Upper North Island Supply Chain Strategy

Traffic Assessment of Port Options

June 2020

flow

TRANSPORTATION SPECIALISTS

flow
TRANSPORTATION SPECIALISTS

Disclaimer- This report was prepared for Sapere Research Group, to inform their work on the Upper North Island Supply Chain Strategy. It does not represent the views of the Ministry of Transport.

Project: **Upper North Island Supply Chain Strategy**
Title: **Traffic Assessment of Port Options**
Document Reference: **P:\SRGL\001 Upper North Island Supply Chain Work Programme\reporting\R1C200605 Final.docx**
Prepared by: **Qing Li, Allan Liu, Mat Collins, Ian Clark**
Project Manager **Ian Clark**
Reviewed by: **Angie Crafer**

Revisions:

Date	Status	Reference	Approved by	Initials
4 April 2020	A Draft	R1A200404 draft	I Clark	IDC
27 April 2020	B Draft	R1B200427 draft	I Clark	IDC
5 June 2020	C Final	R1C200605	I Clark	IDC

EXECUTIVE SUMMARY

This report provides a high level assessment of the road transport implications of five options for ports in the Upper North Island, these being retention of the existing Ports of Auckland Limited (POAL) site on the Auckland Waterfront, or four relocation options.

The content of this report represents the work of Flow (with inputs from the wider team led by Sapere). Due to the COVID-19 lockdown, the intended close collaboration with officials has not yet been possible.

For each scenario we have considered:

- The future truck volumes likely to be associated with the POAL operations, and therefore the quantum of trucks likely to be relocated for the four other options
- The total travel times and distances for road transport associated with each of the options
- Potential road and public transport investment needed to support each of the options
- Changes in traffic volumes and travel times in the vicinity of the existing POAL site, within the Auckland CBD.

Scenarios

We have considered the following scenarios:

- Scenario 1. Retention of the existing freight operations at the existing POAL site. This is in effect the "business as usual" case
- Scenario 2. POAL freight operations relocated to Northport, with redevelopment of the POAL site
- Scenario 3. POAL freight operations relocated to Port of Tauranga, with redevelopment of the POAL site
- Scenario 4. POAL freight operations relocated a site in the Firth of Thames, adjacent to Kawakawa Bay, with redevelopment of the POAL site
- Scenario 5. POAL freight operations relocated to a site in the Manukau Harbour, to the south of the Airport and adjacent to Wiri, with redevelopment of the POAL site.

Truck Forecasts

We have been provided details of the total freight quantities that currently pass through the POAL site, in terms of container freight, car freight and bulk goods. We have also been provided with two growth scenarios, as set out in Table ES1.

Table ES1: Growth Scenarios for POAL (percentage growth from 2020 to 2052/3)

Scenario	Low Growth Scenario	High Growth Scenario
Container Freight	+38%	+132%
Car Freight	+38%	+190%
Bulk Freight	+38%	+80%
Total	**+38%**	**+98%**

The above increases relate to total freight, and clearly the number of trucks will depend on the proportions of goods that can be transported by rail. It is assumed that all port options will be served by rail (and the feasibility and cost of this assumption, including the feasibility of accommodating a high freight mode share by rail, is being assessed by a different workstream).

Table ES2 summarises the future assumptions for rail. It is assumed that the low growth scenario will be accompanied by a fairly low proportion of goods by rail (derived in part from the existing mode shares), while the higher growth scenario will be accompanied by higher proportions by rail.

Table ES2: Assumptions regarding freight to be carried by rail (2052/3)

	Auckland Port Options		Tauranga and Northport Options	
Scenario	**Low Growth**	**High Growth**	**Low Growth**	**High Growth**
Container Freight	13.5%	30%	35%	70%
Car Freight	0	0	0	0%
Bulk Freight	0	0	0	0

The above assumptions lead to the forecasts of the daily truck movements to/from each of the options, as set out in Table ES3. In the case of Tauranga and Northport, these will be in addition to the movements relating to the existing operations to/from these Ports.

Table ES3: Truck Forecasts (per day) in 2052/3

Scenario	Low Growth Scenario	High Growth Scenario
POAL Site	3,975	5,725
Relocation of trucks to Northport	3,350	3,825
Relocation of trucks to Tauranga	3,350	3,825
Relocation of trucks to Firth of Thames	3,975	5,725
Relocation of trucks to Manukau Harbour	3,975	5,725

It can be seen that the differences between the low and high growth forecasts for Auckland are quite significant, whereas those for Tauranga and Northport are quite modest, due to the higher proportion of containers assumed to travel by rail. Clearly there could be a wider range of growth and mode share scenarios, for each location.

Redevelopment at POAL Site

If the POAL site is vacated, it is highly likely that the site will be redeveloped. Previous work by Warren and Mahoney, set out in a 2019 report by EY[1], suggested that the site could be used for a significant mixed use development, including residential, hotel, commercial and retail uses, as set out in Table ES4.

Table ES4: POAL redevelopment land-use assumptions

	Gross Floor Area or apartments	Employees or residents
Residential	5,800 apartments	11,600 residents
Commercial	227,500 m^2	11.380 employees
Hotel	600 rooms	-
Retail	20,200 m^2	2,525 employees

As noted below, the modelling for the Auckland CBD has also considered a scenario with 50% of these land uses.

Total Road Transport Costs

An assessment has been carried out of the total transport costs, in terms of total travel times and travel distances, using the following transport models:

- The Auckland Macro Strategic Model (MSM)
- The Tauranga Transport Strategic Model
- A SATURN traffic model which covers State Highway 1 in Northland, from north of Wellsford to Whangarei.

These three models all consider different design years, but the truck forecasts for 2052/3 have been applied consistently to these models. The Auckland MSM considers the year 2048, so the following results refer to this being the assessment year.

Table ES5 below provides a summary of the differences in total travel times and distances by road. These have been converted to NZ dollar values in 2048, for travel times, vehicle operating costs and carbon dioxide emissions, using the procedures and the different dollar values for light and heavy vehicles set out in the NZ Transport Agency's Economic Evaluation Manual. We acknowledge that there are gaps between the Auckland and Tauranga models, and between the Auckland and Northland models. The effects of these gaps have been taken into account by manual corrections (for example, based on the quantum of trucks travelling the distances between the models, and an estimate of the average speeds over these distances).

[1] EY, (August 2019), "Economic Analysis of Upper North Island Supply Chain Scenarios"

Also, it needs to be recognised that the values in the tables only relate to road transport. This means that the values are not comparing like with like, as the Northport and Tauranga scenarios assume a greater proportion of freight moving by rail. This will need to be taken into account in the overall economic analysis.

Table ES5: Differences in vehicle hours and vehicle-kilometres, and total monetary values

Scenario	Vehicle -Hours travelled by road (per day in 2048)	Vehicle Kilometres travelled by road (per day in 2048)	$ costs (per year in 2048 (undiscounted)
1: Business as usual	Future base	Future base	Future base
2: Northport	+6,750 hrs/day	+210,000 km/day	+$250 million
3: Ports of Tauranga	+7,400 hrs/day	+435,000 km/day	+$410 million
4: Firth of Thames	+1,550 hrs/day	+7,500 km/day	+$85 million
5: Manukau Harbour	-1,950 hrs/day	-125,000 km/day	-$25 million

The table indicates that the Northport and Tauranga scenarios will lead to greater road user costs, even with a lower quantum of freight goods being transported by road, as a significant proportion of goods will need to travel to Auckland. The Manukau Harbour option is predicted to lead to some (modest) travel cost savings, due to the closer proximity to the freight hubs within South Auckland.

Transport Investment

Table ES6 sets out the roading infrastructure projects expected to be required for each scenario, by the time the relocation of the port occurs, which is assumed to be within 20 to 30 years.

In addition, the redevelopment of the POAL site (assumed for scenarios 2 to 5) will require additional access intersections, a rail station on the eastern line, investment in walking and cycling connections, plus bus stops and additional bus services along Tamaki Drive/Quay Street and through the site.

As noted earlier, it is assumed that each of the relocation options will be served by rail, and the feasibility and cost of this assumption is being assessed in a separate workstream.

Table ES6: Roading infrastructure projects

Scenario	Roading infrastructure already assumed or committed	New roading infrastructure that may be required
1: Business as usual	Improved access to the Port / Grafton Gully is identified in the Auckland Transport Alignment Project (ATAP)[2])	
2: Northport	Improvements of SH1 from Whangarei to SH15 are already proposed by NZ Transport Agency (in line with the recent Government announcement) plus safety works from SH15 to Te Hana. The NZTA SH1 Warkworth to Wellsford project (to Te Hana) is also assumed to have been progressed, although this project may need to be brought forward	Additional works along SH1 between SH15 and Te Hana are likely to be required, with safety improvements. Also, corridor widening / rerouting at the Brynderwyn Hills is likely to need to be brought forward
3: Ports of Tauranga	The following works are assumed to have been progressed by NZTA: • SH1 Cambridge to Piarere safety improvements • SH1/SH29 intersection upgrade • SH29 Piarere to Tauriko safety improvements	Longer term works on SH1/ SH29 from south of Cambridge to Tauriko are likely to need to be brought forward, with additional works at the SH2/Dive Crescent interchange, adjacent to the Port operations at Sulphur Point
4: Firth of Thames	The Mill Road project is assumed to have been progressed, in line with the recent Government announcement	A new roading link from Mill Road to the Firth of Thames site will be required, with a bypass of Clevedon. An improved connection from Mill Road to the Southern Motorway is also expected to be necessary
5: Manukau Harbour	The Collector Road network proposed as part of the Southern Gateway development, within the Puhinui Precinct, is assumed to be provided. The Airport to Botany rapid transit is assumed to be progressed (as envisaged by ATAP), using SH20B from Puhinui to the airport (via the SH20/SH20B motorway interchange)	A new arterial standard road link from Roscommon Road/Wiri Station Road is assumed to be required, out to the Manukau Harbour site

[2] NZ Government, et al (April 2018), "Auckland Transport Alignment Project"

Traffic Congestion in Auckland CBD

A specific aspect of this study has been to consider the effects of the scenarios on congestion within the Auckland CBD, firstly for scenarios that consider the Port remaining in the city centre, and, secondly, scenarios for the Port relocating and redevelopment occurring at the POAL site.

