EY ARUP

Auckland Transport

Time of Use Charging

Options Assessment and Policy Framework Report

Reference: TOU-EYARP-IAXX-RPT-000005_v4_202507_OAPF Report

4 | 10 July 2025

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AT contract number 781-24-657-PS

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Executive Summary

Despite significant investment in road infrastructure and public transport, ongoing population growth means Auckland is now the most congested city in Australasia. Conditions are expected to worsen in future years as Auckland's rapid growth continues.

In common with cities around the world, and in line with government policy, Auckland is considering time of use (ToU) charging on selected roads. Along with other policy and investments supporting Auckland's overarching transport strategy, ToU charging could help manage travel demand, reduce congestion, and make better use of the existing road network.

The Time of Use charging study

The current programme of work builds on the strong foundations of previous studies. It is focused on understanding the role ToU charging plays in better connecting people, places, goods, and services across Auckland by maximising the productivity of the road network. In time, it will determine the respective costs, benefits, and impacts of potential ToU charging options to recommend the most appropriate way forward for Auckland.

This report

This report is an interim output of the AT/Auckland Council ToU programme, following an initial phase of activity. The focus of this phase was to review the identified potential options for ToU charging. The aim was to narrow the options under consideration, and develop further and more up-to-date insights into a fundamental question: *what could a successful time of use charging scheme for Auckland look like, and what benefits and disbenefits could such a scheme generate?*

This report serves two purposes:

1. Documenting the optioneering process undertaken so far, building from a clearly defined point of entry to a narrowed field of options which will be subject to further consideration as the programme progresses. It records evidence and aligns with the expectations of the New Zealand Transport Agency and Treasury's Better Business Case requirements.
2. Outlining emerging conclusions about the characteristics, requirements, benefits, challenges and opportunities associated with implementing a successful ToU charging scheme in Auckland that encourages public support, and produces outcomes aligned to the policy objectives.

It is important to note that this interim report represents a 'point in time view', which will need to be further refined and interrogated as the project progresses. At the time of writing, the ToU charging programme and corresponding options assessment has begun – but is not completed.

This document will ultimately form an addendum to a future feasibility and/or business case assessment of ToU charging for Auckland. It does not seek to fully articulate the strategic rationale for ToU charging, but instead documents the findings and implications of the work undertaken to-date to consider possible ToU options, as well as highlighting key insights from the analysis undertaken that should inform further options assessment and development.

A time of use scheme for Auckland

Successfully developing a ToU charging scheme for Auckland requires blending international best practice with a clear understanding of the city's unique needs and characteristics.

Eleven options were developed as part of this ToU study, focusing on geographical implementations of three scheme typologies (area charges, cordon charges, and link charges).

These options were subjected to two stages of assessment. The first, which considered a wide range of factors at a high level, resulted in the initial 11 options being reduced to six options.

Five of these options were assessed in further detail in relation to two critical issues: local economy impacts and socio-economic impacts, while the sixth, which was developed retrospectively, was recommended for but has not yet been taken forward for further assessment.

Options considered

The following summarises the options considered through this stage of the ToU study. Further detail can be found in Chapter 4.

1. Option Category 1 focused on applying charges for trips to / from Auckland city centre.
2. Option Category 2 focused on applying charges for trips to / from and within Auckland's inner isthmus area.
3. Option Category 3 focused on applying charges to trips using various sections of the motorway or arterial network.

Analysis of these options was based on a consistent charge applied during the morning and afternoon peaks. Option Category 1 charges were applied to the inbound direction only, while Options 2 and 3 were inbound and outbound directions.

Policy Framework

The options assessment was guided throughout by the Auckland ToU Policy Framework. This states that fundamentally, any ToU scheme for Auckland must deliver on the core objective of reducing congestion. This objective is underpinned by the principles of effectiveness, fairness, and simplicity.

Elements of a ToU scheme

A ToU scheme consists of four elements. Two of these – the charging location and charging tariff – form the 'core scheme'. The design of the core scheme is the most powerful tool to optimise effectiveness and simplicity and avoid problematic impacts before they occur.

Beyond the core scheme, complementary measures and targeted mitigation measures provide additional levers to enhance effectiveness and help to ensure a scheme is fair and has a social licence to operate. This includes reducing any significant negative impacts on vulnerable groups which cannot be avoided through the design of the core scheme. Since some of these measures work by selectively reducing the charge for some users, is important that they are applied sparingly to avoid undermining efficiency and simplicity of the core scheme. All of the elements of a ToU scheme were investigated as part of this study and are discussed in this report.

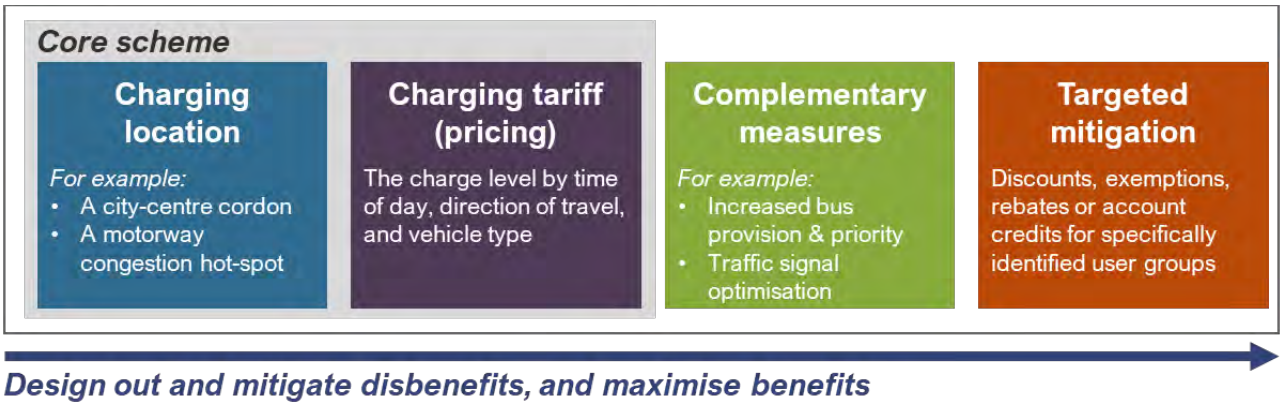

Figure 1: Elements of a time of use changing scheme

Emerging conclusions

While the study is ongoing, the following 'emerging conclusions' have been developed from work undertaken to date. These are based on learnings from global evidence, initial modelling analysis, and early engagement with key stakeholders.

Specific details refer to the three main categories of scheme described above: city centre cordon, inner isthmus area charge and motorway or arterial road links.

In this initial analysis, a consistent charge was applied across all options. This means that further improvements could be made by optimising the charge to the specific scheme.

1. **Every scheme option assessed could improve overall travel speeds and reduce overall congestion to a greater or lesser extent depending on the scale and location of the scheme and availability of alternatives.**
   All of the modelled scheme options improved regional average travel speeds and reduced overall congestion. However, despite a consistent charge being applied, effects varied significantly depending on the scale of the scheme, the nature of the locations charged and the availability of alternatives.

   Changes in congestion can be viewed from the perspective of the road network, which is represented as road kilometres congested. Alternatively, changes in congestion can be viewed from the perspective of road user journeys, represented as VKT congested (i.e. Level of Service E or above), which takes both traffic volume and road kilometres congested into account.

   Using these measures, congestion is shown in Table 1 and 2 respectively. These tables illustrate the differences in congestion on a regional level, and how these differences would be distributed between different road types by scheme options. For instance, modelling indicated that city centre cordon or area charges pushes traffic onto motorways, while charges on the motorway network divert traffic onto the arterial and local road network.

   In some schemes, while there may be a reduction in the length of road network congested, Aucklanders may end up spending greater distances of their journeys in congested conditions, but this does not necessarily equate to longer journey times (as discussed in later sections).

Table 1: Proportion of road network kilometres in congested conditions (AM and PM peak) by option

		Baseline	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	3e
% Road kms congested in AM peak	Motorway	20.1%	21.2%	20.1%	21.6%	20.8%	20.9%	23.7%	11.8%	18.5%	18.9%	21.7%	18.5%
	Arterial	10.9%	10.3%	10.3%	9.9%	9.5%	9.5%	9.4%	11.7%	11.1%	10.4%	10.6%	11.5%
	Local / Collector	2.6%	2.4%	2.5%	2.6%	2.0%	2.1%	2.1%	2.8%	2.8%	2.6%	2.5%	2.8%
	Region-wide Road Network	***7.8%***	***7.6%***	***7.6%***	***7.6%***	***7.2%***	***7.2%***	***7.5%***	***7.7%***	***7.7%***	***7.5%***	***7.8%***	***7.9%***
% Road kms congested in PM peak	Motorway	28.1%	26.7%	25.5%	27.1%	24.4%	25.1%	25.9%	14.1%	22.6%	23.1%	27.8%	23.4%
	Arterial	11.3%	10.9%	11.1%	10.7%	10.0%	9.9%	10.1%	12.4%	12.1%	11.7%	11.3%	12.0%
	Local / Collector	2.9%	2.7%	2.7%	2.6%	2.3%	2.3%	2.4%	3.2%	3.1%	2.9%	2.8%	2.9%
	Region-wide Road Network	***9.2%***	***8.9%***	***8.8%***	***8.8%***	***8.3%***	***8.3%***	***8.5%***	***8.7%***	***9.0%***	***8.9%***	***9.1%***	***9.0%***

No change	Decrease in road kms in congested conditions	Increase in road kms in congested conditions

Table 2: Proportion of vehicle kilometres travelled (VKT) in congested conditions (AM and PM peak) by option

		Baseline	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	3e
% VKT congested in AM peak	Motorway	33.4%	35.0%	32.0%	35.5%	34.1%	34.8%	38.5%	22.3%	30.0%	30.6%	35.9%	31.1%
	Arterial	22.0%	20.8%	20.7%	20.2%	19.8%	19.7%	19.4%	22.3%	21.9%	20.7%	21.7%	22.8%
	Local / Collector	8.1%	7.7%	7.8%	8.1%	6.1%	6.6%	6.6%	8.3%	8.3%	7.7%	7.5%	*8.8%*
	Region-wide Road Network	***24.8%***	***25.0%***	***23.7%***	***25.1%***	***24.1%***	***24.4%***	***25.9%***	***20.6%***	***23.3%***	***23.0%***	***25.6%***	***24.0%***
% VKT congested in PM peak	Motorway	44.8%	41.5%	39.2%	42.4%	38.3%	39.1%	40.3%	25.7%	35.8%	36.1%	43.9%	37.7%
	Arterial	21.1%	20.6%	20.8%	20.3%	19.3%	19.1%	19.2%	22.3%	22.3%	21.6%	21.3%	22.0%
	Local / Collector	8.4%	8.0%	7.9%	7.9%	7.2%	7.0%	7.3%	9.2%	8.9%	8.4%	8.3%	8.5%
	Region-wide Road Network	***29.6%***	***28.1%***	***27.2%***	***28.3%***	***26.4%***	***26.6%***	***27.2%***	***22.5%***	***26.3%***	***26.1%***	***29.3%***	***26.9%***

No change	Decrease in VKT in congested conditions	Increase in VKT in congested conditions

2. **Traffic diversion is a key consideration for any scheme - it is difficult to charge only one part of the road network without having negative impacts on other parts.**
   Network modelling demonstrates that when parts of the network are charged under any scheme type, some traffic will divert to uncharged routes to avoid charges. At the simplest level, charging only arterial routes will see traffic divert to motorways. Similarly, charging only motorway routes will see traffic will divert to arterials. These diversionary impacts can be particularly significant when uncharged routes are already nearing congestion, when they are not designed to accommodate high traffic volumes, or when they impact key bus routes.

   Modelling indicated that the highest volume of diversion occurs for motorway link schemes. By contrast, relatively little traffic diverted in the city centre schemes, but this was still enough to congest some key motorway links in the morning peak.

   Although not definitive, the need to avoid significant diversion impacts suggests advantages for cordon and area schemes, which are more difficult to avoid. It also suggests advantages for schemes that can combine both local roads and motorways, which are also more difficult to avoid.

   Diversion is far less likely when a *destination* is charged, since the charge cannot be avoided by taking an alternative route.

3. **Charging access to a destination is also likely to stimulate more mode shift than charging a link.**
   The existing public transport network is generally configured to provide access to key centres – or destinations – where trips converge. The availability of a public transport alternative means that charging a destination will see a relatively high proportion of trips swap to public transport.

   By comparison, the PT network is not generally configured to provide an alternative for travel through specific links on the network. Travel through links generally comes from, and is going to, many different origins and destinations, which makes it more difficult to service with public transport. Charging a network link will generally see a relatively small number of trips swap to public transport.

