improve safety as traffic volumes on Brigham Creek Road are high and the operating speeds are fast.

During the operational phase of the pump station, the traffic generation would normally be one vehicle per week and could be up to 1 vehicle per day. The impact on the road capacities is considered insignificant. There should be no issue for truck turning movements at the site access. The shortfall of sight distance at the site access was considered minor, it is recommended to include the issue of visibility in the operational health and safety plan so that the operations personnel will be aware of that.

A

Appendix A – Crash Data Map

Crash Data Map



B

Appendix B – SIDRA Results for One-lane Two-way Operation

Normal Traffic Scenario

MOVEMENT SUMMARY

Site: 101 [Normal Traffic (Site Folder: Whenuapai Watercare TIA)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 120 seconds (Site Practical Cycle Time)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Eastern Leg														
5	T1	600	8.0	632	8.0	0.889	48.3	LOS D	40.0	299.3	1.00	1.02	1.16	21.4
Approach		600	8.0	632	8.0	0.889	48.3	LOS D	40.0	299.3	1.00	1.02	1.16	21.4
West: Western leg														
11	T1	400	8.0	421	8.0	0.909	62.7	LOS E	28.7	214.6	1.00	1.09	1.28	19.8
Approach		400	8.0	421	8.0	0.909	62.7	LOS E	28.7	214.6	1.00	1.09	1.28	19.8
All Vehicles		1000	8.0	1053	8.0	0.909	54.1	LOS D	40.0	299.3	1.00	1.05	1.21	20.7

Christmas Traffic Scenario

MOVEMENT SUMMARY

Site: 101 [Christmas Traffic (Site Folder: Whenuapai Watercare TIA)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 90 seconds (Site Practical Cycle Time)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES [Total veh/h]		DEMAND FLOWS [Total veh/h]		Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh]		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver Speed km/h
East: Eastern Leg														
5	T1	450	8.0	474	8.0	0.821	36.2	LOS D	21.4	160.2	0.99	0.98	1.13	23.1
Approach		450	8.0	474	8.0	0.821	36.2	LOS D	21.4	160.2	0.99	0.98	1.13	23.1
West: Western leg														
11	T1	300	8.0	316	8.0	0.852	45.6	LOS D	15.4	115.3	1.00	1.06	1.27	21.8
Approach		300	8.0	316	8.0	0.852	45.6	LOS D	15.4	115.3	1.00	1.06	1.27	21.8
All Vehicles		750	8.0	789	8.0	0.852	40.0	LOS D	21.4	160.2	0.99	1.01	1.19	22.6