As noted above, the relocation of the POAL site is likely to lead to the redevelopment of that site, and the two growth scenarios associated with the POAL remaining for freight uses have been compared with two redevelopment scenarios:

- The first is the redevelopment scenario referred to above (with 5,800 apartments, hotels, plus commercial/retail for a total of almost 14,000 employees
- The second scenario represents 50% of this level of development without hotel development (i.e. 2,900 apartments, commercial/retail for a total of almost 7,000 employees).

Table ES7 identifies the traffic generating potential of these scenarios, in passenger car units (PCUs[3]). The table provides forecasts for the weekday evening peak, this being the busiest time period in the Auckland CBD, along with the weekday inter peak, which will be the situation for much of the day. It should be acknowledged that truck movements associated with the POAL operations are relatively consistent throughout the day, whereas traffic associated with the redevelopment scenarios will be more heavily concentrated toward the weekday morning and evening peaks.

Table ES7: Movements from POAL site (Passenger Car Units (PCUs)/hour, two way)

Scenarios	Inter Peak			Evening Peak		
	Cars	Trucks	Total	Cars	Trucks	Total
Existing	160	470	630	170	500	660
POAL operations: Low Growth	210	630	840	210	630	840
POAL operations: High Growth	320	950	1,250	340	1,030	1,370
Redevelopment of POAL, higher intensity	2,170	130	2,300	2,450	150	2,600
Redevelopment of POAL, lower intensity	1,090	70	1,150	1,220	80	1,300

The above figures indicate that the total PCUs for the POAL high growth scenario would be similar to the lower intensity redevelopment scenario. However, the higher redevelopment scenario would be likely to lead to significantly greater numbers of PCUs. This is even with the assumption that significant proportions of new residents and employees would be likely to travel by modes of transport other than the private car to and from this central Auckland site.

The results of these forecast flows associated with the POAL site have been assessed in the Auckland City Centre SATURN model. This currently exists with a furthest horizon year of 2036, so this year has been used for the assessment.

[3] Cars are 1 PCU, while large trucks are assumed to equate to 3 PCUs.

The ATAP assumption, that improved access to the Port will be provided through Grafton Gully, has been included in the model (although ATAP acknowledges that if the Port activities relocate, this may not be the case). Table ES8 summarises the average travel speeds within the model.

Table ES8: Average Travel Speeds in the Auckland CBD (Kilometres per hour)

Scenarios	Morning Peak	Inter Peak	Evening Peak
Existing	22.4	34.1	18.9
POAL operations: Low Growth	17.6	28.2	14.5
POAL operations: High Growth	16.9	27.8	13.8
Redevelopment of POAL, higher intensity	16.3	25.8	12.7
Redevelopment of POAL, lower intensity	17.2	27.5	14.2

The above speeds relate to the averages within the entire model, so the results may under-represent the extent of congestion in particular areas. However, the model outputs indicate the extent to which the higher intensity redevelopment scenario will lead to lower vehicle speeds in the city centre.

The MSM assumes that the total population of the Auckland region will remain constant if the POAL redevelopment occurs, and the model indicates a reduction in total vehicle trips within the Auckland region, due to the implied relocation of some future land use changes from the suburbs to the city centre.

We should emphasise that the above results may be viewed in a number of ways:

- While it may be possible for a greater proportion of freight to be carried by rail, if the POAL operations remain in central Auckland, freight trips by road will be considered as essential, and congestion for these essential trips may be considered to be unacceptable
- On the other hand, congestion for trips associated with residential and commercial development could be considered to be less unacceptable, as many of these trips will be made by modes other than the private vehicle. This may either be by walking and cycling modes, due to the proximity of the POAL site to the range of facilities within the CBD, or by public transport, given the proximity to bus, rail and ferry.

Other reports

This report should not be read in isolation, but should be read in conjunction with other reports being prepared concurrently, namely:

- A report relating to future freight demands
- A report into the future road and rail transport investment required for each of the scenarios
- The overall economic analysis.

CONTENTS

1 INTRODUCTION

Flow Transportation Specialists, as sub consultants to the Sapere Research Group, has been appointed by the Ministry of Transport to carry out a comparison of the traffic characteristics of scenarios being considered by the Upper North Island Ports study. The outputs from our study are being included in the economic evaluation and costings for the options, being undertaken by others.

The content of this report represents the work of Flow (with inputs from the wider team led by Sapere). Due to the COVID-19 lockdown, the intended close collaboration with officials has not yet been possible.

1.1 The scenarios

We have considered the following scenarios:

- Scenario 1. Retention of the existing freight operations at the existing Ports of Auckland Ltd (POAL) site. This is in effect the "business as usual" case
- Scenario 2. POAL freight operations relocated to Northport, with redevelopment of the POAL site
- Scenario 3. POAL freight operations relocated to Port of Tauranga, with redevelopment of the POAL site
- Scenario 4. POAL freight operations relocated to Firth of Thames, with redevelopment of the POAL site
- Scenario 5. POAL freight operations relocated to Manukau Harbour, with redevelopment of the POAL site

1.2 Scope of this report

For each scenario we have considered:

- The future truck volumes likely to be associated with the POAL operations, and therefore the quantum of trucks likely to be relocated for the four other options
- The total travel times and distances for road transport associated with each of the options
- Potential road and public transport investment needed to support each of the options
- Changes in traffic volumes and travel times in the vicinity of the existing POAL site, within the Auckland CBD.

1.3 Other workstreams relevant to our study

Our work has had input from several other workstreams, as follows:

- Forecast freight demands have been developed by Murray King & Francis Small Consultancy Ltd (King-Small)

- Future land use assumptions for the existing POAL site, if freight operations are moved elsewhere, have been taken from the 2019 report by EY[4].
- Assumptions regarding future road and public transport infrastructure have been developed in partnership with the infrastructure workstream led by Sapere.

2 POAL 2019/20 FREIGHT VOLUMES

2.1 Container and car freight

POAL has provided freight and truck movements from 1 February 2019 to 31 January 2020. This data includes:

- Container and car units processed
- Details of the proportion of trucks arriving or departing the Port empty
- Estimates on the average number of containers or cars carried per truck

We have analysed data from March, October and November 2019. We chose to use data from Tuesdays, Wednesdays and Thursdays as these generally represent "neutral" weekdays. This work was carried out during the early stages of the COVID-19 outbreak, before the lockdown, but at a time when it was considered that counts of existing truck flows entering/exiting the Port would not be representative of "normal conditions". Therefore we used SCATS (traffic signal) data from the intersections of Quay Street with Solent Street and Tinley Street to establish the daily flow profiles, and we then converted the average daily trips to two-hour totals for the weekday morning peak, inter peak and evening peak.

As the truck movements for March, October and November are similar, we have used the March data as inputs into the traffic modelling. This information is presented in Table 1.

Table 1: March 2019 truck movements, container and car freight

Month	Location	Average daily weekday truck movements (2 way)	Morning peak 2-hour volume (2 way)	Interpeak 2-hour volume (2 way)	Afternoon peak 2-hour volume (2 way)
March 2019	Solent Street	1,800	215	200	215
	Tinley Street	1,080	130	120	130
	Total	2,880	345	315	345

[4] EY, (August 2019), "Economic Analysis of Upper North Island Supply Chain Scenarios"

3 FREIGHT FORECASTS

3.1 Daily freight forecasts for each scenario

We have been provided details of the total freight quantities that currently pass through the POAL site, in terms of container freight, car freight and bulk goods. King-Small have provided details of two growth scenarios, as follows:

Table 2: Growth Scenarios for POAL (percentage growth from 2020 to 2052/3)

Scenario	Low Growth Scenario	High Growth Scenario
Container Freight	+38%	+132%
Car Freight	+38%	+190%
Bulk Freight	+38%	+80%
Total	**+38%**	**+98%**

The above increases relate to total freight, and clearly the number of trucks will depend on the proportion of goods that can be transported by rail. It is assumed that all Port options will be served by rail (and the feasibility and cost of this assumption, including the feasibility of accommodating a high freight mode share by rail, is being assessed by a different workstream).

The following table summarises the future assumptions for rail. It is assumed that the low growth scenario will be accompanied by a fairly low proportion of goods by rail (derived from existing mode shares), while the higher growth scenario will be accompanied by higher proportions by rail.

Table 3: Assumptions regarding freight to be carried by rail (2052/3)

	Auckland Port Options		Tauranga and Northport Options	
Scenario	**Low Growth**	**High Growth**	**Low Growth**	**High Growth**
Container Freight	13.5%	30%	35%	70%
Car Freight	0	0	0	0%
Bulk Freight	0	0	0	0

The above assumptions lead to the following forecasts of the daily truck movements to/from each of the options. In the case of Tauranga and Northport, these will be in addition to the movements relating to the existing operations to/from these ports.

Table 4: Truck Forecasts (per day) in 2052/3

Scenario	Low Growth Scenario	High Growth Scenario
POAL Site	3,975	5,725
Relocation of trucks to Northport	3,350	3,825
Relocation of trucks to Tauranga	3,350	3,825
Relocation of trucks to Firth of Thames	3,975	5,725
Relocation of trucks to Manukau Harbour	3,975	5,725

It can be seen that the differences between the low and high growth forecasts for Auckland are quite significant, whereas those for Tauranga and Northport are quite modest (+15%), due to the assumption that a higher proportion of containers will travel by rail. Clearly there could be a wider range of growth and mode share scenarios, for each location.