   Modelling indicated that charges on the motorway network – particularly at individual links - saw a relatively small shift to PT compared to charging the city centre as a destination.

Table 3: Change in proportion of daily trips by car and public transport relative to baseline

Daily trips (%)	Baseline	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	3e
Car	4,824,369	-0.5%	-0.5%	-0.6%	-0.8%	-0.8%	-0.8%	0.0%	-0.1%	-0.5%	-0.1%	-0.1%
PT	433,509	+1.9%	+2.2%	+2.6%	+5.8%	+5.9%	+3.6%	+1.9%	+1.4%	+2.5%	+0.9%	+0.5%

No change	Increase in trips made by mode	Decrease in trips made by mode

4. **It will be more complex and costly to provide public/active transport alternatives for charges covering large areas or motorway links as opposed to trips towards a defined area.**

   Trips to and through large areas or using motorway links typically have both dispersed origins and dispersed destinations. As a result, it is harder (and therefore more costly) to use public transport to mitigate impacts since public transport networks are configured to provide access between origins and destinations rather than alternatives to major highway links themselves.

   In contrast when charges are focused on access to or from a defined area then the complexity of journeys that need to be provided for is reduced. These journeys are also likely to be better captured by existing public transport networks focused on access to key destinations such the city centre.

   Other complementary measures, particularly network optimisation (e.g. high occupancy vehicle or bus lanes), could however support and enhance link schemes.

5. **Charging large areas, or very high-volume road networks, will bring greater trade-offs.**

   Geographically larger schemes, such as those covering the whole inner isthmus, or those charging very heavily used routes, such as the entire motorway network, capture more people. This tends to lead to a greater absolute reduction in time savings, as shown below.

   The relationship between the scale of the scheme and absolute reduction in time savings is non-linear. The number of network-wide minutes saved per vehicle trip charged by scheme option decreases as the number of people charged increases.

   The travel time savings indicated in Table 4 are a ratio to demonstrate the effectiveness of scheme scale on network-wide travel time savings. It is important to note that this does not represent travel time savings experienced by any individual user of the network.

Table 4: Network-wide travel time saved compared to number of charged vehicle trips (AM and PM peak)

		1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	3e
AM	Total person hours saved/(added) *(network wide, 000s)*	5.0	7.3	6.6	12.7	9.8	8.9	13.3	7.7	8.2	0.6	5.1
	Charged vehicle trips *(network wide, 000s)*	19.0	29.6	30.7	105.6	89.0	47.3	100.0	45.4	53.2	2.2	34.8
	Number of minutes saved/(added) *(network wide)* per vehicle trip charged	15.9	14.8	12.8	7.2	6.6	11.3	8.0	10.2	9.3	16.7	8.8
PM	Total person hours saved/(added) *(network wide, 000s)*	1.6	4.6	3.3	11.9	8.3	5.7	13.0	6.4	7.3	(0.4)	6.6
	Charged vehicle trips *(network wide, 000s)*	17.9	33.0	28.2	107.6	89.7	46.3	104.0	44.8	52.8	2.4	40.5
	Number of minutes saved/(added) *(network wide)* per vehicle trip charged	5.3	8.4	7.0	6.6	5.5	7.4	7.5	8.5	8.3	(10.9)	9.8

The proportionate impact on low-income groups is broadly consistent between options. This means that options which cover larger geographical areas or charge a higher number of trips impact a correspondingly higher absolute number of people on low-incomes.

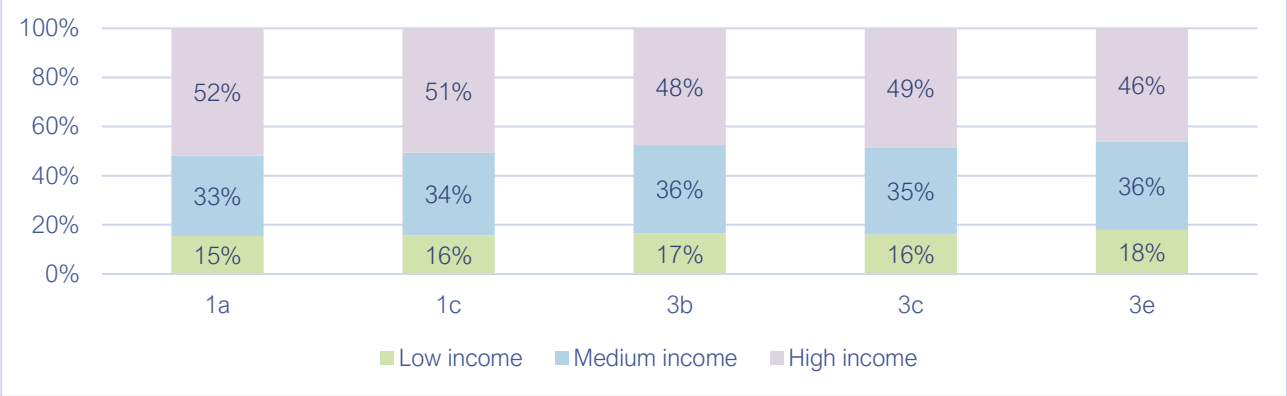

Figure 2: Daily number of trips charged by income group (note only assessed for schemes assessed at Stage B – source ABM)

Combined with the structure of the public transport network, which is primarily focused on servicing trips to / from the city centre, those subject to charges on motorways have fewer opportunities to avoid charges by changing mode.
Trade-offs between scheme effectiveness, fairness, and simplicity will therefore be key considerations in future phases of scheme assessment and design.

6. **Some targeted mitigation is likely to be warranted but must be very carefully considered.**

In line with the Policy Framework, and to secure social licence, a ToU scheme for Auckland should avoid creating disproportionate disbenefits for vulnerable communities.

Some groups – particularly those who are most dependent on cars, such as some people with mobility impairments, are likely to be systematically disadvantaged by charges, regardless of the location of the scheme. The case for targeted mitigations is likely to be very strong for this group of users in particular. International experience shows that the majority of schemes have introduced discounts for disabled people to address similar concerns.

Beyond this, all schemes will affect some user groups who may be considered vulnerable to some extent, with larger schemes having a greater impact. Coupled with the greater difficulty of delivering the public transport alternatives that can avoid unfairness, this is likely to lead to correspondingly greater calls for targeted mitigation.

This must be carefully considered since discounts and exemptions will tend to directly undermine the effectiveness of the scheme, and if large numbers of recipients are identified this could be a significant effect.

7. Our assessment has found all scheme options considered would generate revenue that exceeds their implementation and operating costs.

   International precedent typically applies scheme revenues first to support scheme delivery and efficiency, and then to complementary measures, and then to other local priorities.

   Further work is needed to optimise the approach to charging to determine the most appropriate charge level. It will be important to balance the charge level required to generate the necessary congestion reduction without being perceived as a 'revenue-focused' scheme.

8. A trial may provide useful information relating to behaviour change but will not demonstrate network effects or enable the testing of technology or systems.

   Without enabling legislation and investment in back-office technologies it would be extremely challenging to deliver a trial that would be representative of a full scheme.

   Since a trial is unlikely to provide more than a partial view of what a full scheme could achieve, the value of this approach is likely to be limited. Further testing and refinement of the options considered in this paper, including progressing work on key inputs such as willingness to pay by different user groups, is likely to be more beneficial to technical understanding.

9. The scheme that is right for Auckland will need to respond to Auckland's challenges.

   Internationally, every scheme that has been implemented has been successful in achieving that scheme's objectives, but they all differ to some extent from one another in one way or another. This reflects the fact that scheme design must be tailored to address contextually specific trade-offs.

   Ultimately the scheme that is right for Auckland will need to respond to Auckland's challenges, while maximising the benefits of time of use charging, including for those who pay the charge. Flexibility will be key to ensuring a scheme is able to respond to locally specific conditions and continue to deliver benefits as conditions and behaviours change.

Next steps

This report represents a 'point in time view', which will need to be further refined, developed and interrogated as this work progresses. The immediate next step will be to complete the remaining components of the Stage B assessment.

Additional next steps may involve:

- Carrying out mana whenua and Māori impact analysis and engagement.
- Carrying out Stage B Assessment of Option 2c.
- Undertaking more detailed analysis to better understand the impacts of a cordon charge on the city centre, taking account of the impacts of the COVID-19 pandemic and ongoing construction.
- Undertaking a more robust assessment of the origin-destination patterns of motorway trips, alongside mapping of the public transport network, to better understand public transport alternatives that could provide viable alternatives to motorway journeys.

- Gaining a deeper understanding of the impacts on groups adjacent to the cordon boundary, as well as the potential effect these impacts could have on a scheme's social licence, and appropriate approach to mitigating these impacts on particular groups.
- Better understanding the natural 'competitors' to the charged areas, and the influence time and price level of charge is likely to have on discretionary trips.
- Reviewing the diversionary impacts of link scheme types in greater detail – to better understand the degree to which these could be mitigated, and the resulting impact on the options effectiveness.
- Early economic modelling to understand economic costs associated with network performance, social and distributional impacts, environmental impacts, impacts to local businesses and wider economic impacts.
- Early financial modelling to understand capital costs, lifecycle costs and revenue associated with each of the shortlisted options.
- Engaging with SMEs, community, and stakeholders to better understand their concerns / needs and inform the refinement of complementary measures and mitigations.
- Progressing pricing work to more fully understand the factors to consider when setting a scheme charge. This should include:
    - testing and optimisation of the pricing level (charge),
    - removal of pricing on counter directional flow,
    - review of current willingness to pay values used in transport modelling to represent response to ToU charging. Consideration should be given to collecting new primary data which is specific to Auckland and the different user groups accounted for in transport models, and
    - testing of different pricing levels in different locations.
- Undertaking adjustment and optimisation of options where this could improve effectiveness or social licence.

1. Introduction

1.1 Context

Despite significant investment in transport infrastructure, Auckland is now the most congested city in Australasia. Conditions are expected to worsen in future years despite further planned multi-billion-dollar transport investments.

In common with cities around the world, and in alignment with recent government policy, Auckland is considering time of use (ToU) charging on selected roads. This could help manage travel demand, reduce congestion, and make better use of the existing road network.

The idea of a ToU charging scheme for Auckland is not new. The proposition was first contemplated in earnest in 2006's Auckland Road Pricing Evaluation Study. The options and impacts have been further developed and examined, most recently and extensively between 2017 and 2020 in The Congestion Question (TCQ), as well as the 2021 Select Committee inquiry into congestion pricing in Auckland.

What is time of use charging?

Time of use (ToU) charging is a form of congestion charging. Charging road users during peak times can help ease congestion by encouraging people to use public roads in the most productive way possible, resulting in better use of the road network. It may also encourage people to travel at different times, or by different modes – contributing to reduced congestion at peak times.

Time of use charging has been rolled out successfully in cities around the world. There is an opportunity to deliver a scheme that has Auckland's issues in mind, developed by the people who experience congestion daily.

It is widely recognised that time of use charging in any form is not a 'silver bullet' to addressing all congestion issues but rather a tool in a broader toolbox of measures to enable effective, efficient and sustainable movement throughout Auckland.

In 2023, Auckland Council (AC) and the Transport Infrastructure Committee (now the Transport, Resilience and Infrastructure Committee [TRIC]) endorsed the creation of a programme team to progress ToU charging. The current time of use programme builds on the strong foundations of previous studies to, in time, determine the respective costs, benefits and impacts of each option to recommend the most appropriate way forward for Auckland.

In line with TRIC direction, Auckland Transport (AT) has led the development of a Policy Framework. The Framework sets out the primary objective of the scheme (managing travel demand to achieve an improvement in road network performance) and core policy principles (effective, fair, simple) which are fundamental to scheme design and development.

The Policy Framework has informed all aspects of the options assessment including consideration of transport metrics like traffic volumes, average speed and volume of people and goods movement, journey time reliability and alternative transport options. This has been supplemented by social factors, such as the positive and negative impacts on communities, residents and businesses.

1.2 Purpose of this report

This report is an interim output of the AT ToU programme and is intended to summarise an initial period of activity. The core focus of this period of the programme was to review the identified potential options for ToU charging with an aim to narrow the options under consideration. In doing so this work develops further and more up-to-date insight into a fundamental question:

What could a successful time of use charging scheme for Auckland look like, and what benefits and disbenefits could such a scheme generate?

Further insight and understanding on the appropriate characteristics of a successful ToU charging for Auckland is of particular importance given the government is currently drafting legislation for ToU charging.

This work is intended to inform the AC Group submission to draft Time of Use legislation. It will also mean that the Council Group can move quickly to propose a scheme, if desirable, once the legislation is in place.

This study has further explored the assessment of critical impacts and benefits that might arise from potential schemes, establishing a three-stage options assessment process (explained in more detail in Chapter 3). Through this the granularity of assessment is increased as the field of options reduces, while variations on promising scheme options are tested and refined.