C

Appendix C – Vehicle Tracking

SAP 1 In



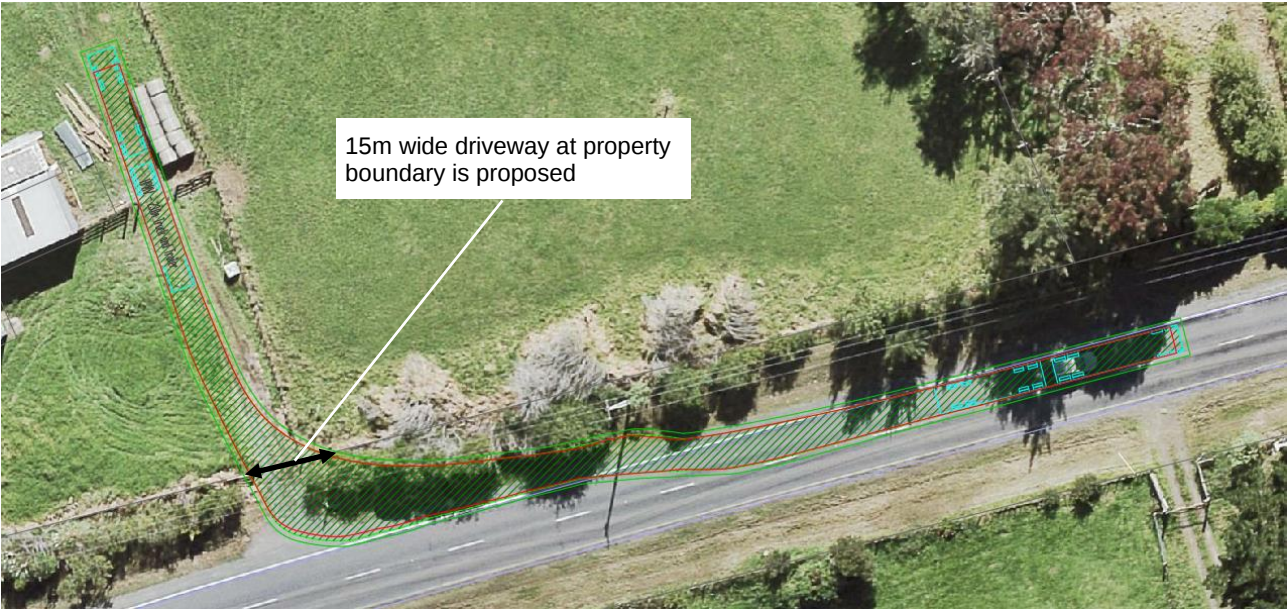
SAP 1 Out



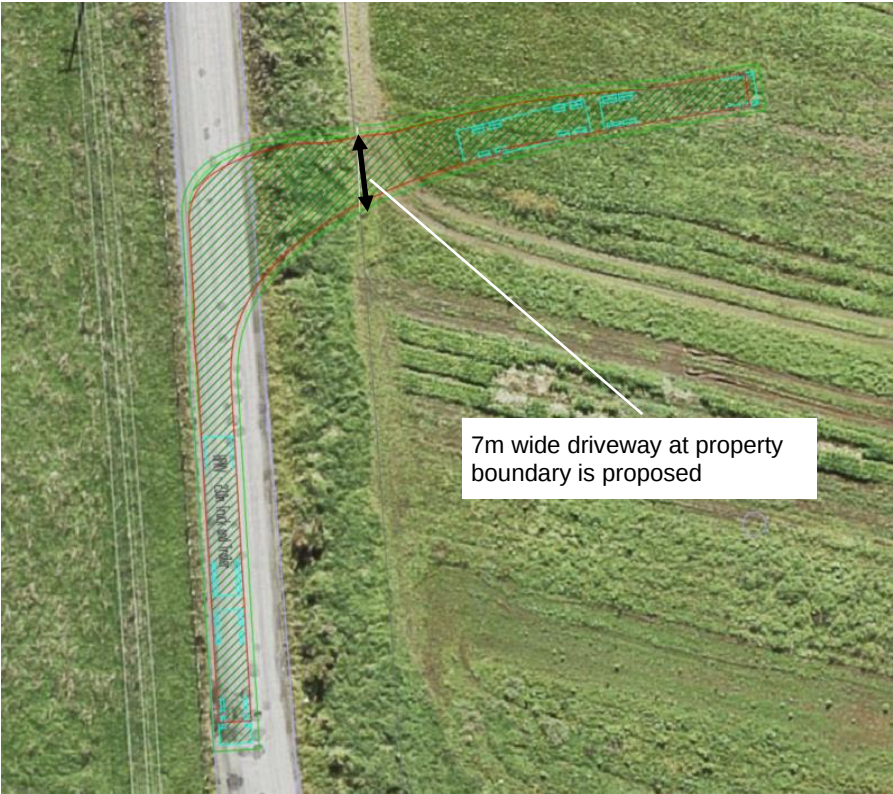
SAP 3 In



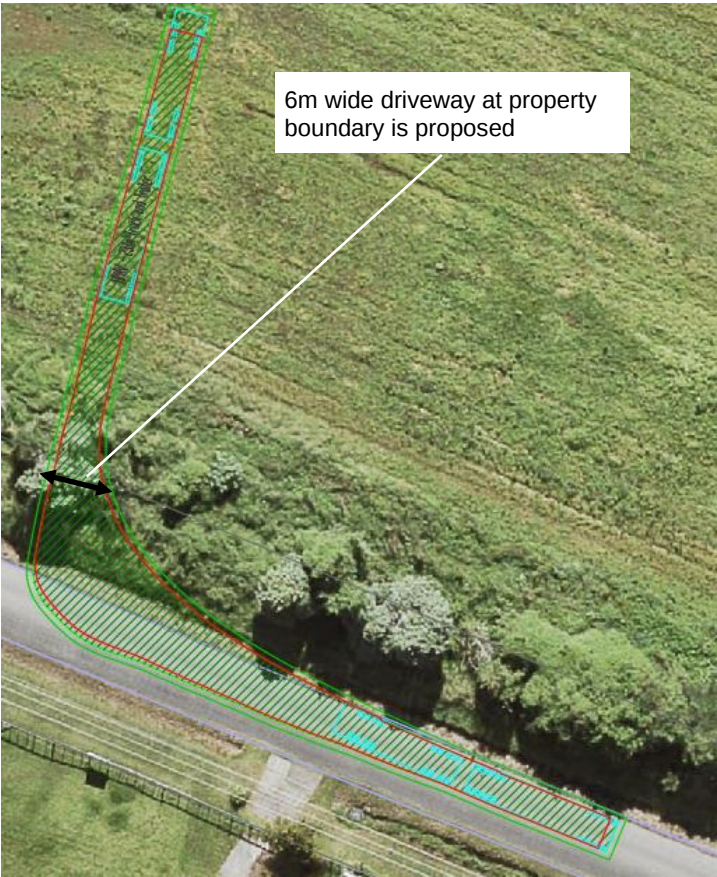
SAP 3 Out



SAP 5A In