It has been suggested by King-Small that not all bulk freight will necessarily follow the Port relocation. For example, some goods may transfer to Tauranga if the Port moves from Auckland to Northport. The traffic modelling referred to in Section 5 therefore assumed lower numbers of trips relocating for the Northport and Tauranga options. For the low growth scenario, the reductions are around 300 and 450 truck movements per day for the Tauranga and Northport options, and these numbers have been manually added back into the calculations in Sections 6 and 7.

4 LAND USE FORECASTS FOR REDEVELOPMENT OF POAL LAND

If the POAL site is vacated, it is highly likely that the site will be redeveloped. A previous study by Warren and Mahoney (referred to within the 2019 EY Economic Analysis report) suggested that the site could be used for significant mixed use development, including residential, hotel, commercial and retail uses, as set out in Table 5. The Warren and Mahoney figures included allowances for streets and laneways, and public spaces / parks.

Table 5: POAL redevelopment land-use assumptions

	Gross Floor Area or apartments	Employees or residents
Residential	5,800 apartments	11,600 residents
Commercial	227,500 m^2	11.380 employees
Hotel	600 rooms	-
Retail	20,200 m^2	2,525 employees

We have also considered the effects of a second scenario which assumed a lower intensity of redevelopment (generally 50% of the figures in Table 5), with analysis provided in Section 8 below.

5 TRANSPORT MODELLING

5.1 Methodology, assumptions and limitations

This work has been carried out within a challenging timeframe, meaning that we have not developed any new transport models. Instead, we have relied on three existing regional or sub regional transport models:

- Auckland Regional Macro Strategic Model (MSM), which includes 2048 as the most distant forecast year
- Tauranga Transport Strategic Model (TTSM), which includes 2043 as a forecast year forecast
- Whangarei to Te Hana SATURN traffic model, which includes 2046 as the most distant forecast year.

In addition, the effects of the Port relocation on congestion within the Auckland CBD have been assessed using the Auckland CBD SATURN Model, which includes 2036 as the most distant forecast year.

We note that the above models represent different forecast years, between 2036 and 2048. Ideally, models representing a single forecast year should be used. However, as noted above, this has not been possible given the limited timeframe for this assessment. We consider that our approach is appropriate for a high level strategic assessment, and note that the models used for the regional assessments all have fairly similar forecast years, these being 2043 and 2048.

The truck forecasts for 2052/3 that were identified in Section 3 above have been applied to the various regional/sub-regional models (i.e. those for 2043 to 2048), and to avoid over complicating the assessment, the following sections all refer to the forecasts as relating to 2048.

It has long been objective of Auckland Council (and Auckland City Council before that) that any increase in morning peak hour trips into the CBD should be accommodated by modes of transport other than the private car. Therefore the effects of the earlier horizon of the Auckland CBD model may not be that significant, particularly as the effects of all options on congestion within the CBD are being assessed on an equal basis (i.e. overall forecasts are for the year 2036, with truck forecasts for 2052/3).

To make sure the models used are fit for purpose, we undertook checks to make sure the base year scenarios for each model are reasonably reflecting the current situation, in terms of:

- Truck volume checks at the existing Ports of Auckland and Ports of Tauranga sites, and at the intersection of State Highway 1 and State Highway 15, close to Northport
- Broad checks on truck distribution, based on observed data.

Modelling limitations include the following:

- Each model only covers a specific area, and therefore on its own does not capture the full effects of traffic re-routing associated with Port relocation. For example, the MSM only covers the transport networks within the Auckland region and does not include full road sections between Auckland and Tauranga. Similarly, the TTSM model only covers the Tauranga network and does not include SH2 north of Pahoia or SH29 west of Lower Kaimai
- Possible route choices between models have been identified based on our knowledge of the networks, and assumptions have been made with regard to the travel times and distances associated with the relocated trucks travelling between the new Port locations and the various model boundaries. These are further discussed in Section 6.1 below
- We have considered what effect the various scenarios may have on the long term investment assumptions for Auckland (the Auckland Transport Alignment Project, ATAP)[5] and Tauranga (Programme 8.1 TTSM Model assumptions) and the recent NZ Government announcement regarding investment in infrastructure[6].

5.2 Auckland transport modelling

5.2.1 Auckland Regional Model (MSM)

The MSM model is the tool that has been used for the strategic assessments of most if not all large scale transport studies in the Auckland region for some time. It is operated by the Auckland Forecasting Centre (AFC), which is funded jointly Auckland Transport, Auckland Council and NZ Transport Agency. This model has been used to assist the assessment of all Port scenarios.

Prior to using the model for the assessment, modelled truck volumes to/from the POAL and origin/destinations in the model in 2016 were checked against observed data, and they were found to be generally reasonable.

The forecast 2048 MSM model incorporates the current I11.5 land-use scenario and reflects the future network assumptions from ATAP.

For each of the scenarios, truck volumes associated with the POAL site in MSM have been factored to match the future truck volumes described in Section 3.

For scenarios 2 to 5, redevelopment of the POAL site, detailed in Section 4, has been assumed within the MSM model.

[5] NZ Government, et al (April 2018), "Auckland Transport Alignment Project"

[6] https://www.beehive.govt.nz/release/transport-infrastructure-upgrades-get-nz-moving-and-prepared-future

5.2.2 Auckland CBD Saturn model

The Auckland CBD SATURN model was originally developed by Flow for the former Auckland City Council, and it is now maintained by the AFC, who provided the latest version of the model for the year 2036. This model has been used to assess localised traffic conditions in the vicinity of the existing POAL site, for low and high growth scenarios without and with relocation of the Port.

We made the following refinements to the model:

- The existing base model was reconfigured by adding trucks as a second user class. This allows the model to reflect the extra congestion effects of trucks, by converting the model from vehicles/hour to passenger car units/hour
- In order to separate truck volumes from total flows, a low percentage of heavy vehicles (3%) was applied to the majority of the City Centre model zones. A higher percentage of heavy vehicles was applied to the POAL model zones, based on site observations which indicate that heavy vehicles make up around 50% of total traffic volumes to/from Tinley Street and Solent Street.

It is commonly assumed in traffic models that trucks equal two passenger car units (PCUs), and this assumption has been made for the redevelopment scenarios (see below), as trucks for these scenarios will be a mix of medium and large trucks. However, for the scenarios in which the existing POAL operations remain, the vehicles will be predominantly large trucks, which have been given a value of 3 PCUs in the SATURN model. This is considered to be reasonable in general, although the effects of these large trucks up the relatively steep gradients of Grafton Gully are likely to be greater still.

We consider that this change from vehicles/hour to PCUs/hour will have had little impact on model validation.

We have tested four scenarios in the SATURN model:

- 2036 without Port relocation, with low growth (as defined in Section 3)
- 2036 without Port relocation, with high growth (again as defined in Section 3)
- 2036 with Port relocation, with redevelopment of POAL land (as set out in Section 4)
- 2036 with Port relocation, with reduced redevelopment (this being assumed to be 50% of the land use scenario set out in Section 4).

The 2036 SATURN model provided by the AFC included a number of proposed transport projects which will reduce the capacity of the network for general traffic, for the benefit of other transport modes. Such projects include the Victoria Street Linear Park and the Fanshawe Street busway. We added in the Quay Street Boulevard project into the model, noting that this will reduce traffic capacity along that route (west of Tangihua Street).

We have also added into the model the Grafton Gully motorway upgrade, which will increase vehicle capacity, as this project is included within ATAP (and is therefore included in the MSM, as grade separation to north-east of Beach Road from 2036).

The forecast traffic flows in the 2036 evening peak model were around 5 % higher than those in the previous version of the 2021 models. However, as a result of reductions in general traffic capacity along Quay Street, Victoria Street and Fanshawe Street (due to the projects noted above), the model was unable to converge during the evening peak period. Fairly significant congestion was forecast, and a lack of model convergence would indicate that limited weight would have been given to any results for the evening peak, if these were "unstable". To address this issue, we reduced the forecast evening peak demands by 5 %, in order to be able to provide more stable and reliable results. This is considered to be reasonable, since, as stated above, there has been a long standing aim that additional travel demands to/from the Auckland CBD in the peak periods should be accommodated by transport modes other than the private car.

Details of the changes to the transport networks for the scenarios with the redevelopment of the Port are provided within Section 8 below.

The redevelopment assumptions were run through the MSM as part of MSM scenarios 2 and 6. In addition, we prepared "bottom up" trip predictions. These were developed using trip rates that were generally consistent with those used for the planning of the Wynyard Quarter redevelopment, which relied heavily on travel by modes of transport other than the private car. These "bottom up" predictions were found to be some 15% higher than those indicated by MSM as heading into or out from the site and onto Quay Street. We therefore applied a 15% reduction to the "bottom up" forecasts.

5.3 Tauranga transport modelling

The Tauranga Transport Strategic Model (TTSM) has been used to assess the effects of Scenario 3 and acts as a base case for the other scenarios, in terms of total travel times and distances within Tauranga and the Western Bay of Plenty. The model includes land use assumptions provided by Tauranga City Council (TCC), and transport infrastructure assumptions are as included in Programme 8.1 of the TTSM.

Truck volumes and distributions associated with the existing Ports of Tauranga operations in the 2018 base model were checked against observed data. We found that the model has an acceptable degree of accuracy. However, the forecast models for 2043 included only modest growth in Port related traffic, so these were modified in accordance with the low growth forecasts provided for Tauranga by King-Small.

To assess the effects of POAL relocation, truck numbers discussed in Section 3 were added to the 2043 forecast Port demands. The models assumed that the truck distributions predicted between SH2 and SH29 would be kept consistent between the scenarios without and with POAL relocation, and this assumption has been carried through for the purposes of assessing total travel times and distances (See Section 6). However, from discussions with Environment Waikato, it may be that a higher proportion of trucks between Auckland and Tauranga could route via SH29 and SH1 (Waikato Expressway, see Section 7).