It is important to note that this interim report represents a 'point in time view', and the findings will need to be further refined and interrogated. At the time of writing, the ToU charging programme and corresponding options assessment has begun – but is not completed.

1.3 Material and analysis feeding into this report

This report summarises and draws insights from the substantial body of new policy and option development work that has been undertaken to-date, and encompasses the following activites:

1. **The development of three 'option categories' and subsequent detailed scheme options within each category**, allowing the implications and trade-offs between a wide range of options to be considered,
2. **Modelling and analysis using Auckland Forecasting Centre's (AFC's) Macro Strategic Model (MSM)** to identify expected benefits, such as congestion reduction and time savings, along with other impacts such as time shift and modal shift and traffic diversion impacts.
3. **Application of an Agent-Based Model (ABM) for Auckland** [1] to derive detailed insights into potential impacts on people across diverse demographic segments,
4. **Development of a comprehensive multi-criteria options assessment framework** to explore the performance of the scheme options against Auckland Transport's (AT's) Policy Framework for ToU charging,
5. **Development of a structured three-stage assessment process** designed to steer the selection of a preferred option for Auckland,
6. **Completion of the first stage of the assessment process** [2], confirmation of prioritised and deprioritised options, and the commencement of components of the second stage assessment including initial social impact assessment and local economy assessments drawing on the ABM and international case studies, and
7. **Extensive exploration of key aspects of wider policy** connected to ToU charging, covering pricing policy, complementary measures, and mitigations.

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[1] Traditional methods to tackle similar national and local demographic investigations often make use of aggregated data such as the national census. This provides high-level, sensible estimates for transport service performance, but limits the accuracy and granularity of the data. Agent Based Models take a different and more detailed approach in comparison to traditional transport modelling by seeking to replicate and understand the interactions of individuals (the agents) with a transport network. Agents represent real people with daily activity plans who are then simulated in terms of decision making and use of the transport network. This allows examination of the impact of a range of policy questions that can then be understood both from a transport perspective but also in terms of social and demographic factors in a level of detail not possible by other approaches.

[2] All initially short listed options have been taken through a full Stage A assesssment. Option 2c has gone through the Stage A Assessment but has not been considered through the Partial Stage B Assessment. New and emerging options (3f and 3g) have undregone a network assessment but no additional analysis has been carried out on these options.

Drawing from all these activities, this report provides key insights and recommendations for the development of a successful ToU charging scheme for Auckland. This report is further supported by a series of detailed Appendices which provide more specific commentary on the activities listed above.

Insight derived from integrated input from across the time of use programme workstreams

The AT ToU programme involves five different workstreams, shown in Figure 3, who are closely collaborating to develop assess and identify an appropriate ToU charging solution for Auckland.

The approach detailed in this report has been led by the Policy workstream with the analysis, insights and conclusions being informed to varying degrees by all workstreams involved in the programme.

Figure 3: AT Time of use programme workstreams

2. Point of Entry and Approach

2.1 Building on The Congestion Question

This study builds on the findings of TCQ, which itself built on seven years of work focused on understanding the potential congestion charging opportunity for Auckland. TCQ provides the robust starting point for all aspects of this phase of work.

This study takes as its starting point the City Centre Cordon and Strategic Corridors scheme options recommended by TCQ, together with additional 'hot-spot' options developed in response to feedback from the TRIC.

These different overarching scheme typologies have informed a 'three categories' approach to option development, as summarised in Table 4, below. More information on the options developed within these categories is set out in Chapter 4.

Table 4: The "Three Categories" of options in this ToU study

Option and source	Approach taken forward in this study
City Centre Cordon (TCQ)	Option 1 Category included three different options built around a city centre cordon. Variants include the inclusion or exclusion of motorway trips, and the extension of the cordon boundary to encompass city fringe suburbs
Strategic Corridors (TCQ)	Option 2 Category built around charges on roads in the Inner Isthmus, representing a scaled approach to delivery of the Strategic Corridors option envisaged in TCQ. Variants include the inclusion or exclusion of motorway trips, and the use of cordon charge or area charge typology.
Hot-Spots	Option 3 Category which targets congestion hotspots across the network. Variants include motorway or arterial hotspots, as well as testing the impact of charging different points of the network.

As well as informing the options under consideration for development and assessment, TCQ has also helped to define the scope of the wider policy and assessment work undertaken through this study.

Dedicated streams of policy work have been established to give further detailed consideration to three key aspects highlighted in TCQ as being important to the eventual definition of a successful congestion pricing scheme:

1. Pricing and tariffs,
2. Complementary measures, and
3. Mitigation measures.

The insights drawn from further consideration of these three aspects of any ToU scheme are summarised in Chapter 9.

2.2 The Auckland time of use charging policy framework

The core guiding consideration through all the policy work undertaken in this ToU charging study has been the Policy Framework developed by AT and AC, which sets out the objectives and principles of the scheme. This is based on the policy direction approved by TRIC, and also aligns to Central Government's focus on congestion reduction.

The Policy Framework has been particularly important in shaping the development of the ToU Options Assessment Framework (discussed further in Chapter 3) – informing the objectives and criteria to be assessed – and the exploration of wider policy issues.

Primary Objective	The central goal that drives what we're trying to achieve	To manage travel demand to achieve an improvement in road network performance by: • Reducing congestion • Increasing throughput of people and goods • Improving reliability of the road network
Core Policy Principles	The critical success factors which will be fundamental to scheme design	1. **Effective**: Improve network performance. 2. **Fair**: Minimise and mitigate adverse social impacts and ensure benefits and costs are fairly distributed across users. 3. **Simple**: Be understandable and avoid complexity. 4. **Feasible:** Be practical, acceptable, and affordable.
Supporting Policy Principles	These will guide the development of the scheme design	1. Be flexible in time, location, and pricing to achieve target congestion levels. 2. Target travel in congested conditions. 3. Target locations and routes where users have viable alternatives and discourage lower value discretionary trips. 4. Vary for different vehicle types according to the contribution they make to congestion. 5. Improves accessibility for most people and most businesses. 6. Be technologically achievable, adaptable, cost effective, and efficient. 7. Avoid mitigations that undermine the efficacy of the scheme. 8. Support ability to spatially extend and modify the scheme. 9. Avoids unwanted consequences, e.g. significant fiscal costs for vulnerable communities, diversions, community severance.
Secondary Outcomes	There are not objectives being sought and do not shape scheme design but are expected to occur as a result of time of use charging. They will be tracked and measured.	1. Share of travel by public transport, walking, and cycling 2. Carbon emissions reduction 3. Net revenue 4. Improved air and water quality
Assessment Criteria	Provides a framework to consistently assess potions, aligned to the intent of the policy framework	

Figure 4: Auckland time of use charging policy framework

2.3 Components of a Time of Use scheme

As noted above, the point of entry for several of the options assessed through this ToU study was the recommendations of TCQ in terms of the geographical location and types of charges that were shown to be most promising at delivering the objectives and appropriate for implementation.

However, while the geographical location of a charging scheme is often its most recognisable feature, a complete ToU scheme is comprised of a *package* of elements that work together to:

1. Optimise benefits aligned to a scheme's objective (in this case, reducing congestion),
2. Avoid problematic impacts, and
3. Mitigate residual disbenefits.

Through the option development and assessment of options, these elements (shown in Figure 5) have been worked through broadly in sequence, although detailed exploration of charging tariffs has not yet been undertaken. Each of the scheme elements is discussed in turn below.

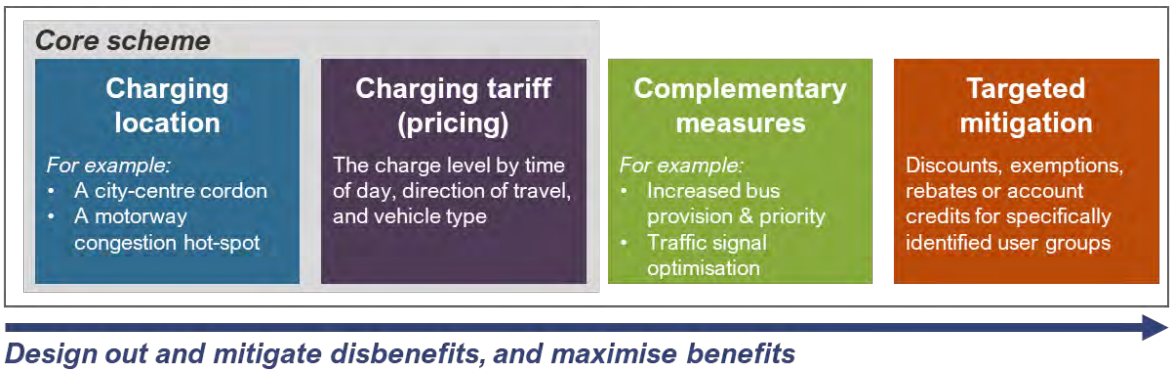


Figure 5: Elements of a time of use charging scheme

The core scheme – a charging location and charging tariff

The core of a congestion pricing scheme is comprised of two elements: a location and a tariff. In practice these issues are sometimes heavily interrelated.

Charging location

The choice of a charging location has a critical role to play in achieving the scheme objective of reducing congestion. It will fundamentally shape which parts of the road network are likely to be impacted, the types of trips which would be charged, and the scale of the impact (benefit and disbenefit) a charge might have.

The bulk of the optioneering work carried out in this study relates to this element of a scheme, with options assessed focusing on and around the city centre, inner isthmus, and motorway network (see Chapter 4 onwards).

Charging tariff

The charges payable under a congestion pricing scheme will also strongly determine its impact. The scheme options assessed to date have adopted a nominal $3 charge as a starting point. This is the same charge level used in TCQ. It is important to note that this is a nominal value which is likely to be higher in real terms. Significant further work will be needed to identify the optimal charging level. No work has yet been advanced on the operating hours of the scheme, and how the tariff may vary across the day.

Three broad 'types' of charging schemes have been considered through this study, as well as hybrid schemes comprised of multiple scheme types:

1. Cordon schemes: In a cordon scheme, charges are payable when crossing a 'boundary' surrounding a defined geographical area. Cordon schemes typically apply to geographic areas which are home to certain attractors, for example a city centre area.
2. Link schemes: In link schemes, charges are payable for use of specific roads or road links on the road network (typically arterials or motorways) rather than extended areas. Vehicles are charged for use of the specific link. Link based schemes can be further divided into two subcategories:
    a) Point charges which are located at a particular location on a network link and charge users for passage. These are often used around key infrastructure points on a network (e.g. bridges and tunnels).
    b) Corridor charges which cover an identified segment(s) of a network link and are applied to any vehicles accessing a portion or all the defined charged corridor. These schemes often exist in relatively controlled link environments (e.g. motorways) with defined entry and exit points. Corridor charges can be applied as a flat rate for accessing any or all the charged segment or varied based on the distance travelled along the charged segment.
3. Area charges: In an area charge, all trips into, out of, though, or within the charged area incur the charge. As with cordon schemes, they typically apply to areas incorporating major trip attractors.

Substantial further work to explore and optimise charge levels and tariffs is likely to be required as the ToU charging options are developed in future stages. Issues that need to be taken into account around the pricing and tariff element of a scheme are considered in Section 9.3, and Appendix B.

3. The Optioneering Process

3.1 A planned three-stage optioneering approach

A three stage optioneering process has been established to guide the development and assessment of options from the point of entry through to a focused shortlist and emerging preferred option that will be subject to a complete business case analysis.

This approach is summarised in Figure 6.