SAP 5B Out



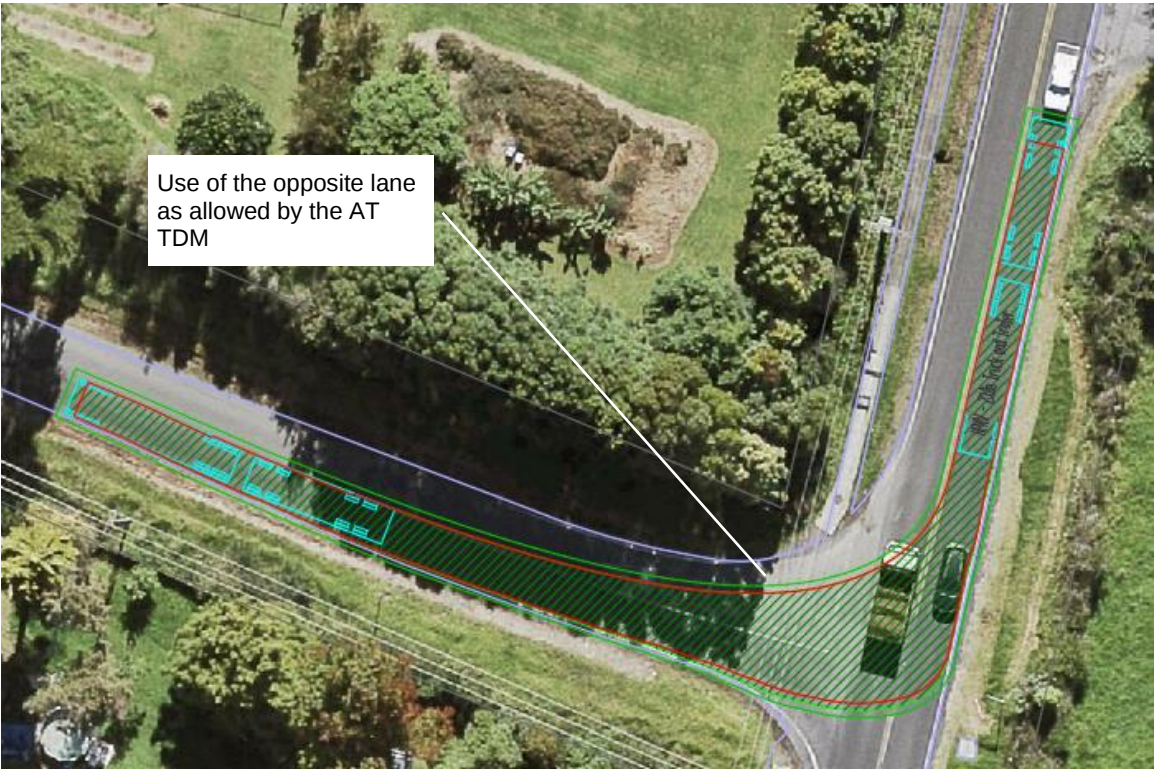
Spedding Road / Mamari Road Left in



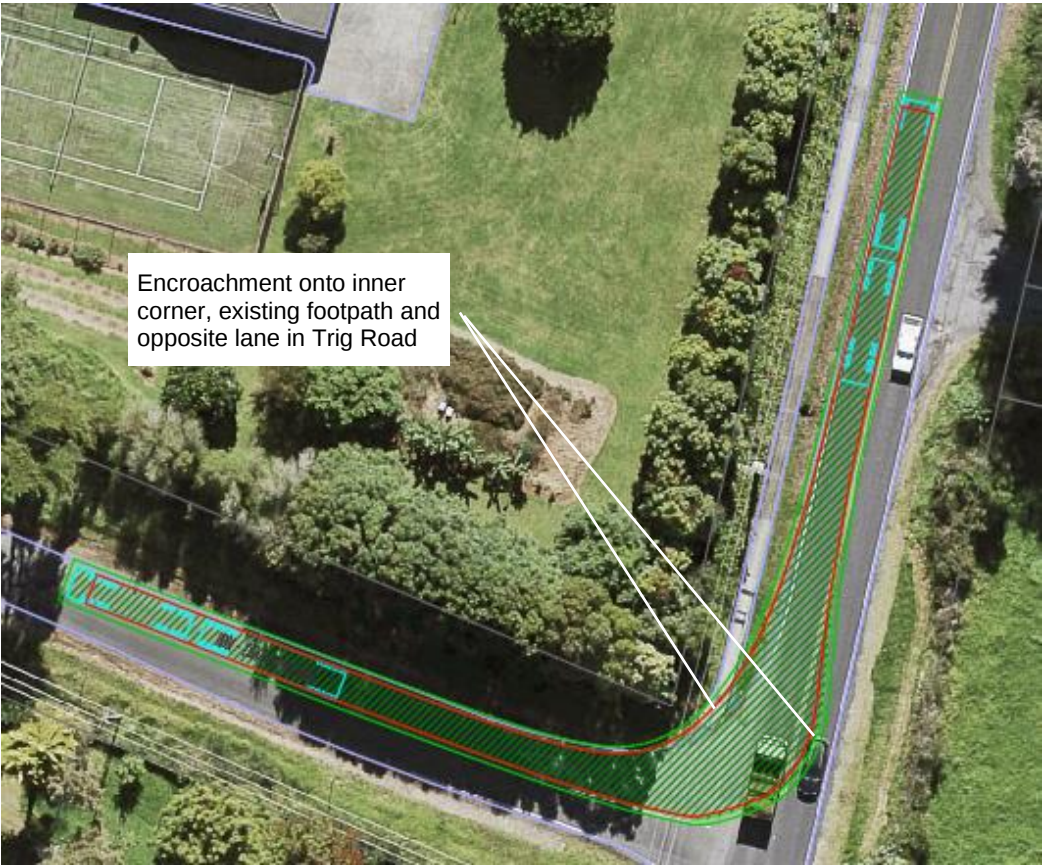
Spedding Road / Mamari Road Right in



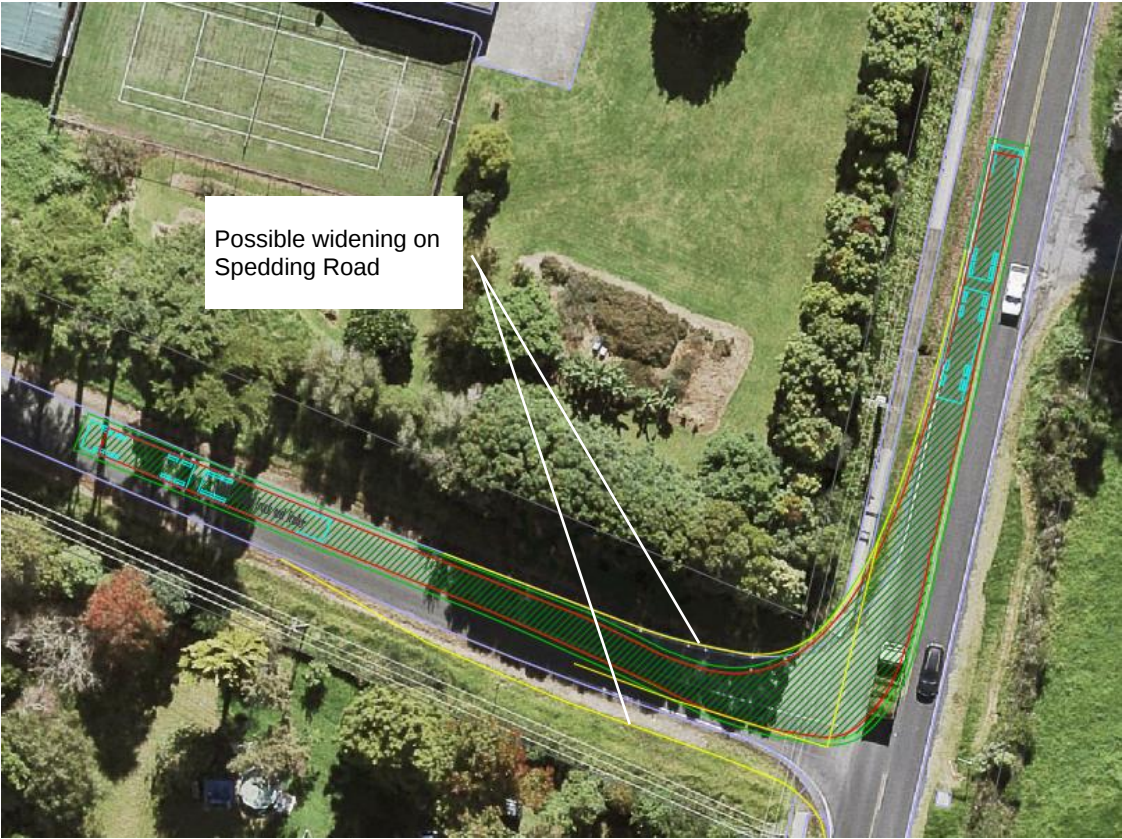
Trig Road / Spedding Road Right in



Trig Road / Spedding Road Left out (Existing Layout)



Trig Road / Spedding Road Left out (Possible Widening)



Operational Phase - Access Left in



Operational Phase - Access Left out