5.4 Northport transport modelling

The SH1 Whangarei to Te Hana SATURN traffic model has been used to assess the effects of Scenario 2, and acts as a base case for the other scenarios.

The base model (year 2017) was checked in the Northport area. We found that the model under-estimated truck volumes at the SH1/SH15 intersection, and we therefore factored up the base truck demands in the model to match the observed truck flows. These changes will have had little impact on the overall model validation and therefore, we consider the model acceptable for further analysis.

A 2046 model was originally developed with forecast changes in traffic demands derived from Whangarei District Council's TRACKS model. We factored up the modelled truck demands to/from Northport, for the scenario without Port relocation, consistent with the changes to the base model.

For the scenario with POAL relocating to Northport (Scenario 2), we added the additional truck movements to the model. These trucks were assumed to route via SH15 and SH1 between Northport and SH1 south of Te Hana (this being the southern boundary of the model).

6 TRANSPORT MODELLING RESULTS

6.1 Total Travel Times and Total Travel Distances

An assessment has been carried out of the total road transport costs, in terms of total travel times and travel distances, using the three regional/sub regional transport models identified within Section 5 above, namely:

- The Auckland Macro Strategic Model (MSM)
- The Tauranga Transport Strategic Model
- A SATURN traffic model which covers State Highway 1 in Northland, from north of Te Hana to Whangarei.

These three models all consider different design years, but the truck forecasts for 2052/3 have been applied consistently to these models. The Auckland MSM considers the year 2048, so the following results refer to this being the assessment year.

Table 6 below provides a summary of the total travel times by road. The results for each of the three modelled time periods have been factored up to daily totals on the basis of three morning and evening peak hours per day (each), seven inter peak hours per day, and 11 "off peak" hours (with the times within the "off peak" derived from a factor of the inter peak models).

The actual numbers of hours and kilometres depend to a significant degree on the size of the models and the key outputs relate to the differences from the future base case (or "Business as Usual") which assumes that the POAL operations remain in the current site.

Table 6: Predicted Vehicle Hours (in 2048)

Scenario	Morning Peak Period (2 hours)	Inter Peak Period (2 hours)	Evening Peak Period (2 hours	Vehicle -Hours travelled by road (per day in 2048)
1: Business as usual	Future base	Future base	Future base	Future base
2: Northport	+ 900	+ 975	+ 950	+6,750 hrs/day
3: Ports of Tauranga	+ 1,175	+ 1,125	+ 750	+7,400 hrs/day
4: Firth of Thames	+ 475	+ 275	- 250	+1,550 hrs/day
5: Manukau Harbour	-	-200	- 900	-1,950 hrs/day

Tables 7 and 8 below provide a summary of the total distances by road, and the average speeds, these being the two main determinants of vehicle operating costs.

Table 7: Predicted Vehicle Kilometres Travelled (in 2048)

Scenario	Morning Peak Period (2 hours)	Inter Peak Period (2 hours)	Evening Peak Period (2 hours	Vehicle -Hours travelled by road (per day in 2048)
1: Business as usual	Future base	Future base	Future base	Future base
2: Northport	+ 24,425	+ 33,375	+ 26,475	+211,000 km/day
3: Ports of Tauranga	+ 62,850	+ 64,075	+ 61,925	+435,500 km/day
4: Firth of Thames	- 4,550	+ 3,500	- 6,575	+7,500 km/day
5: Manukau Harbour	- 24,400	- 14,475	- 26,025	-122,500 km/day

Table 8: Predicted Average Speeds (kph, in 2048)

Scenario	Morning Peak Period (2 hours)	Inter Peak Period (2 hours)	Evening Peak Period (2 hours
1: Business as usual	39.0	47.4	38.9
2: Northport	38.9	47.3	38.9
3: Ports of Tauranga	39.0	47.5	39.1
4: Firth of Thames	38.9	47.4	38.9
5: Manukau Harbour	38.9	47.4	39.0

The predicted total travel times and total travel distances for light and heavy vehicles, separately, are set out in Table 9 below.

Table 9: Predicted Total Travel Time and Travel Distances, for General Traffic and Heavy Vehicles (Daily, 2048)

Scenario	Vehicle Hours Travelled		Vehicle Kilometres Travelled	
	General Traffic	Heavy Vehicles	General Traffic	Heavy Vehicles
1: Business as usual	Future base	Future base	Future base	Future base
2: Northport	+1,550	+5,150	-106,500	+317,500
3: Ports of Tauranga	+200	+7,200	-120,000	+555,000
4: Firth of Thames	-1,550	+3,050	-117,000	+124,500
5: Manukau Harbour	-2,100	+150	-119,500	-3,500

The above figures have been converted to NZ dollar values in 2048, for travel times, vehicle operating costs and carbon dioxide emissions, using procedures and the different dollar values for light and heavy vehicles, set out in the NZ Transport Agency's Economic Evaluation Manual. Again, the absolute values derived are of little importance, as these depend on the extent of the models, but the importance for this study is the magnitude of any differences from the future base case (being the retention of the existing POAL operations).

Table 10: Monetised costs of road transport (per year in 2048, undiscounted)

Scenario	Travel Time Costs (including Congestion Costs)	Vehicle Operating Costs	CO2 Emission Costs	$ costs (per year in 2048, undiscounted)
1: Business as usual	Future base	Future base	Future base	Future base
2: Northport	+$80 million	+$165 million	+$10 million	+$250 million
3: Ports of Tauranga	+$100 million	+$300 million	+$15 million	+$410 million
4: Firth of Thames	+$30 million	+$55 million	+$5 million	+$85 million
5: Manukau Harbour	-$15 million	-$10 million	+$0 million	-$25 million

Table 11: Monetised costs of light and heavy vehicles (per year in 2048, undiscounted)

Scenario	Travel Time Costs		Vehicle Operating Costs		CO2 Emission Costs		$ Million costs (per year in 2048)	
	General Traffic	Heavy Vehicles	General Traffic	Heavy Vehicles	General Traffic	Heavy Vehicles	General Traffic	Heavy Vehicles
1: Business as usual	Future base		Future base		Future base		Future base	
2: Northport	+$13 m	+$68 m	-$10 m	+$172 m	+$0 m	+$7 m	+$2 m	+$247 m
3: Ports of Tauranga	+$1 m	+$97 m	-$11 m	+$311 m	+$0 m	+$12 m	-$11 m	+$420 m
4: Firth of Thames	-$12 m	+$41 m	-$11 m	+$66 m	+$0 m	+$3 m	-$24 m	+$105 m
5: Manukau Harbour	-$17 m	+$2 m	-$11 m	- $1 m	+$0 m	+$0 m	-$28 m	+$1 m

We acknowledge that there are gaps between the Auckland and Tauranga models, and between the Auckland and Northland models. The effects of these gaps have been taken into account by manual corrections (for example, based on the quantum of trucks travelling the distances between the models, and an estimate of the average speeds over these distances).

Also, it needs to be recognised that the values in the tables only relate to road transport. This means that the values are not comparing like with like, as the Northport and Tauranga scenarios assume a greater proportion of freight moving by rail. This will need to be taken into account in the overall economic analysis being carried out by Sapere.

The results indicate that the Northport and Tauranga scenarios will lead to greater road user costs, even with a lower quantum of freight goods being transported by road, as a significant proportion of goods will need to travel to Auckland. The Manukau Harbour option is predicted to lead to some (modest) travel cost savings, due to the closer proximity to the freight hubs within South Auckland. As expected, the majority of the forecast differences due to the Port options relate to HCV costs, although there are some, modest differences in costs for general traffic. This may be due to two separate factors:

- Differences in travel costs for general traffic, due to the different numbers of trucks along certain routes
- The redevelopment of the POAL site with scenarios 2-5, which will have led to reductions in new development elsewhere (as the MSM assumes a constant overall population for all tests).

It is not possible from the data provided to isolate these two issues, and it may be worthwhile, in due course, carrying out additional MSM tests, to explore the relative effects of these two components.

6.2 Travel demand in Auckland

As noted above, a key assumption in the MSM is that the total population of the Auckland region will remain constant if the POAL redevelopment occurs. Therefore, the redevelopment of the Port is assumed to lead to reductions in the magnitude of some future land use changes elsewhere in the region, and a standard calculation is applied in the MSM to share the effects across the region. Put another way, it is likely that the Port redevelopment will shift some land uses from the suburbs to the city centre.

The overall effects of this shift in land use has been assessed in terms of the total travel demands (excluding walking and cycling) in 2048 in the Auckland region, for the following MSM tests:

- Scenario 1. Retention of the existing freight operations at the existing POAL site. This is in effect the “Business as Usual” case
- Scenario 2. POAL freight operations relocated to Northport, with high intensity redevelopment of the POAL site

- Scenario 6. POAL freight operations relocated to Northport, with lower intensity redevelopment of the POAL site[7]

We have assumed that Scenarios 2 and 3 (with the Port being relocated to Northport and Tauranga, respectively) will lead to very similar total travel demands in the Auckland Region. Therefore only Scenario 2 has been used for the sensitivity test. The predicted travel demands are presented in Table 12.

Table 12: Auckland predicted travel demands, by modes (vehicles per hour) – 2048

	Car – Person Trips	Heavy Commercial Vehicle Trips	Bus Trips	Rail/Ferry Trips	Total Trips (excluding active modes)
Scenario with high intensity redevelopment of POAL site: demand difference vs. Scenario 1					
Morning Peak	- 4,700	- 450	- 50	+ 2,400	- 2,850
Inter Peak	- 2,350	- 400	+100	+ 300	- 2,400
Evening Peak	- 4,000	- 550	+150	+ 1,750	- 2,650
Scenario 6 (with moderate intensity redevelopment of POAL site): demand difference vs. Scenario 1					
Morning Peak	- 1,250	- 350	+ 200	+ 350	-1,050
Inter Peak	- 550	- 300	+ 50	-	-850
Evening Peak	- 1,000	- 450	+ 150	+ 100	-1,150

MSM predicts that the relocation of POAL to Northport (or the Port of Tauranga) will result in a minor reduction in travel demands in the Auckland region. An increase in public transport trips is predicted as a result of the redevelopment of the POAL site. We note that MSM assumes limited investment in bus infrastructure along Quay Street, while scenario 2 assumes the provision of a new rail station next to the proposed redevelopment site. This may have led to the very minor decrease in bus trips predicted in the morning peak, with Scenario 2, as there is predicted to be a significant increase in rail trips. If additional bus services were to be provided, then increases in bus trips could be expected (in all time periods, not only the morning peak where minor decreases are currently forecast).