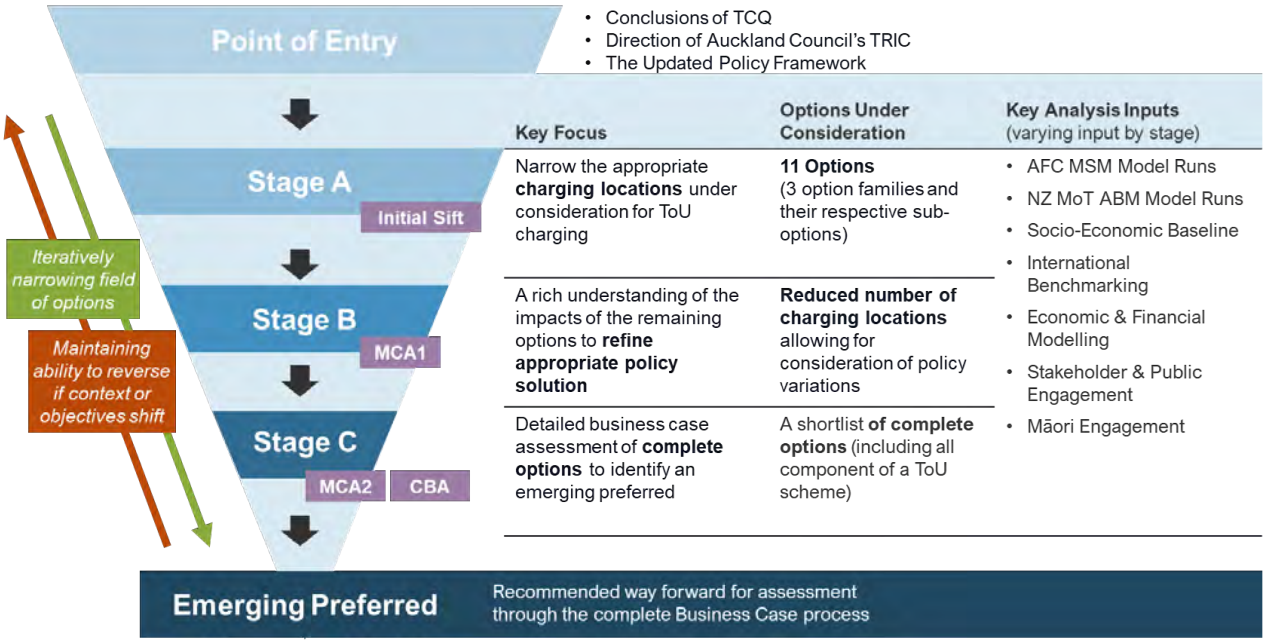


Figure 6: Overview of the ToU optioneering approach

Each stage provides an opportunity to develop a more detailed understanding of the impacts of the options, enabling evidenced decisions regarding which options should be taken forward for further analysis, alongside a rationale for which should be deprioritised.

The approach allows for increasing levels of analysis on a narrowing field of options, with early sifting stages to ensure that modelling analysis and effort is focused on pursuing, interrogating and understanding options that are most likely to be viable.

While options may be deprioritised this process ensures it remains possible to restore options if the context or objectives change or the analysis on prioritised options reveals insight that points to differences or merits to reconsidering an option.

The progression from Stage B to Stage C will be supported by a complete multi-criteria assessment (MCA) using the programme specific ToU Options Assessment Framework (described in Section 3.2). The progression from Stage B to Stage C will also be supported by a full cost-benefit analysis (CBA) in alignment with business case expectations of moving from a shortlist of options to an emerging preferred.

It is important to note that, to date, only two elements of the Stage B Assessment have been undertaken, namely the initial Local Economy and Social and Distributional Impact Assessments. Further work will be required to complete the remaining areas of assessment for all options, to enable progression to Stage C and subsequently the identification of an emerging preferred option.

3.1.1 MSM and ABM Modelling

The ToU options were assessed in a 2026 scenario of Auckland's land use and transport network assumptions, which included City Rail Link (CRL) and its opening day services, as well as other major transport projects anticipated to be completed by this point.

The MSM model was adopted for the network assessment in Stage A, and the local economy assessment in Stage B. Meanwhile, the ABM, with strengths in analysing impacts to travel behaviour by demographic groups, was adopted for equity analysis for Stage B. Detail of which strategic transport model was adopted is further described in the following Sections 5 and 6.

3.2 Applying a consistent assessment framework

The ToU Options Assessment Framework, shown in Figure 7, includes direct references to the primary objective, secondary outcomes, and core principles established in the AT ToU Policy Framework.

Primary Objective (1)	Core Principles (4)	Assessment Areas (10)	Criteria (26)	Metrics
To **manage travel demand to achieve an improvement in road network performance** by: • reducing congestion • increasing throughput of people and goods • improving reliability of the road network.	**Effective**	Network Assessment (Local and City-wide)	Congestion & Reliability	Appropriate metrics to be defined for each stage of assessment including a mix of: • Quantitative, • Qualitative and, • Monetised.
			Accessibility & Productivity	
			Through-put	
	Fair	Social & Distributional Assessment	Equity	
			Distribution of Impacts	
			Mana Whenua Assessment	
			Safety	
		Local Economy Assessment	Local Economy Performance & Prosperity	
	Simple	User Experience & Understanding Assessment	Public Interpretability & Understanding	
			User Experience	
	Feasible	Practicality Assessment	Flexibility	
			Privacy	
			Enforcement	
			Deliverability	
		Social License Risk Assessment	Stakeholder Perspectives	
			Public Perspectives	
			Political Perspectives	
		Affordability Assessment	Capital Costs	
			Lifecycle Costs & Revenue	
Secondary Outcomes These are not objectives being sought and do not shape scheme design but are expected to occur as a result of time of use charging. They will be tracked and measured.		Environmental Assessment	Greenhouse Gas Emissions	
			Local Pollution (e.g. air & water)	
		Sustainable Travel Assessment	Public Transport Usage	
			Active Travel Usage	
			Available Revenue for Investment	
		Wider Economic Impacts	Agglomeration	
			Move to more productive jobs	

Figure 7: ToU options assessment framework

The Options Assessment Framework provides a consistent approach for initial sifting and more holistic multi-criteria assessments. The criteria included in the Options Assessment Framework will provide a strong indication of the likely direction of travel for later cost-benefit analysis and commercial assessments. The assessments carried out in this study are also closely rooted in the assessments undertaken for TCQ.

3.2.1 Transport modelling in the options assessment

Transport modelling has taken an important role throughout the stages undertaken so far during the ToU optioneering process. Analysed model results were used to provide the metric values to evaluate the impact of charge options within the ToU Options Assessment Framework.

Two strategic transport models have been adopted for different parts of the options assessment:

1. Auckland Forecasting Centre's (AFC) Macro Strategic Model (MSM) – a trip-based four-step transport mode.
2. New Zealand Ministry of Transport's Agent-based Model (ABM) – a simulation that emulates 24-hour itineraries of activities and travel between these activities for a representative population depending on their demographic attributes.

Each model plays a specific role in the assessment. The legacy of the MSM enables the model to provide stronger answers for more traditional network assessment metrics, such as throughput and congestion. The ability to differentiate trip-making behaviour by trip purpose (e.g. employers business, shopping, freight) also allows MSM to evaluate travel impacts for different local economic sectors. The people-centric design of the ABM makes it well-suited for assessing equity impacts of each option. The role of each model within the ToU Options Assessment Framework is outlined in Table 5, with the applicability of each model by optioneering stage further discussed in Sections 5 and 6 of this report. .

Table 5: Transport models used by criteria in ToU options assessment framework

Core Principles	Assessment Areas	Criteria	Transport Model Used
Effective	Network Assessment (Local and City-wide)	Congestion & Reliability	MSM
		Accessibility & Productivity	
		Through-put	
Fair	Social & Distributional	Equity	ABM
	Local Economy	Local Economy Performance & Prosperity	MSM

4. Developing Options for Assessment

4.1 Options for assessment

Three Option Categories were developed and assessed through the Stage A and partial Stage B Assessment process. Each Option Category is made up of variants which share similar fundamental features. Each variant within an Option Category is distinct from the others, for example containing different boundaries or charging points.

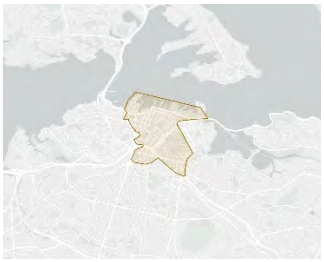
The three Option Categories touch on different geographies, at different scales, and across both the local and national road network. A description and purpose for each Option Category and variants is outlined over the following sections.

Option 1 Category: City Centre Cordon

The Option 1 Category takes forward the first of TCQ's recommended options. In this Option Category, vehicles are charged for entering and exiting the charged area during peak travel periods.

Rationale: While a very small portion of Auckland's regional geographic area (approximately 0.1%), the city centre receives a high volume of trips, with around 10% of all peak hour vehicle trips in the region terminating in the city centre. The area is well serviced by public transport alternatives, however arterials and motorways feeding into the city centre experience congestion.

Table 6: Option 1 Category

Option	Description and rationale	Image
1a: City centre cordon within motorway	City centre cordon charges 'magnet' area with greatest public transport alternatives. Operates as a cordon charge, with cameras/gantries at all entry/exit points into the city centre, using the Motorway as the cordon boundary. Trips entering the cordon during the morning peak and exiting the cordon during the afternoon peak are charged.	
1b: City centre cordon within motorway + motorway links	Tests impact of the city centre cordon option in combination with motorway corridors immediately adjacent to city centre. This captures trips to the city centre, as per Option 1a, plus all motorway trips using the Central Motorway Junction via a corridor charge. Motorway locations near Newmarket, Ponsonby, Eden Terrace charged to discourage rat-running.	
1c: Fringe suburbs cordon	Expanded city centre cordon that incorporates neighbouring areas of Newmarket, Grafton and Eden Terrace. These areas include significant commercial land use, have similar levels of public transport connectivity to city centre and are thoroughfares for several key PT routes. Motorways excluded to test the effect of adding in fringe suburbs compared to Option 1a	

Option 2 Category: Inner Isthmus Strategic Corridors (Inner Isthmus Area)

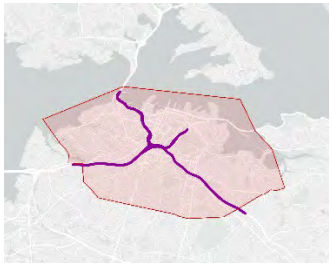
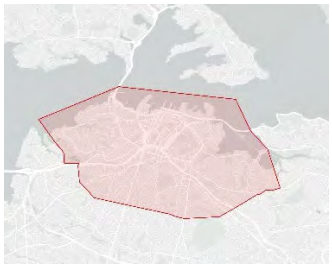
The Option 2 Category represents a scaled approach to achieving Phase 2 of TCQ's recommended option.

Rationale: The Inner Isthmus Area encompasses a much larger proportion of activity with 18% peak hour vehicle trips crossing into or occurring within the area. It represents approximately 1% of Auckland's regional land area.

The Inner Isthmus includes both the city centre, and many surrounding metro and town centres (e.g. Newmarket, Mount Eden, Ponsonby) and local neighbourhoods. The Inner Isthmus Area is also relatively well served with public transport services, improving opportunities to mode shift (relative to the rest of Auckland)

Following the initial Stage A Assessment Option 2c was introduced which operates as a cordon charge, rather than the area charge deployed in options 2a and 2b.

Table 7: Option 2 Category

Option	Description and rationale	Image
2a: Inner Isthmus incl motorways	A comprehensive area charge for the inner isthmus area including motorway access charge. Full area charge. All vehicular movements into area charged in AM, all movements out of area charged in PM, trips within area charged AM and PM. This includes through motorway trips.	
2b: Inner Isthmus excl motorways	A comprehensive area charge for the inner isthmus area excluding through motorway trips. Allows motorway effect to be compared to 2a. Full area charge. All vehicular movements into area charged in AM, all movements out of area charged in PM, trips within area charged AM and PM. Motorway through trips excluded.	
2c: Inner Isthmus cordon	Covers strategic areas of the isthmus where congestion is greatest. Tests the effect of increasing scale of cordon charge areas beyond the city centre to encompass the Inner Isthmus. Operates as two cordon areas – the inner cordon following the same boundary as existing Option 1a, while the outer cordon follows the same boundary as previously assessed for Option 2a/b. Motorway through-trips are not charged. Cordons are charged inbound AM (0700-0900) and outbound PM (1600-1800) only. Double charging (e.g. when driving from outside the outer cordon into the city centre area) is not intended but is theoretically possible in the modelling. (However, model enables double charges to be avoided by use of motorway routes.) These rules make this option similar in functionality to the city centre cordon (Option 1a) with similar overall coverage to Option 2a/2b	

Option 3 Category: Highly Congested Locations: motorways and arterials

The Option 3 Category was developed to test the impact of targeting specific highly congestion locations, with the potential for scalability following feedback from AC and the AT Board.

Approach to developing Option 3 Category variants

To develop the Option 3 Category variants, the areas with the greatest congestion on both arterials and motorways were identifed. This included 13 locations on the motorway network and 25 on the arterial network. Variables considered included:

- Origin and destination analysis at hotspot,
- Identification of principal traffic flows,
- Public transport alternatives, and
- Volume of traffic at each hotspot.

From this initial indentification of hotspots, the following key findings informed the development of five Option 3 Category variants:

- Hotspots can be categorised by geography and their function in the broader road network: inner isthmus arterials, outer suburb hotspots, arterials that feed into the motorway network and motorway links.
- Congested Inner Isthmus arterials have good geographical continuity so could potentially form a hotspot cluster. Targeting inner isthmus arterials would create a cordon very similar to the Option 2 Category and as a result do not need to be taken forward for assessment.
- Motorways have highest volume of congested traffic with direct links to many congested arterials. As a result, the recommended Option 3 Category variants focus on motorways.
- Outer suburb hotspots show dispersed origins and destinations, with poor PT alternatives. As a result, it was recommended these are not taken forward for assessment as part of Option 3 Category.
- Targeting the arterials that feed into the motorway network would not be as efficient as targeting the motorways themselves. This is due to frequent junctions and alternative routes which are more likely to result in the need for extensive traffic management to prevent rat-running.