In addition, the reduction of the total trips in MSM suggests that the redevelopment of the POAL site may result in additional active mode trips, which is a logical outcome.

Further commentary on effects in the City Centre that may result from redevelopment of the POAL site are discussed in Section 8.

[7] The sensitivity test, called Scenario 6, generally assumed 50% of the development set out in Section 4, but it included 25%, not 50%, of commercial uses

7 REGIONAL TRANSPORT INVESTMENT

The following section sets out the roading infrastructure projects expected to be required for each scenario, if the relocation of the Port occurs, which is assumed to be within 20 to 30 years.

As noted earlier, it is assumed that each of the relocation options will be served by rail, and the feasibility and cost of this assumption is being assessed in a separate workstream.

Section 3 above referred to low and high growth scenarios, in terms of future freight and therefore truck numbers, and this section refers primarily to the low growth scenario. Section 3 indicated that the difference in truck numbers between the low and high growth scenarios for the Tauranga and Northport options would be relatively modest (+15%), due to the assumption that the differential freight volume between the low and high growth scenarios would rely on a higher proportion of freight travelling by rail.

As discussed in Section 4, we have considered two redevelopment scenarios for the POAL land (a high intensity and a low intensity scenario), in the instance that the Port relocates. Section 8 below considers the implications of these scenarios on congestion in or around the Auckland CBD.

The following sections refer to the forecast operation of a number of intersections. An intersection that has a volume to capacity ratio of 100% is said to be at theoretical capacity. In reality, conditions tend to deteriorate before a value of 100% is reached, and values of 85 to 90% capacity are said to represent practical capacity. Values of over 100% represent an intersection that is predicted to operate over capacity.

7.1 Scenario 1: Business as Usual

The transport investments that may be required to support the expected increase in freight movements associated with the Port staying in its existing location are listed in Table 13, and relate to the numbered items shown in Figure 1 .

Figure 1: Scenario 1 potential roading investment

Table 13: Scenario 1 potential roading and public transport investment

	Location	Observed (2019) daily traffic flow	Modelled base year (2016) daily traffic flow	Future daily flows (2036)	Potential Roading/Public Transport Investment
1.	Grafton Gully	51,600	54,300	85,600	Improved Port Access through Grafton Gully is included in ATAP. This can be expected to be one of the key reasons for the significant forecast increase in forecast flows
2.	Tangihua Street	10,900	10,400	25,700	A significant increase in traffic is forecast, probably due to the need for traffic to switch from Quay Street to Customs Street, due to the Quay Street Boulevard project, to the west
	Beach Road (west of Grafton Gully)	-	20,900	27,200	The forecast flow should be within midblock capacity, but intersections will be the main constraint (eg Beach/Tangihua)
3.	The Strand (north-east of Grafton Gully)	25,600	23,000	37,200	This may be beyond (north of) the Grafton Gully improvements noted above. Consideration of intersection improvements will be required, to allow traffic to safely turn into/off The Strand
4.	Quay Street (between SH16 and Plumer Street)	22,000	24,200	30,000	This is to the east of the Quay Street Boulevard project, so is assumed to remain as four lanes. The intersections (including the two Port access intersections, below, plus Quay Street/SH16) will be the main constraints
5.	Tinley St/Quay St/Tangihua St	-	-	-	Predicted to be at capacity with low growth scenario, and significantly over capacity with high growth scenario
	Solent St/Tamaki Dr	-	-	-	Predicted to be at practical capacity with low growth scenario, and at theoretical capacity with high growth scenario
6.	Potential extension of SH16 to the Port	N/A	N/A	N/A	Viaduct and underpass options suggested in late 1990s would blight the lower Parnell area and were not progressed. An alternative could be The Strand becoming a Multilane Boulevard

The completion of improved access to the Port through Grafton Gully, assumed as part of ATAP, is an assumption of significant relevance to accommodating additional growth in activities associated with the existing Port. This project is not fully committed, and it would appear quite challenging to implement.

We are unclear at this stage whether this project is expected to continue along The Strand and through to the intersection with Quay Street. This would appear essential, in order to minimise adverse impacts within the CBD, i.e. along Beach Road and Tangihua Street.

7.2 Scenario 2: Northport

The transport investments that may be required to support the expected increase in road transport to/from the Port are listed in Table 14, and shown in Figure 2.

We noted that the Government's Infrastructure announcement in January 2020 included the proposal to upgrade SH1 between Whangarei and Port Marsden (SH15) to four lanes. This relates to the section north of Northport, so while this is of some relevance to this study, it is assumed that the vast majority of trucks will between Northport and the south.

The 2020 announcement did not refer to the Warkworth to Wellsford project, or any improvements along SH1 north as far as Port Marsden (SH15). Therefore we are generally assuming that these projects will proceed as proposed by the Whangarei to Auckland Programme Business Case[8], by the time of any Port relocation. However, based on the current Government's funding priorities, it may be that the Warkworth to Wellsford needs to be brought forward, if the Port moves to Northport.

The 2019 study into the Port relocation[9] recommended that a relocation to Northport should be accompanied by the establishment of a rail hub in northwest Auckland, around Kumeu. We understand that the completion of the Avondale – Southdown rail line is also proposed due to the Port relocation. With most freight between Northport and Auckland travelling to south Auckland, we assume that this rail based freight should continue by rail, and not transfer to road in Northwest Auckland.

[8] NZ Transport Agency (August 2017), "Whangarei to Auckland – Connecting Northland, Programme Business Case"
[9] NZ Government Working Group (November 2019), "Final Report of the Upper North Island Supply Chain Strategy Working Group"

Figure 2: Scenario 2 potential investment

Table 14: Scenario 2 potential roading and public transport investment

	Location	Observed daily traffic flow (2019)	Modelled base year (2017)daily traffic flow	Future daily traffic flow (2048) without Port move	Future daily traffic flow (2048) with Port move	Potential Roading/Public Transport Investment
1	SH15: SH1 to Port	6,900	8,000	15,700	19,000	Localised improvements to handle increases in local traffic, public transport and cycling, associated with an increase in the Port's workforce, may be required
2	SH1: SH15 to northern base of Brynderwyn Hills	11,300	11,900	20,100	23,400	Climbing lanes and safety improvements are expected likely to be provided, without the Port relocation, for safety and resilience reasons, as proposed in the Whangarei to Auckland PBC. Additional measures may be required due to the Port relocation, eg additional passing lanes, to allow cars/light vehicles to pass slowing moving trucks
3	SH1: Brynderwyn Hills	7,800	8,600	16,700	20,000	As above. Extra lanes or an alternative route is likely to be required due to the steep gradients and the additional slow trucks, as a result of relocation of the Port
4	SH1: southern base of Brynderwyn Hills to Te Hana	9,600	10,200	19,900	23,200	As (2) above. Additional measures may be required due to the Port relocation, eg additional passing lanes, to allow cars/light vehicles to pass slowing moving trucks
5	Warkworth to Te Hana	12,200	-	24,500	27, 800	The Warkworth to Wellsford project (which actually extends as a new "off line" four lane highway to Te Hana) is assumed to have been progressed, without the Port relocation, primarily for safety and resilience reasons, although it may need to be brought forward if the Port relocates to Northport
6	SH1/SH15 intersection	-	-	-	-	The intersection is predicted to operate at practical capacity, if it is upgraded to provide two entry lanes (on each approach) and two circulating lanes. A more significant solution (eg grade separation) may be required with higher growth, or for safety reasons

7.3 Scenario 3: Port of Tauranga

The transport investments that may be required to support the expected increase in road transport to/from the Port are listed in Table 15 and Figure 3.

Figure 3: Scenario 3 potential investment

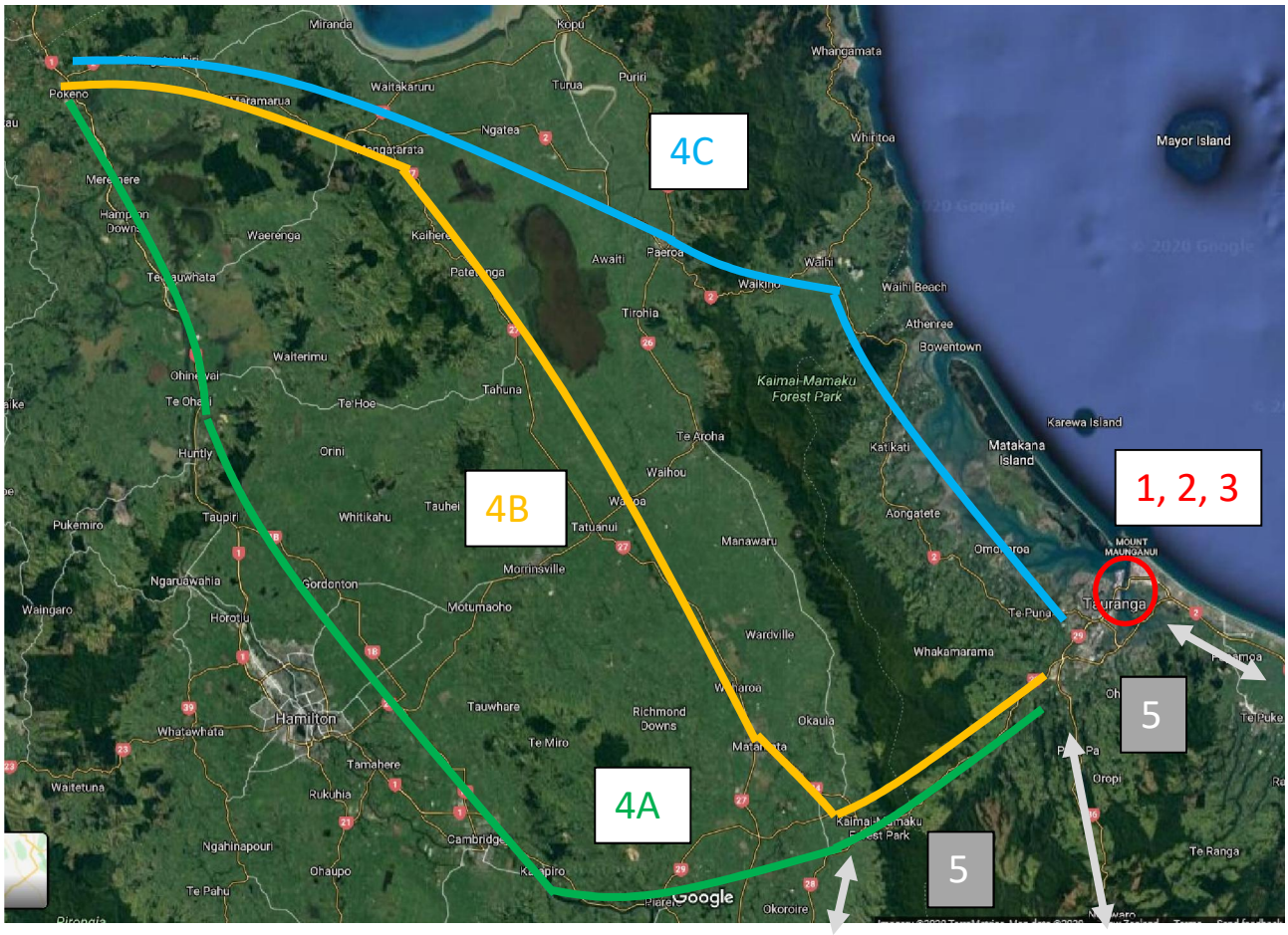

Table 15: Scenario 3 potential investment

	Location	Observed (2019) daily flow	Base Year (2018) daily flow	Future daily flow (2043) without Port move	Future daily flow(2043) with Port move	Potential Roading/Public Transport Investment
1.	SH2/Dive Street and SH2/ Chapel Street interchange	-	-	-	-	The intersection is predicted to be at practical capacity by 2048 with the Port relocation
2.	SH2/Tasman Quay Street intersection	-	-	-	-	The intersection is predicted to be operating over capacity by 2048 for the scenario without Port relocation
3.	SH2/Totara Street intersection	-	-	-	-	The intersection is predicted to be operating over capacity by 2048 for the scenario without Port relocation
	SH2 Waikareao Expressway: Elizabeth Street to Waipa Road SH29	42,400	47,900	71,200	74,500	Existing expressway anticipated to accommodate additional trucks
4. A	Tauranga to Pokeno: Option A SH29 and Waikato Expressway					Preferred freight route option for Environment Waikato
	SH29/29A intersection	-	-	-	-	NZTA/TCC are currently considering improvement options in the Tauriko area, without the Port relocation
	SH29: west of SH36 roundabout	24,000	25,600	32,300	34,600	NZTA is proposing safety and resilience improvements along SH29, which are likely to include intersection enhancements, for the scenario without the Port relocation[10]

[10] https://www.nzta.govt.nz/media-releases/new-plans-to-deliver-safety-improvements-for-three-waikato-state-highway-projects/

Table 15: Scenario 3 potential investment

	Location	Observed (2019) daily flow	Base Year (2018) daily flow	Future daily flow (2043) without Port move	Future daily flow(2043) with Port move	Potential Roading/Public Transport Investment
	SH29 Kaimai-Mamaku ranges	12,100	11,500	17,500	19,800	Safety and resilience improvements are proposed[11], but extra passing/overtaking lanes as a result of relocation of POAL are likely to be required, due to steep gradients and additional slow trucks
	SH29: Piarere to western base of Kaimai-Mamaku ranges	5,900	[12]	11,300	13,600	Safety improvements are expected to be provided, without the Port relocation[13]
	SH1: Cambridge to Piarere	19,900	-	25,300	27,600	The NZTA's longer term proposals may need to be brought forward, with the Port relocation
4. B	Tauranga to Pokeno: Option B SH29 and SH24/SH27/SH2					Shorter (by 17 km) and potentially faster (by 10 minutes) than using Waikato Expressway, but not the preferred route for Environment Waikato. Not assessed further
4. C	Tauranga to Pokeno: Option C SH2 via Waihi:					Not the preferred route, primarily due to significant constraints through the Karangahake Gorge. Not assessed further
5.	Improvements between Tauranga and the south					We have assumed that no further improvements are required to the south of the Tauranga Eastern Link, due to the Port relocation
6.	Relevant ATAP projects					• Rail electrification as far as Pukekohe is proposed (and will assist to free up SH1)

[11] See footnote 8
[12] The TTSM does not extend beyond the Kaimai Ranges, so the forecast flows have been derived from differences in flows on SH29 to the east of the Ranges
[13] See footnote 8

Table 15: Scenario 3 potential investment

	Location	Observed (2019) daily flow	Base Year (2018) daily flow	Future daily flow (2043) without Port move	Future daily flow(2043) with Port move	Potential Roading/Public Transport Investment
						• SH1 (Papakura to Bombay) is to provide additional capacity along SH1, south of the works currently under construction • The Mill Road project was reconfirmed by the Government's recent announcement, and should offer some relief to SH1 through South Auckland
	Tauranga long term projects that may be affected (with dates indicating which TTSM forecast years assume completion of each project)					• Takitimu Drive/Elizabeth Street signalised roundabout (2026) and grade separation (2031) • Ring Road connection from SH29 to SH36 (new Belk Road). 2026 • Ring Road from SH29 to SH36/Lake Blvd intersection. HOV priority. 2063 • SH29 4 lanes, Belk Road to Barkes Corner. 2043 • Takitimu Drive 4 lanes from SH29/SH36 to the Tauranga Northern Link. 2043 • Takitimu Drive/TNL connection to Elizabeth Street. Upgraded capacity with HOV lane • Signalisation of SH29/Cambridge Road intersection. 2021 • Roundabout at SH29/Redwood Lane. 2026 • Signalisation of SH29/Tauriko West access intersection. 2026 • Signalisation of SH29/Takitimu Drive intersection. 2026 • Signalisation of SH29/Cameron Road intersection. 2031

The routing of trucks between Tauranga and Auckland is a key issue for this option. The model assumes some 70% of trucks will use SH29, then the Waikato Expressway, with the other 30% assumed to use SH2, thereby travelling via the Karangahake Gorge. However, it should be stressed that this is an input assumption to the model, not a model prediction. It seems likely that additional work will be required along SH29 (assuming this is the preferred route) to accommodate the additional trucks.

Some localised intersection issues within Tauranga have also been identified.

We noted that the 2019 Working Group Study into Port relocation considered Auckland's East-West link to be a cost that should be attributed only to the Tauranga option. This was presumably on the basis that this option would need to get additional trucks across from SH1 in South Auckland across to Metroport. However, the ATAP 2018 document states that the lower cost option now proposed for the East-West Link is to be implemented within the first decade, meaning that it can be assumed to take place irrespective of the Port relocation.

7.4 Scenario 4: Firth of Thames

In this scenario POAL activities would relocate to the Firth of Thames, assumed to be a location offshore from Kawakawa Bay. The detail within the MSM in the area from Clevedon to Kawakawa Bay is very limited, to the extent that we have manually added the forecasts for the Port related trucks to the forecast flows without the relocation.

The transport investments that may be required to support the road transport to/from the Port are listed in Table 16 and Figure 4.