Rationale: Current network conditions include significant amounts of congestion on urban motorways and arterial roads radiating towards and away from central Auckland. The Option 3 Category focuses on targeting charging at links on the network where congestion currently exists.

Table 8: Option 3 Category

Option	Description and rationale	Image
3a: Extensive Motorways	Charges through-traffic, plus movements on and off the motorway within the charged corridor. Includes all highly congested locations on the motorway network. Testing a very comprehensive charge allows us to bookend the options assessment. Allows for comparison with other options to understand the impacts of assessing various extents of the motorway. Through trips included for consistency across all motorway options.	
3b: Core Motorways	Charges through-traffic, plus movements on and off the motorway within the charged corridor. Testing whether a charge on the core motorway through the isthmus sufficiently reduces congestion on the motorway network. Allows for comparison between other options that include motorways.	
3c: Core Motorways + City Centre	Charges through-traffic, plus movements on and off the motorway within the charged corridor. Testing whether a charge on the core motorway through the isthmus sufficiently reduces congestion on the motorway network. City centre included to prevent rat-running on arterials into the city centre Allows for comparison across the motorway options. Extends charges further along motorway than 1b: City Centre and CMJ option.	
3d: Limited isthmus hotspots	The main north/south arterials of the inner isthmus are congested. Along most of these corridors 12-24% of trips in the AM peak have a single destination - the city centre. This is a significant proportion compared to other hotspot clusters. These trips have good PT alternatives. This option allows the effects of placing a charge on a cluster of hotspots on the arterial network to be explored.	
3e: Targeted motorway hotspots	This option targets three key hotspots on the motorway network that are well known points of congestion. The purpose is to test what happens when a small number of congested locations on the motorway network are charged.	

5. Stage A Assessment

5.1 Overview of the Stage A assessment

The primary aim of the Stage A assessment was to consider the potential impacts of the wide range of options included in the initial long list and determine whether there were any which appeared likely to be problematic because of their location, size, or charging approach.

Approach

In common with all planned stages of the assessment, criteria relating to the four assessment objectives (Effective, Fair, Simple, and Feasible) were considered.

The specific metrics used to assess the likely performance of the options against these criteria are set out in Figure 8, including a mix of quantitative and qualitative measures.

Reflecting the very early stage of development of this study, a formal assessment of mana whenua and political perspectives was not completed. Efforts are underway to appropriately incorporate these perspectives into the option assessment process as it progresses. In addition, the available revenue for investment criterion was incorporated into the lifecycle costs and revenue assessment.

Consistent for all Stages

Specific to Stage A

Assessment Areas (10)+	Criteria (26)	Stage A Metrics	
Network Assessment (Charge Area and City-wide)	Congestion & Reliability	Length of congested network	Peak (AM / PM) proportion of motorway road kms congested
			Peak (AM / PM) proportion of arterial road kms congested
			Peak (AM / PM) proportion of local / collector road kms congested
		Modal shift from private vehicles	Daily no. of car person trips
		Modal shift to public transport	Daily no. of public transport trips
	Accessibility & Productivity	Impacted population	No. of vehicle trips charged (AM peak)
		Accessibility to Economic Opportunities (Journey Time)	No. of jobs within 30 minutes by car (regional average, AM peak)
			No. of jobs within 45 minutes by PT (regional average, AM peak)
		Accessibility to Economic Opportunities (Generalised Cost)	No. of jobs within 30 GC-equivalent minutes by car (regional average, AM peak)
			No. of jobs within 45 GC-equivalent minutes by PT (regional average, AM peak)
		Accessibility to Amenities	% of population who can access metro centres within 30 minutes by car (AM peak)
			% of population who can access metro centres within 45 minutes by PT (AM peak)
	Through-put	Peak spreading	No. of trips made during AM and PM peak periods
		Total travel time	Region-wide peak (AM / PM) person hours travelled
		Network efficiency	Peak (AM / PM) average car trip speed
Social & Distributional Assessment	Equity	Initial consideration of potential for problematic impacts on particular user groups - older people, younger people, parents of young families, low-income, *mana whenua assessment not undertaken*	
	Distribution of Impacts		
	Mana Whenua Assessment		
	Safety	Initial assessment of potential impacts on road safety due to changes in traffic patterns	
Local Economy Assessment	Local Economy Performance & Prosperity	Initial consideration of potential impacts on the local economy within charge area	
User Experience & Understanding Assessment	Public Interpretability & Understanding	Initial assessment of likely user comprehension and understanding	
	User Experience		
Practicality Assessment	Flexibility	Narrative assessment of relative complexity of implementation	
	Privacy		
	Integrity (Enforcement)		
	Deliverability		
Social License Risk Assessment	Public Perspectives	Initial assessment of potential stakeholder and public perspectives; *assessment of political perspectives not undertaken*	
	Stakeholder Perspectives		
	Political Perspectives		
Affordability Assessment	Capital Costs	Indicative assessment of relative capital and lifecycle costs & revenue potential	
	Lifecycle Costs & Revenue		
Environmental Assessment	Greenhouse Gas Emissions	Indicative monetised estimate of carbon emissions reduction (single-year)	
	Local Pollution (e.g. air & water)	Anticipated likely impact on local pollution	
Sustainable Travel Assessment	Public Transport Usage	Change in annual public transport trips	
	Active Travel Usage	Likely relative impact on active travel	
	Available Revenue for Investment	Potential scale of available revenue for investment, *incorporated into lifecycle costs & revenue assessment*	
Wider Economic Impacts	Agglomeration	Indicative assessment of likely relative impact on wider economics benefits	
	Move to More Productive Jobs		

Figure 8: Stage A options assessment criteria and measures

Subject-Matter Experts (SMEs) representing the 11 assessment areas shown in Figure 8 undertook an assessment of options. Each provided an evidenced account of their findings in a detailed options assessment template and a summary findings presentation.

SMEs were not asked to formally allocate scores to their findings, or to rank the options, but were tasked with identifying any 'areas of caution', where there appeared to be significant concerns.

The assessments were reviewed collectively in a workshop session in which each assessment area was represented by one or more SMEs. Findings were debated and validated by a team including both AT, AC, and Lead Advisory representatives.

The workshop was used to:

- understand the assessment methodology each assessor had employed,
- test and constructively challenge assessment findings, and
- ensure consistency and a reasonable degree of consensus over the findings and how they should be interpreted.

Through discussion in the workshop, several additional 'areas of caution' were identified and agreed by the group, and a small number of areas of caution identified by individual assessors were removed.

The workshop ended with a discussion of the implications of the finalised assessment, including which options should be taken forward and which should be deprioritised from further consideration due to significant concerns raised.

The complete Stage A Assessment method described above is summarised in Figure 9 below.

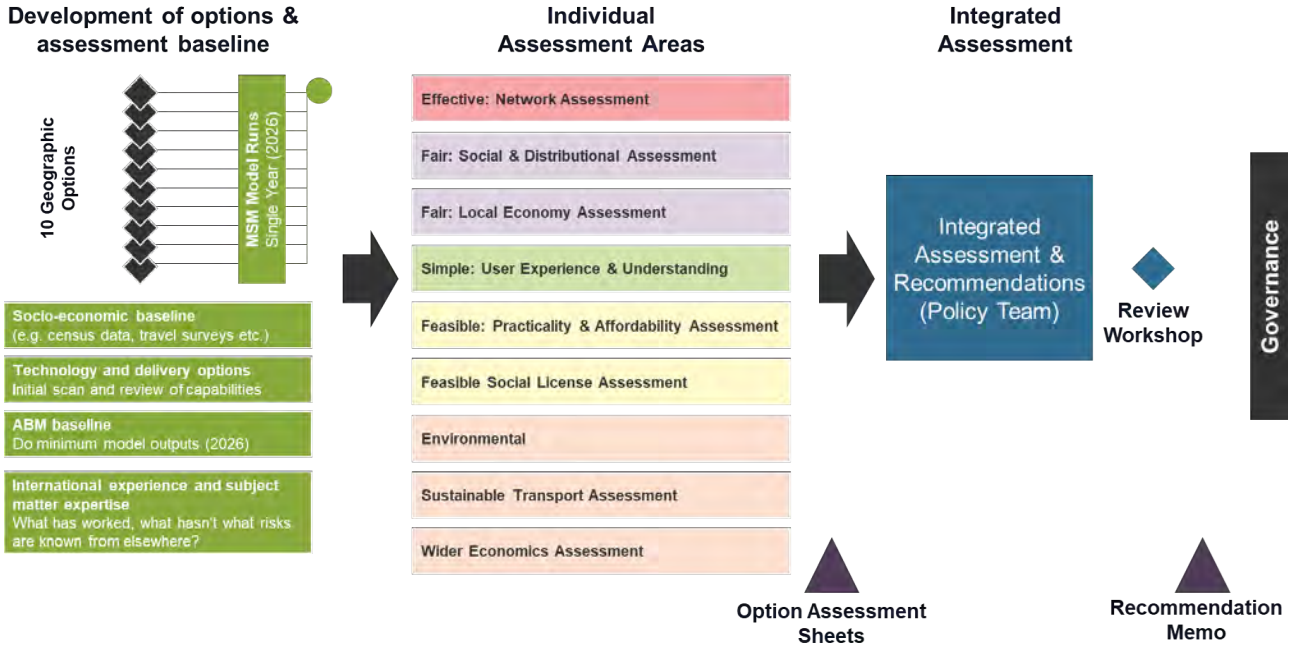


Figure 9: Overview of Stage A assessment

Options under consideration

Stage A assessment began with ten options under consideration, with Option 2c added and assessed following the initial assessment of options. These were the options described above in section 4.1.

5.2 Stage A Assessment findings

Findings from the Stage A Assessment are detailed over the following sections, with reporting aligned with the structure of the assessment framework.

5.2.1 Network assessment

The Network assessment focused on the analysis of AFC's MSM outputs to understand the outcomes of each option on Auckland's transport network.

Outcomes for the transport network are caused by changes in travel patterns in response to ToU charges. Initial analysis on these causes was undertaken to understand forecast effects on the transport network.

Responses to the charges can be characterised into four main types:

- Continuing to travel by car during charged peak periods, while paying the charge to travel through the charged network.
- Continuing to travel by car during charged peak periods, but changing travel route to avoid charged network.
- Continuing to travel during charged peak periods, but changing modes (e.g. public transport).
- Changing trip departure time from charged peak periods to uncharged off-peak periods (i.e. peak spreading).

These changes in travel patterns in turn lead to impacts on the region's transport network. The scale of change in travel patterns for each option is summarised in Figure 10.

Options 2a/b and 3a capture around 1 in 6 of vehicle trips across the entire region during the AM peak. Options 2 is particularly effective in reducing the number of vehicle trips, modal shift towards public transport, and peak spreading.

Measure *(for AM Peak Period)*	1a: CBD Cordon	1b: CBD Cordon + Mway	1c: CBD + Fringe Cordon	2a: Inner Isthmus Area incl. Mways	2b: Inner Isthmus Area excl. Mways	2c: Inner Isthmus + CBD Double Cordon	3a: Extensive Mways	3b: Core Mways	3c: Core Mways + City Centre	3d: Limited Congested Hotspots	3e: Targeted Congested Hotspots
Vehicle trips that pay a toll (% of total regional trips)	18,980 (3%)	29,613 (5%)	30,651 (5%)	105,578 (18%)	89,008 (15%)	47,286 (8%)	100,024 (17%)	45,353 (7%)	53,247 (9%)	2,190 (0%)	34,798 (6%)
Change in vehicle trips (% change in vehicle trips)	-3,631 (-1%)	-4,164 (-1%)	-6,215 (-1%)	-16,737 (-3%)	-17,835 (-3%)	-9,331 (-2%)	-8,166 (-1%)	-3,271 (-1%)	-5,387 (-1%)	-3,498 (-1%)	-3,817 (-1%)
Change in no. of public transport passengers (% change in public transport passengers)	+2,351 (+2%)	+2,718 (+3%)	+3,082 (+3%)	+6,484 (+6%)	+6,450 (+6%)	+4,099 (+4%)	+2,100 (+2%)	+1,574 (+1%)	+2,954 (+3%)	+970 (+1%)	+577 (+1%)
Change in number of person trips made in AM peak period	-1,678	-2,445	-4,328	-14,542	-15,875	-6,978	-7,096	-2,273	-3,800	-3,086	-3,792

CBD cordons (Options 1) see higher reduction in vehicle trips and shift to public transport relative to number of people charged since public transport alternatives are abundant.

Targeting motorways alone sees lower reduction in vehicle trips and switch to public transport relative to number of people charged compared to Options 1 and 2, since those who travel on motorways have fewer public transport alternatives.

Figure 10: Summary of changes in travel patterns due to ToU charge options

For instance, compared to other options, city centre cordon charges (Option 1 category) are more effective in reducing the number of vehicular trips and shifting trip modes towards public transport at a lower overall expense to travellers (i.e. number of vehicle trips that pay a charge). This results in a small but effective improvement in congestion, journey time accessibility, and throughput of the transport network around the city centre area.

In contrast, link schemes charging the motorway network (such as Options 3a/b/c/e) result in a higher number of vehicles charged, but a relatively lower reductions in number of vehicular trips, mode shift towards public transport, and peak spreading. This is a result of a lack of viable public transport alternatives for many motorway-based trips, as well as the inflexible nature of the trips (i.e. often longer-distance, non-discretionary) travelling on motorways. As a result, improvements in congestion,

accessibility, and throughput are very targeted to the road links (i.e. motorways) that are being charged, but at the expense of traffic diversion onto alternative routes (i.e. arterial / local roads).

Changes in transport network performance as a result of the options have been assessed under the following three criteria:

1. Congestion and reliability
2. Accessibility and productivity
3. Throughput

A summary of findings for each option is outlined in Table 9 below.

Table 9: Stage A Network Assessment summary

	Congestion and Reliability	Accessibility and Productivity	Throughput
Option 1a	• Reduction in congestion on all road types (motorway, arterial and local) close to the city centre. • VKT reduction within charged cordon and uncharged areas. • +1.9% increase in daily public transport trips.	• Moderate improvement in access to jobs by both car and public transport. • Origin commuting Generalised Cost (GC) is positive, except for city fringe locations (smaller impact under 1a compared to other options). • Destination GC is largely neutral (positive in city centre fringe, and negative in city centre).	• 1.6% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by less than 1 km/h. • Minor peak spreading effect.
Option 1b	• Consistent with Option 1a. • +2.2% increase in daily public transport trips.	• Consistent with Option 1a.	• 2.4% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 1 km/h. • Minor peak spreading effect.
Option 1c	• Consistent with Option 1a. • +2.6% increase in daily public transport trips.	• Consistent with Option 1a.	• 2.1% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 1 km/h. • Moderate peak spreading effect.
Option 2a	• Reduction in congestion on all road types, focused within charged area. • VKT reduction in both charged and uncharged areas. • +5.8% increase in daily public transport trips.	• Very significant impact on job access by car and public transport. • Origin commuting GC is positive on the periphery and negative in the charged area. • Destination GC is largely neutral, but very negative within the charged area.	• 4.1% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 2 km/h. • Significant peak spreading effect.
Option 2b	• Consistent with Option 2a. • +5.9% increase in daily public transport trips	• Moderate improvement in access to jobs by car and high by public transport. • GC consistent with Option 2a (with negative destination GC extending to fringe areas).	• 3.2% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 1 km/h. • Significant peak spreading effect.
Option 2c	• Increase in motorway congestion and decrease in congestion on arterial and local roads – with the most significant change occurring close to the cordon area. • VKT reduction in both charged and uncharged areas.	• Moderate improvement in access to jobs by both car and public transport. • In AM peak the GC reduces for trips originating in the north / west and within the outer cordon and increases for city	• 2.9% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by 1.2 km/h in the AM and 0.8km/h in the PM. • Significant peak spreading effect.

	Congestion and Reliability	Accessibility and Productivity	Throughput
	• +3.6% increase in daily public transport trips	centre and Isthmus area outside of the cordons. • AM destination GC largely neutral, reduces on cordon fringe, increases within cordons.	
Option 3a	• Marked with an area of caution due to significant scale of diversionary impact resulting increased journey times on local and arterial roads. • Reduction in both congestion and VKT on charged motorway links. • +1.9% increase in daily public transport trips	• Very high improvement in access to jobs by car and minor by public transport. • Origin commuting GC cost is negative across central area, while destination GC is negative across peripheral area.	• 4.3% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 2 km/h. • Moderate peak spreading effect.
Option 3b	• Reduction in motorway congestion, alongside moderate VKT reduction on charged links. • Moderate VKT increase on uncharged links (increase in arterial congestion and negligible congestion impact on local roads). • +1.4% increase in daily public transport trips	• Very high improvement in access to jobs by car and minor by public transport. • Origin commuting GC cost is positive in the north and negative in central locations. • Destination GC is largely neutral.	• 2.5% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by around 1 km/h. • Minor peak spreading effect.
Option 3c	• Minor impact on congestion on all road types, with VKT reduction identified on both charged and uncharged links and areas. • +2.5% increase in daily public transport trips	• Moderate decrease in job access by car, minor increase by public transport. • Origin commuting GC cost is positive in the north and negative in central locations. • Destination GC is largely neutral but negative within city centre charged area.	• 2.7% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by more than 1km/h. • Moderate peak spreading effect.
Option 3d	• Reduction in motorway congestion, alongside minor VKT reduction on charged links. • Minor VKT increase close to charged links and moderate VKT reduction in wider area. • +0.9% increase in daily public transport trips	• Moderate increase in job access by car, minor decrease by public transport. • Origin commuting GC cost is largely neutral, expect for a negative cluster to the south of the charged links. • Destination GC is largely neutral but negative within city centre and city fringe locations.	• 0.2% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region remain similar. • Minor peak spreading effect.
Option 3e	• Reduction in motorway congestion, alongside moderate VKT reduction on charged links. • Minor VKT reduction on wider network. • +0.5% increase in daily public transport trips	• High increase in job access by car, moderate increase by public transport. • Origin commuting GC cost is positive in the north and negative for Isthmus locations. • Destination GC is largely neutral except for minor negative GC near charged points.	• 1.7% reduction in total AM peak person hours travelled. • Average vehicle speeds across the region increase by less than 1 km/h. • Minor peak spreading effect.

A detailed summary of network impact metrics is included in Appendix A.

Congestion and reliability

As noted, all options assumed the same nominal $3 charge, consistent with the approach used in TCQ.

Analysis highlighted that options which specifically target one road type tend to bring trade-offs relating to congestion and reliability. Both cordon and area charges (Option 1 and 2 Categories) are most effective in reducing congestion on any road links connecting targeted destinations. This is demonstrated in Example A of Figure 10 where blue indicates reduction in traffic volume within the charged city centre cordon. Only modest increases in traffic volume (orange) are visible - mainly on motorways and motorway access routes. This is because it is relatively difficult to avoid the charge (i.e. divert routes) in these schemes, and thus travellers must either shift mode to public transport (which provides good access to the charged cordon/area) or not travel during the charged peak periods.

By contrast, link options with charged motorways derive some of the reduced motorway congestion from 'pushing' traffic onto arterial and local roads. This is demonstrated in Example B of Figure 10 where there is a significant reduction in traffic volumes on the charged motorway corridors, but significant increase in traffic volumes indicated by orange across uncharged urban arterials. This results in increased traffic and journey times on arterial and local roads.

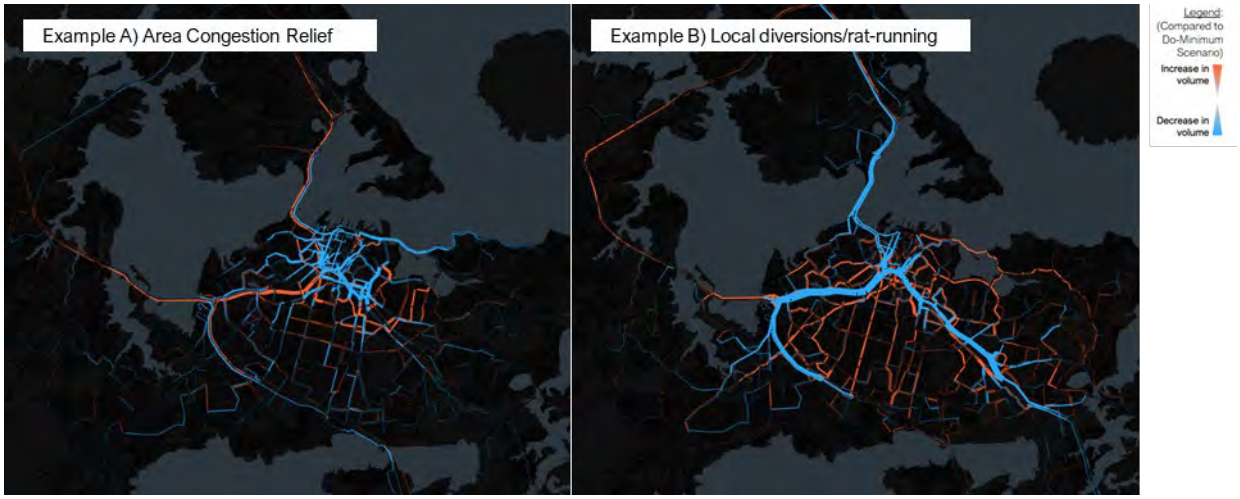
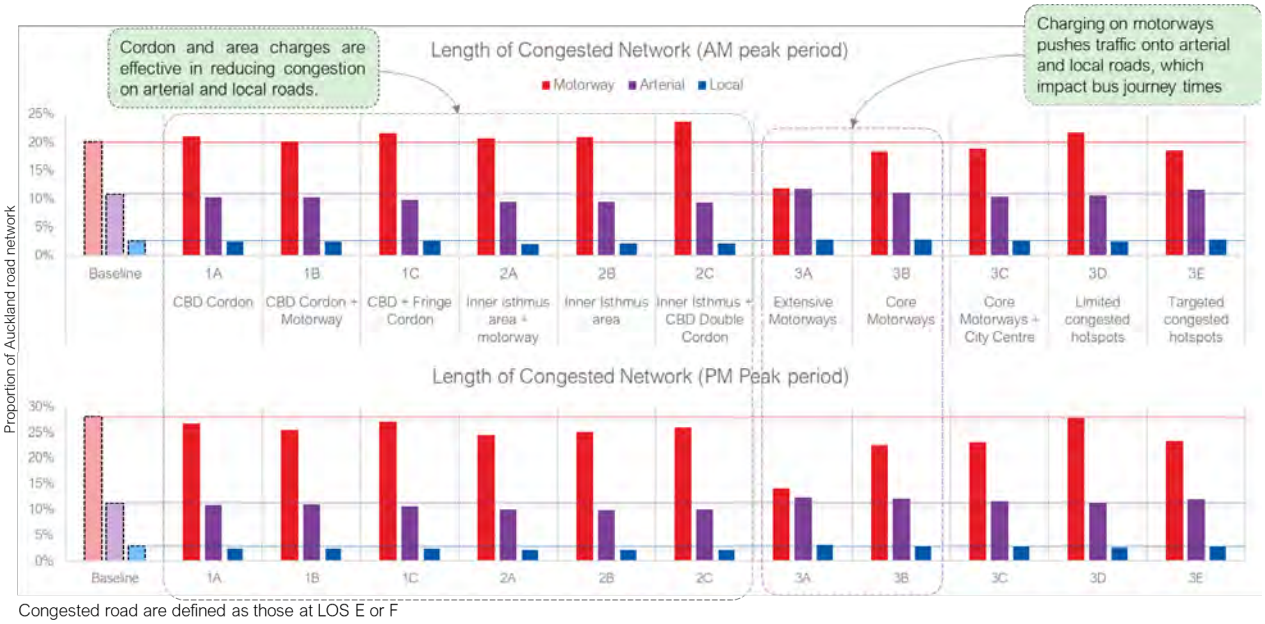


Figure 11: Main types of congestion relief and impacts

In summary and as illustrated in Figure 11:

- Cordon options (1a/c) result in lower region-wide reduction in traffic compared to more extensive options (eg. 3a which charge higher volume links), but result in significant benefits for the road network in the city centre and its approaches.
    - Since the city centre is a key destination (within top five destinations for trips originating in most local board area), these options reduce the travel time of trips that originate across the city. They also reduce the cost of trips which do not have origin/destination in the city centre and, due to time saved, the overall cost of some trips to/from the city centre.
    - Reduction in traffic is primarily on arterial and local road types with minimal rat-running induced. There are some redistribution effects on the central state highways as a result of these routes being uncharged, as well as changes in trip destinations.
- Area charges (2a/b) on the larger inner isthmus area result in higher congestion relief than cordon options in those areas. As the majority of charged users live within the charged area this results in a more focused increase in public transport demand.
- Motorway charges (1b, 3a/b/c) result in significant congestion relief on motorways but worsen congestion on local and arterial roads due to charge avoidance. However, the net overall result is still significantly positive from the perspective of network efficiency.