Figure 4: Scenario 4 potential investment

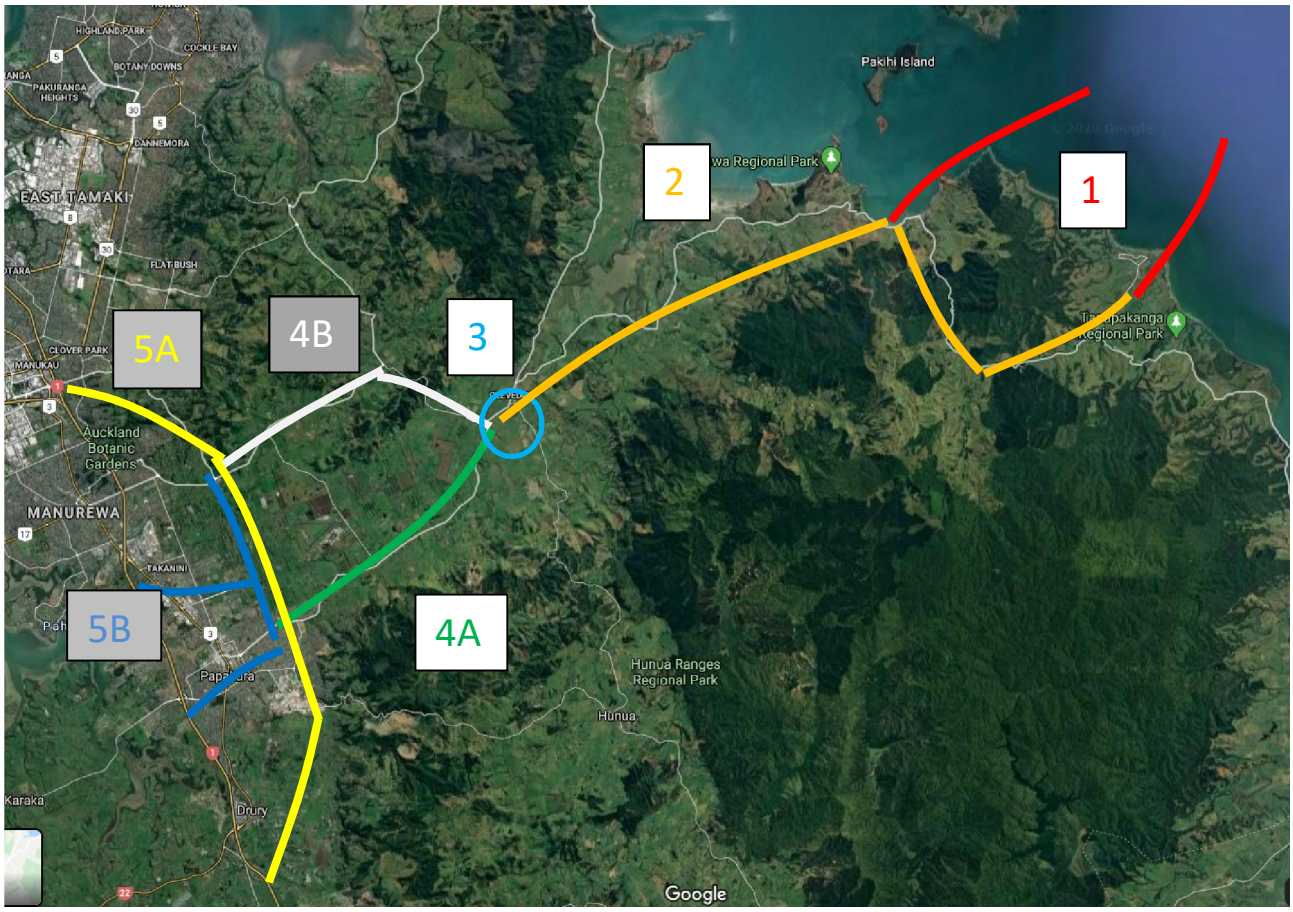

Table 16: Scenario 4 investment

	Location	Observed (2019) daily traffic flow	Future daily traffic flow (2048) without Port move	Future daily traffic flow (2048)with Port move	Potential Roading/Public Transport Investment
1.	New arterial road to Port via Clevedon Kawakawa Road	N/A	N/A	4,000 trucks	New access road (2 lanes plus slow vehicle/passing lanes where required)
2.	Clevedon-Kawakawa Road	4,400	5,800	9,800	Existing road likely to need safety and resilience improvements to accommodate Port traffic.
3.	Clevedon Village				
3A	Option A: Clevedon main street	6,400	-	-	Vehicle traffic is an existing concern to Clevedon residents. Routing Port traffic through the main street is unlikely to be palatable and therefore has not been considered further.
3B	Option B: Clevedon bypass	N/A	-	4,000 trucks	2-lane bypass, primarily for trucks, to the south and east of Clevedon
4. A	Clevedon to Mill Road: via Clevedon Papakura Road				
	Clevedon-Papakura Road	4,200	5,500	9,500	Existing road may need safety and resilience improvements to accommodate Port traffic.
4. B	Clevedon to Mill Rd: via West Road/Brookby Road: Alternative route to Papakura-Clevedon Road				Not preferred route due to steep gradient of West Road. Not further assessed.
5. A	Mill Road to SH1: New Mill Road corridor				
	Mill Road Stages 1 to 3	N/A	N/A	N/A	Included in ATAP and reconfirmed in Government's recent announcement

Table 16: Scenario 4 investment

	Location	Observed (2019) daily traffic flow	Future daily traffic flow (2048) without Port move	Future daily traffic flow (2048)with Port move	Potential Roading/Public Transport Investment
5. B	Mill Road to SH1: Using existing corridors as an alternate route to Mill Road project				Mill Road will take traffic to north or south, with traffic able to join SH1 at Redoubt Road (to the north) or Drury South)to the south). However, a more direct connection to SH1, probably at the Takanini interchange, would appear to have merit, although it will be challenging.
6.	ATAP projects that might be affected				• Rail Crossing grade separation (several crossings in the Takanini area) • Rail electrification as far as Pukekohe is proposed (and will assist to free up SH1) • The Mill Road project was reconfirmed by the Government's recent announcement

Therefore, the recommendations for the Firth of Thames option are that:

- A new roading link from Mill Road to the Firth of Thames site will be required, with a bypass of Clevedon.
- An improved connection from Mill Road to the Southern Motorway is also likely to be necessary.

7.5 Scenario 5: Manukau Harbour

In this scenario POAL activities would relocate to the Manukau Harbour, assumed to be a location offshore south of Auckland International Airport, with road access through the Puhinui Precinct to Roscommon Road.

The transport investments that may be required to support the expected increase in road transport to/from the Port are listed in Table 17, with options provided for each section.

Figure 5: Scenario 5 potential investment

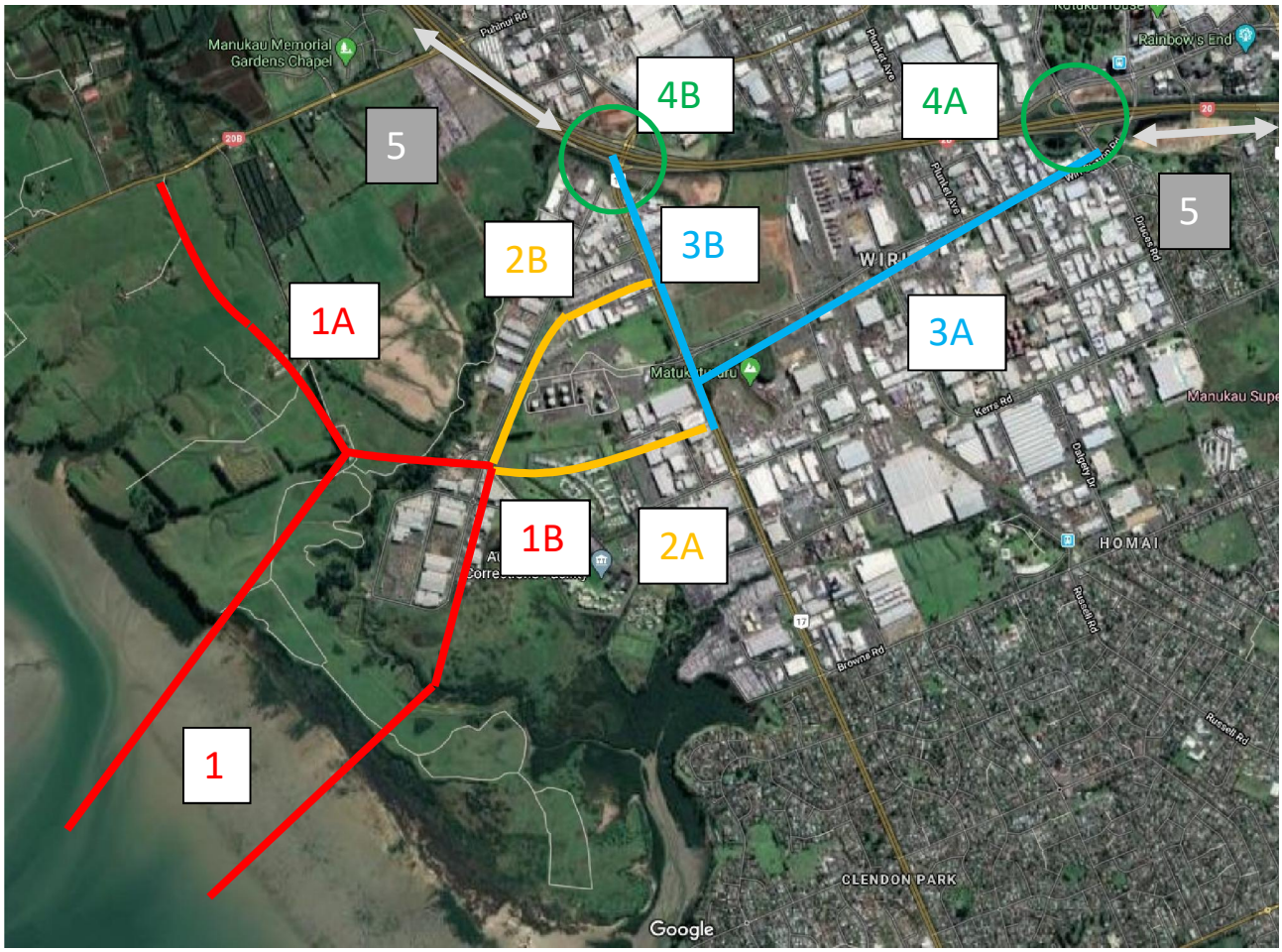

Table 17: Scenario 5 investment

	Location	Observed daily traffic flow (2019)	Future daily traffic flow (2048) without Port move	Future daily traffic flow(2048 with ort move)	Potential Roading/Public Transport Investment
1.	New arterial road to Port				New access road.
A	Via Southern Gateway precinct to SH20B, or	N/A	28,300	32,300	New arterial required with relocation of Port
B	Via McLaughlin's Road	2,600	28,300	32,300	Second alternative for new arterial required with relocation of Port
2.	McLaughlin's Road to Roscommon Road				
A	New arterial road between Wiri Oil and Women's Prison, or	N/A	42,000	46,000	New 4 lane arterial which could connect Port through to Roscommon Road. This would appear to be preferable, if it can fit between the identified land constraints.
B	McLaughlin's Road and Vogler Drive	N/A	42,000	46,000	Widen existing corridors to 4 lanes with associated intersection capacity improvements
3.	Roscommon Road to SH20				
A	Wiri Station Road to SH20 Lambie Drive interchange, or	14,000	17,400	21,400	Existing 4-lane arterial likely to be able to accommodate increase in trucks but some intersection and capacity improvements may be required. This is expected to be the preferred option due to greater available capacity compared with Roscommon Road route.
B	Roscommon Road to SH20 Cavendish Drive interchange	18,100	45,700	49,700	Widening may be required to accommodate anticipated general growth in traffic.