- Arterial hot-spot charges (3d) result in localised congestion relief but significant diversion of trips to route around charged links.
- Motorway hot-spot charges (3e) result in significant congestion relief particularly at charged locations/links. A key aspect of the observed response is localised diversion/distribution of trips to avoid charges, leading to congestion in arterial and local roads near the charged link. The overall network result is significantly positive from the perspective of network efficiency.



Congested road are defined as those at LOS E or F

Figure 12: Proportion of network in congested conditions for each option

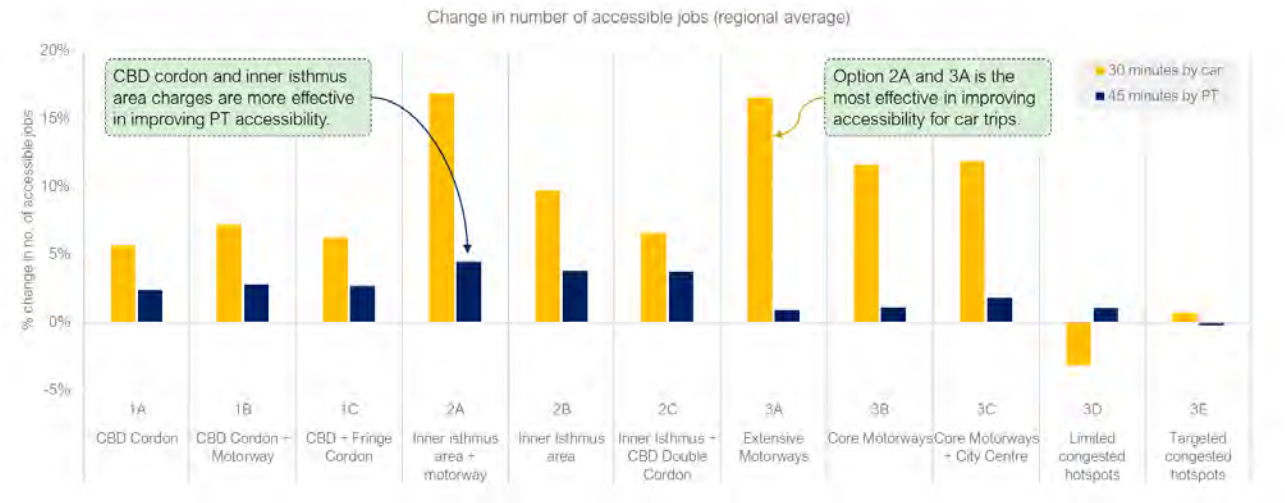
Accessibility and productivity

Analysis relating to accessibility and productivity considered the number of trips charged, and accessibility to both economic opportunities and amenities by both journey times and Generalised Cost (GC).

Access to economic activities, which is a measure of the number of jobs or other opportunities that can be accessed within a fixed travel time/cost is used as a proxy indicator for likely economic productivity impacts.

When considering access to economic opportunities (jobs) within a specific travel time (ignoring the cost of the charge), Options 2a, 3a, and 3e emerge as providing the largest improvement in accessibility. However, the city centre cordon (Option 1 Category) and inner Isthmus area charges (Option 2a and 2b) improve both car and public transport accessibility.

Access to metro centres was used as a proxy for access to amenities – with no major impacts identified for any option. These results change when the costs of the charge are considered – although more work is needed to test this metric.



Note: This does not take into account the change in generalised cost to gain or lose access to economic opportunities.

Figure 13: Journey time accessibility to economic opportunities (jobs) by option

A key difference between options was the number of people charged, which influenced changes in travel patterns and therefore congestion reduction impacts.

The number of people charged relates to the scale, location and type of the scheme. Options 1a/b/c have comparatively low numbers of charged users. Option 2a/b charges a high number of trips since any movement within the charged area is charged. Option 2c which functions as a double cordon is more similar to Options 1a/c in terms of charged users.

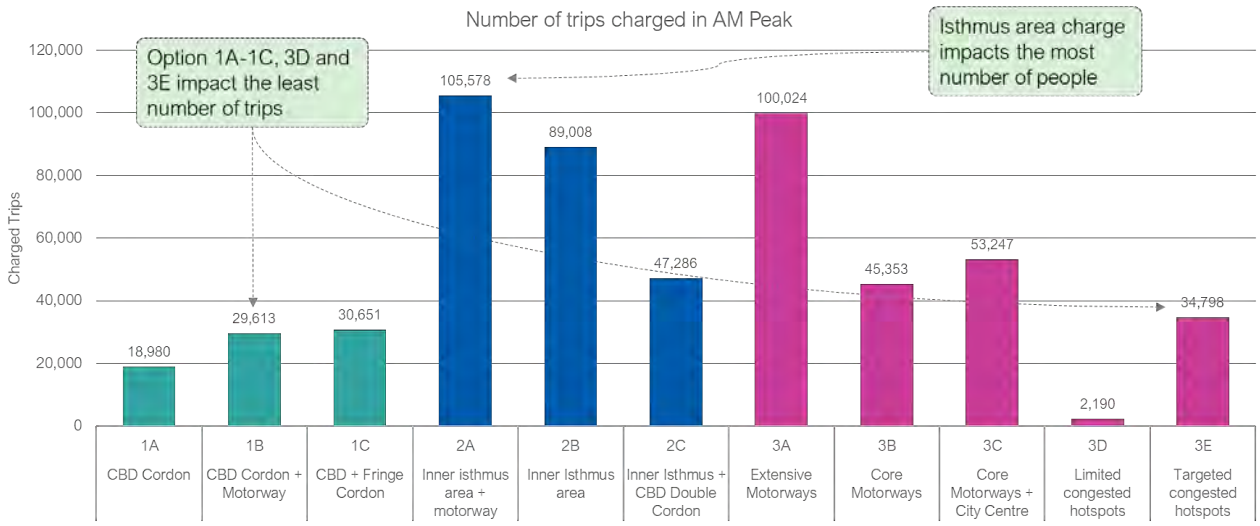


Figure 14: Number of trips charged in AM Peak

For Option 1a the highest proportion of trips charged from a local board is from Whau (6.2%). Generally, the proportion of charged trips is low - a result of the total number of charged trips in Option 1a being both low and fairly evenly distributed across the region.

Option 2a has a very different distribution resulting from the greater scheme extents and charging mechanism. This results in both a higher total number of trips charged and a less even distribution of charged trips with 92.5% of vehicular trips originating from the Waitematā Local Board area being charged.

For Option 3a the total number of charged trips is comparable, but the distribution of charged trips is more evenly distributed. However, several of the local boards where proportion of trips charged is

higher (most notably Henderson-Massey and Māngere-Ōtāhuhu) are lower income outer suburbs with less attractive public transport alternatives.

Options 3a/b charge extensive portions of the state highway network with high numbers of charged users. Option 3d charges the lowest number of trips, but generates poor congestion reduction outcomes, as it is both limited in geographic extent and can be avoided by alternative routes.

Option 3e results in a similar number of trips being charged as several other options but notably this is achieved by charging only three key motorway locations.

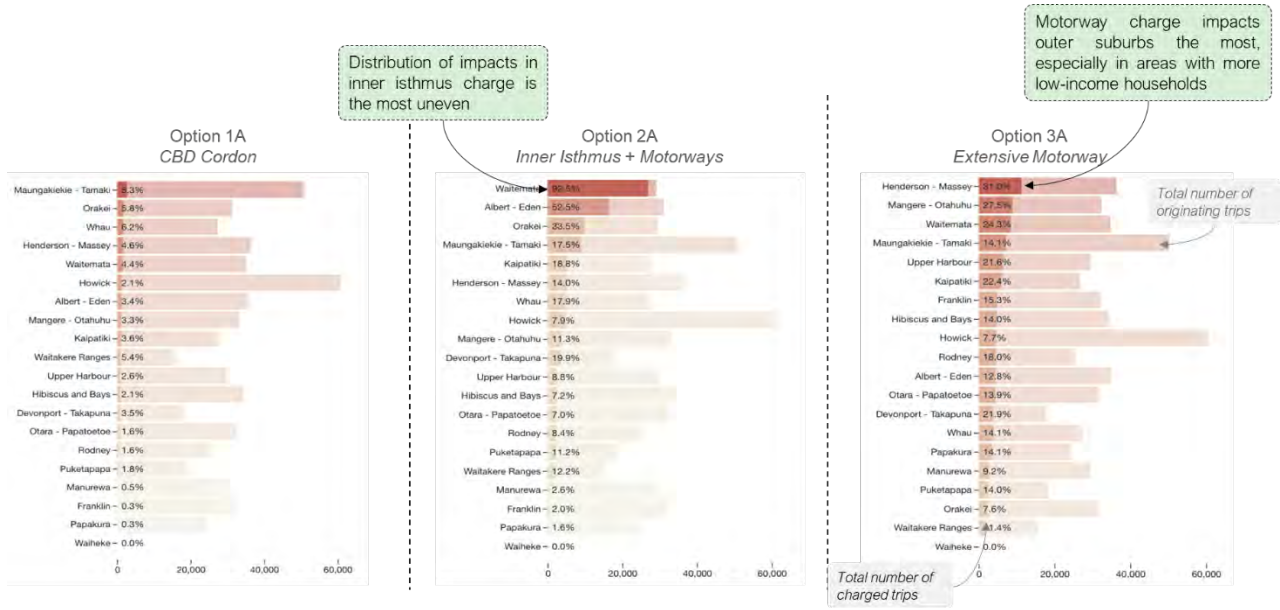


Figure 15: Impacted trips by Local Board area for select options

Throughput

Although most options resulted in an increase in vehicle speeds, the more expansive options which charged significantly more vehicles (2a, 2b, 2c and 3a) had a significantly greater impact on speed than the less expansive options (with the exception of 3e).

The change in traffic speeds forecast ranges from negligible for Option 3d to an additional two kilometres per hour or a 6% increase for Option 2a. While these improvements may appear modest at the regional level, they disguise more significant improvements occurring in localised areas around charging locations.

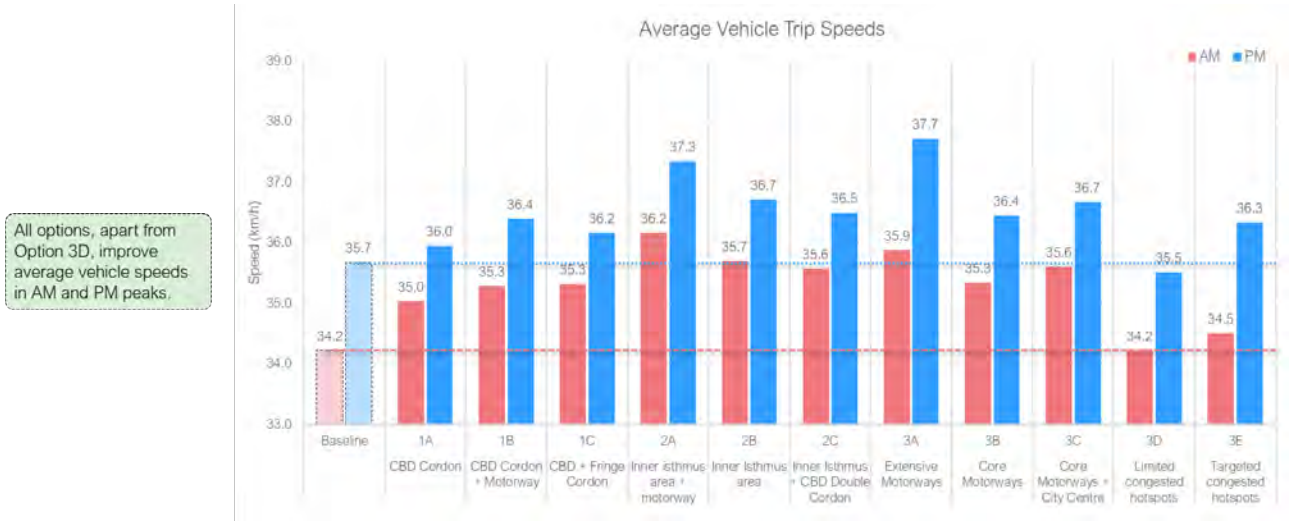


Figure 16: Average vehicle trip speeds

The magnitude of changes in trip departure times (i.e. peak spreading) varies depending on the scale of the charge option and the availability of alternative transport modes. For instance, the more comprehensive area charges of Options 2a/b reduce the greatest number of trips made during peak periods. These two options are two to nine times more effective in shifting AM peak period trips to off-peak periods when compared to other charge options.