Table 17: Scenario 5 investment

	Location	Observed daily traffic flow (2019)	Future daily traffic flow (2048) without Port move	Future daily traffic flow(2048 with ort move)	Potential Roading/Public Transport Investment
4.	SH20 interchange access				
A	SH20/Lambie Drive interchange, or	-	-	-	Expected to be preferred option due to greater available capacity compared with Cavendish Drive interchange
B	SH20/Cavendish Drive interchange	-	-	-	This is a complex "double interchange", with SH20B. The Airport to Botany rapid transit project is expected to include the rapid transit facility passing along Puhinui Road to SH20B, so it would appear desirable to separate Port related trucks away from this complex interchange as far as possible
5.	ATAP projects that might be affected				• Airport to Botany rapid transit. This is expected to free up some capacity, by moving people out of cars, but it is also expected to remove some capacity for general traffic through the SH20/SH20B interchange • SH20B Eastern Airport Access

Therefore, the recommendation for the Manukau Harbour option is for a new arterial standard roading link from Roscommon Road/Wiri Station Road, out to Manukau Harbour site, with access to the State Highway network to be provided via the SH20/Lambie Drive interchange, rather than via the SH20/Cavendish Drive interchange.

8 AUCKLAND CITY CENTRE TRANSPORT EFFECTS

8.1 Comparison of traffic conditions in CBD, with Port retained or with redevelopment

A specific aspect of this study has been to consider the effects of the scenarios on congestion within the Auckland CBD, for scenarios that consider the Port remaining in the city centre, and for the Port relocating and redevelopment occurring at the POAL site.

As noted above, the relocation of the POAL site is likely to lead to the redevelopment of that site, and the two growth scenarios associated with the POAL remaining for freight uses have been compared with two redevelopment scenarios:

- The first is the one referred to above (with 5,800 apartments, hotels, plus commercial/retail for a total of almost 14,000 employees,
- The second scenario represents 50% of this level of development without hotel development (i.e. 2,900 apartments, commercial/retail for a total of almost 7,000 employees).

Table 18 identifies the traffic generating potential of these scenarios. It needs to be recognised that the effects of cars and light goods vehicles have less effect on the operation of the road network than a large truck. Therefore, all vehicles have been converted to passenger car units (PCUs) using a factor of 2 or 3 for large trucks (with cars being 1 PCU)[14]. The table provides forecasts for the weekday evening peak, this being the busiest time period in the Auckland CBD, along with the weekday inter peak, which will be the situation for much of the day. It should be acknowledged that traffic associated with the POAL operations are relatively consistent throughout the day, whereas traffic associated with the redevelopment scenarios will be more heavily concentrated toward the weekday morning and evening peaks.

[14] It is commonly assumed that trucks equal 2 PCUs, and this assumption has been made for the redevelopment scenarios, as trucks for these scenarios will be a mix of medium and large trucks. However, for the scenarios in which the existing POAL operations remain, the vehicles will be predominantly large trucks, which have been given a value of 3 PCUs. This is considered to be reasonable in general, although the effect of these large trucks up the relatively steep gradients of Grafton Gully are likely to be greater still.

Table 18: Movements from POAL site (PCUs/hour, two way)

Scenarios	Inter Peak			Evening Peak		
	Cars	Trucks	Total	Cars	Trucks	Total
Existing	160	470	630	170	500	660
POAL operations: Low Freight Growth	210	630	840	210	630	840
POAL operations: High Freight Growth	320	950	1,250	340	1,030	1,370
Redevelopment of POAL, higher intensity	2,170	130	2,300	2,450	150	2,600
Redevelopment of POAL, lower intensity	1,090	70	1,150	1,220	80	1,300

The above figures indicate that the total PCUs for the POAL high growth scenario would be similar to the lower intensity redevelopment scenario. However, the higher redevelopment scenario would be likely to lead to significantly greater numbers of PCUs. This is even with the assumption that significant proportions of residents and employees would be likely to travel by modes of transport other than the private car to and from this central Auckland site.

The results of these forecast flows associated with the POAL site have been assessed in the Auckland City Centre SATURN model. This currently exists with a furthest horizon year of 2036, so this year has been used for the assessment. The ATAP assumption, that improved access to the Port is to be provided through Grafton Gully, has been included in the model. Table 19 summarises the average travel speeds within the model.

Table 19: Average Travel Speeds in the Auckland CBD (Kilometres per hour)

Scenarios	Morning Peak	Inter Peak	Evening Peak
Existing	22.4	34.1	18.9
POAL operations: Low Growth	17.6	28.2	14.5
POAL operations: High Growth	16.9	27.8	13.8
Redevelopment of POAL, higher intensity	16.3	25.8	12.7
Redevelopment of POAL, lower intensity	17.2	27.5	14.2

The above speeds relate to the averages within the entire model, so the results may under-represent the extent of congestion in particular areas. However, the model outputs indicate the extent to which the higher intensity redevelopment scenario will lead to lower vehicle speeds in the city centre. Indeed, the MSM assumes that the total population of the Auckland region will remain constant if the POAL redevelopment occurs, and as noted in Section 6.2, the model indicates a reduction in total vehicle trips within the Auckland region, due to the implied relocation of some future land use changes from the suburbs to the city centre

We should emphasise that the above results may be viewed in a number of ways:

- While it may be possible for a greater proportion of freight to be carried by rail, if the POAL operations remain in central Auckland, freight trips by road will be considered as essential, and congestion for these essential trips may be considered to be unacceptable
- On the other hand, congestion for trips associated with residential and commercial development could be considered to be less unacceptable, as many of these trips will be made by modes other than the private vehicle. This may either be by walking and cycling modes, due to the proximity of the POAL site to the range of facilities within the CBD, or by public transport, given the proximity to bus, rail and ferry.

8.2 Redevelopment of POAL Land

We note that the actual number of vehicles that may be generated by the redevelopment of the POAL site will be heavily influenced by the availability of transport choice, and any travel demand measures. The transport investments that may be required to support the possible change in land use associated with redevelopment of the POAL land are listed in Table 20, and relate to the numbered items shown in Figure 6.

Figure 6: Scenarios 2 to 5 potential roading and public transport investment due to redevelopment of POAL

Table 20: Scenarios 2 to 5 potential roading and public transport investment associated with redevelopment of POAL land

	Location	Observed (2019) daily traffic flow	Modelled base year (2016) daily traffic flow or V/C at intersections	Future daily flow (2036) with higher intensity redevelopment	Potential Roading/Public Transport Investment
1.	Grafton Gully	51,600	54,300	93,100	See Table 13. The redevelopment is predicted to increase pressure along Grafton Gully
2.	Tangihua Street	10,900	10,400	33,300	See Table 13. The redevelopment is predicted to increase pressure on Tangihua Street
	Beach Road (west of Grafton Gully)		20,900	30,600	See Table 13. The redevelopment is predicted to increase pressure along Beach Road, and intersections are likely to be under increased pressure
3.	The Strand (north-east of Grafton Gully)	25,600	23,000	47,300	See Table 13. This may be beyond (north of) the Grafton Gully improvements noted above, and the redevelopment will increase problems for traffic turning into/off The Strand
4.	Quay Street (between SH16 and Plumer Street)	22,000	24,200	31,700	See Table 13s
5.	Tinley St/Quay St/Tangihua St	-	-	-	Predicted to be over capacity
	Solent St/Tamaki Dr	-	-	-	Predicted to be at practical capacity, even with additional access intersections serving the redevelopment off Quay Street
6.	Rail	N/A	N/A	N/A	New passenger train station proposed to serve POAL site

It will be essential for any redevelopment to seek to maximise accessibility by modes of transport other than the private car. The provision of a rail station on the eastern line, which will take passengers beyond Britomart via the City Rail Link, as well as to the east and south, would be necessary, along with investment in walking and cycling connections, plus bus stops and additional bus services along Tamaki Drive/Quay Street and maybe through the site.

As noted above, improved access to the Port through Grafton Gully is assumed within ATAP. Relocation of the Port could be perceived as reducing the need to accommodate essential truck movements, although Section 8.1 above notes that the redevelopment scenario is expected to increase traffic demands.

8.3 Effects of removing Ports related traffic

To understand the traffic impacts in the Auckland City Centre associated with the POAL operations, we have carried out a test in which we removed all traffic demands from and to the POAL site from the SATURN traffic model (i.e. this is a theoretical test, with no redevelopment of the site). Table 21 summarises the average travel speeds within the model, with the bottom line showing the results of the additional test (i.e. the test not referred to within Table 19).

Table 21: Average Travel Speeds in the Auckland CBD (Kilometres per hour)

Scenarios	Morning Peak	Inter Peak	Evening Peak
Existing	22.4	34.1	18.9
POAL operations: Low Growth	17.6	28.2	14.5
POAL operations: High Growth	16.9	27.8	13.8
POAL operations: traffic removed	17.9	28.9	15.5

The table indicates modest increases in overall travel times (comparing the future scenario with low growth at the Port, compared with the scenario with no Port related traffic). However, this hides the greater localised increases in travel times that can be expected. In the weekday evening peak these increases in speed (meaning reductions in congestion) are predicted to occur not just along Grafton Gully, but also within the City Centre, as some traffic is predicted by the model to reroute to Grafton Gully as a result of the (theoretical) removal of Port related traffic.

We have also considered the effect of existing Port related traffic on the Southern Motorway, this being the main route for the majority of Port related trucks. The existing daily weekday two way flow on the Newmarket Viaduct is around 180,000 vehicles/day. We have converted this current daily flow to passenger car unit equivalents, giving a total of 197,500 PCUs/day. By comparison, Port related trucks contribute about 6,500 PCUs/day, or about 3.3% of the total.