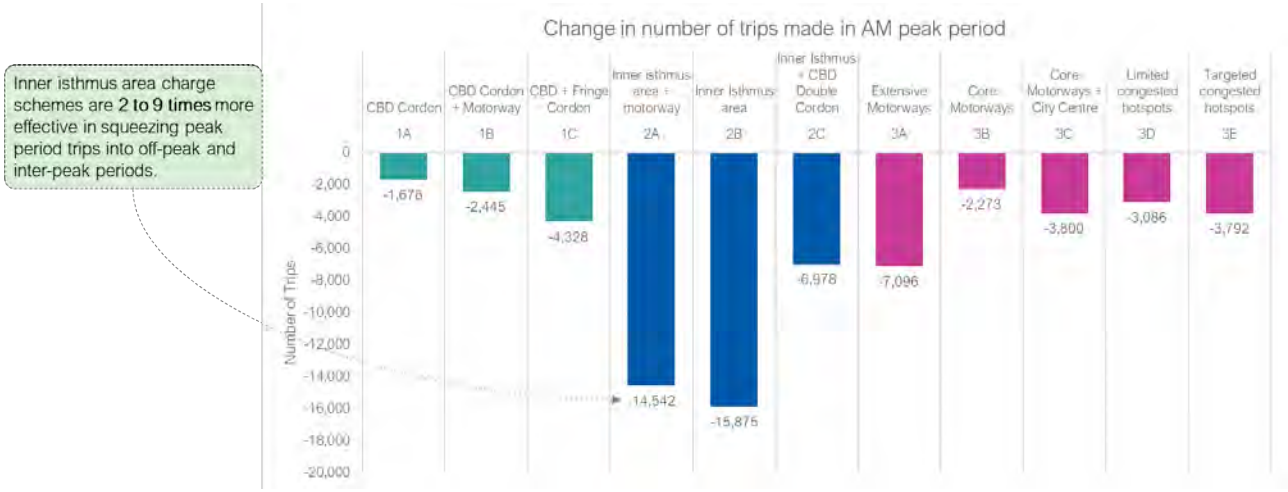


Figure 17: AM Peak spreading impact by option

The Option 2 category is also effective in peak spreading of demand relative to the number of vehicle trips charged compared to other options, mainly due to the large geographical area that is charged.

In contrast, motorway charges such as Options 3a/b/c result in lower relative peak spreading due to the characteristics of trips travelling along these motorways. These long-distance trips tend to be non-discretionary, and therefore inflexible in adjusting in departure time.

Options 1a/b/c result in peak spreading levels that are is closer to the average of options. While the cordons do not permit for route diversion into the city centre, the availability of public transport services offsets the need for travellers to make trips in another period. In other words, they are more likely to shift modes to make the same or similar trip.

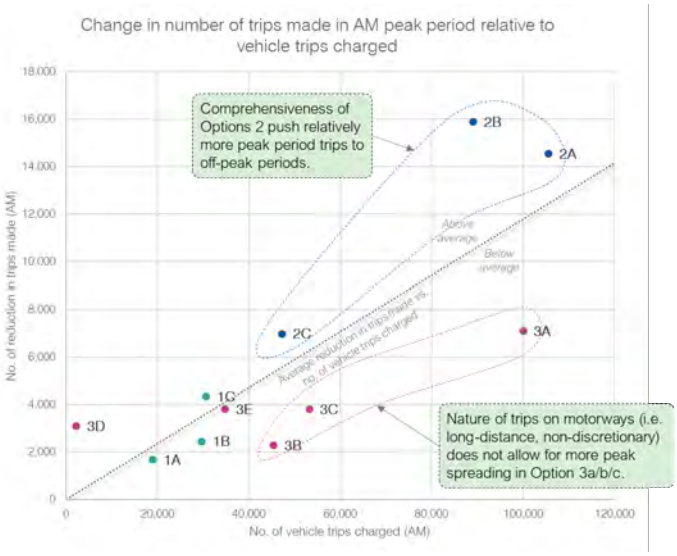


Figure 18: Peak spreading impact relative to number of vehicle trips charged by option

Key findings

- All options assessed have the potential to reduce congestion in Auckland. However, the level and distribution of outcomes varies as a result of a variety of factors including the competitiveness of public transport alternatives and the options/capacity of alternative routes.
    - If public transport alternatives are fast, direct and frequent, mode shift from car to public transport becomes a main contributor to alleviating congestion.
    - If alternative road routes are available, congestion can shift to uncharged arterial and local road alternatives, as seen in Option 3 Category hot-spot schemes where diversion occurs. This diversion can be problematic leading to new localised

congestion, longer journeys, use of less suitable routes and impacts on public transport routes.

  - Peak spreading contributes to reduced congestion in peak periods whereby vehicle trips that can be made at times of day when charges to do not apply retime journeys.

- Charges on motorways (such as Options 3a, 3b, and 3e) reduce congestion predominantly for through trips that start and/or end at outer suburbs. In contrast, charges on arterial or local roads (such as Option 1 and 2 category schemes, or Option 3d) alleviate congestion mainly for shorter, local trips that start or end close to where the charges are located.

5.2.2 Social and Distributional assessment

The Social and Distributional assessment considered the following criteria – drawing on global benchmarking and analysis of AFC model outputs:

1. Equity and distribution of impacts
2. Safety

A summary of findings for each option is outlined in Table 10 below.

Table 10: Stage A Social and Distributional Assessment summary

	Equity and distribution of impacts	Safety
Option 1a	• The city centre is well serviced by the existing public transport network which provides viable alternatives to vehicle travel – with residents benefiting from reduced congestion. • Charged trips are distributed evenly amongst higher and lower income Local Board (LB) areas. • As the city centre is a key employment destination shift workers could be impacted (although this is mitigated by the time of use element of the charges. • Access to a number of sites of significance could be impacted.	• Moderate positive impact on arterial/local road safety across the central city in line with reductions in VKT.
Option 1b	• Impacts are consistent with 1a, however more lower income drivers are impacted indicated by increase in number of charged trips from lower income LB areas (9% of trips from Maungakiekie-Tāmaki and 8% of trips from Henderson-Massey). • Increase in impact of diversion on local residents around motorway charged points. • Possible greater impact on people travelling to Auckland Hospital.	• Moderate positive impact on road safety across all road types across the central city in line with reductions in VKT.
Option 1c	• Impacts are consistent with Option 1a, however the total volume of trips charged increases, and therefore impact increases. • Inclusion of Hospital could impact low-income workers and patients who are less able to use alternative modes.	• Moderate positive impact on arterial/local road safety across the central city in line with reductions in VKT.
Option 2a	• Impacts are consistent with Option 1a. However, the scale of charged area means this option effects a significantly high number of trips, with a high proportion of trips from higher income LB areas impacted. 93% of trips from Waitematā and 53% of trips from Albert-Eden LB areas are charged. • Large number of residents in scope for scheme facing significant increase in costs for day-to-day trips. Benefits less likely to outweigh costs for this more car dependent area, especially for journeys on less congested local roads.	• Major positive impact on arterial/local road safety across the central city in line with reductions in VKT.
Option 2b	• As with Option 2a however exclusion of motorways means a lower proportion of through trips are impacted. • Additional negative equity implication as people travelling through the area by motorway cause congestion and negative	• Major positive impact on arterial/local road safety across the central city in line with reductions in VKT.

	Equity and distribution of impacts	Safety
	externalities (pollution, noise) but pay no charge whilst those not using motorways to travel within the area do have to pay.	
Option 2c	• Consistent with Option 2a and 2b, however cordon charge reduces impact on residents living within the zone. • Potential risk of community severance where boundary residents are negatively impacted for travelling into the cordon to access services and amenities.	• Major positive impact on arterial/local road safety across the central city in line with reductions in VKT.
Option 3a	• Area of caution noted for this option due to large number of trips in scope with disproportionate impact on low-income communities, where PT alternatives are limited. 31% of trips from Henderson-Massey and 28% from Māngere-Ōtāhuhu LB areas are charged – these are lower-income LB areas. Risk that scheme acts as a major barrier to connectivity for these individuals. • Scheme could also disproportionately impact vulnerable groups with accessibility issues who may not have access to public transport. MR • Risk of traffic diversion onto local road network with disbenefits (health, amenity etc) for local residents. • Extent of area impacted by charge means key workers and shift workers likely to be impacted (including those to Auckland Hospital and other healthcare and education facilities).	• **Area of caution noted for this option due to diversionary impacts.** • Major negative impact on road safety across arterial/local roads in the central city, but major positive road safety impacts on motorways in line with changes in VKT.
Option 3b	• Impacts greater in the North and West of the city,but overall, less skewed towards low-income communities than option 3a with higher income communities more likely to pay the charge. 17% of trips from Waitematā and 19% of trips from Kaipatiki LB areas are charged. • Nevertheless, charges large number of journeys which may not have a viable alternative. • Risk of traffic diversion onto less appropriate local roads, with associated safety, noise, air quality and amenity disbenefit, but less so than 3a. • Extent of area impacted by charge means key workers and shift workers likely to be impacted.	• **Area of caution noted for this option due to diversionary impacts.** • Moderate negative impact on road safety across arterial/local roads in the central city, but moderate positive road safety impacts on motorways in line with reductions in VKT.
Option 3c	• Consistent with Option 1b – but greater scale of impact due to greater extent on motorway network charged.	• Moderate positive impact on road safety across the central city, especially on motorways, in line with reductions in VKT.
Option 3d	• **Area of caution noted for this option due to significant re-routing and rat running onto less suitable local roads, with associated safety, noise, air quality and amenity disbenefits.**	• Negligible at regional level due to localised nature of scheme.
Option 3e	• Some re-routing and diversionary impacts, however less significant that Option 3d.	• **Area of caution noted for this option due to diversionary impacts.** • Moderate negative impact on road safety across arterial/local roads near the charged locations, but moderate positive road safety impacts on motorways in line with reductions in VKT.

Equity and distribution of impacts

Initial analysis found that larger scale options impact a greater number and broader cross-section of people – including a greater number of lower income individuals (particularly Options 2a, 2b, and 3a).

Smaller scheme options assessed have fewer impacts which are more likely to be mitigatable. Options which impact a greater number of lower-income drivers create more impacts which may be harder to mitigate through scheme design or complementary measures. This is particularly evident in options which capture a greater number of long distance or motorway journeys such as Option 3a.

Good accessibility to viable public transport alternatives mitigates many of the impacts on vulnerable user groups – this is easier to achieve when trips are being made to a consistent origin / destination point (such as the city centre). There are currently limited viable public transport alternatives to many motorway journeys.

Rat-running on local roads has the potential to impact local residents, through safety and amenity disbenefits. This is experienced most significantly in options where travel on motorways or arterials is charged and surrounding local roads are not.

Safety

Broadly it is anticipated that outcomes relating to road safety will improve in line with reduced VKT. Options 3a, 3b, and 3e were marked with a caution flag for the Safety criterion, reflecting the scale of traffic diversion from motorways to local roads where safety risks are greater.

Key findings

- Larger scale scheme options impact a greater number and broader cross-section of the community (including a greater number of lower-income people).
- Smaller scheme options have fewer impacts which are more likely to be mitigatable and impact fewer lower-income travellers.
- Options which impact a greater number of geographically dispersed lower-income travellers will be harder to mitigate through complementary measures.
    - It is easier to use public transport to mitigate the impacts of a city centre cordon charge on vulnerable user groups due to the geographic concentration of charged trips. There are limited existing viable public transport alternatives to many motorway journeys.
- Rat-running and diversionary traffic has the potential to create negative safety, and amenity impacts on local residents.

5.2.3 Local Economy assessment

The Local Economy assessment considered the following criterion – drawing on global benchmarking and analysis of AFC model outputs:

1. Local economy performance and prosperity

A summary of findings for each option is outlined in Table 11 below.

Table 11: Stage A Local Economy assessment

	Local economy performance and prosperity
Option 1a	• Around 7% of all businesses in Auckland are located within the charged area, including around 4% of vulnerable industries [3] (those most likely to be impacted by a charge). • Potential impact on Auckland's central business district (key role in the regional and national economy) as well as the Port of Auckland.
Option 1b	• Consistent with Option 1a but brings major goods and logistics routes into consideration – with potential impacts on motorway journeys.
Option 1c	• Around 9% of all businesses in Auckland are located within the charged area, including around 6% of vulnerable industries. Potential impact on Auckland's central business district (key role in the regional and national economy) as well as the Port of Auckland and employment and innovation services around Auckland Hospital and Newmarket.

[3] Vulnerable industries were identified based on benchmarked evidence from cities elsewhere of the industries that showed the most significant negative impacts associated with congestion charging (e.g. retail and hospitality). These where then aligned with StatsNZ census business categories.

	Local economy performance and prosperity
Option 2a	• **Area of caution identified due to scale of impact, with around 21% of all businesses in Auckland located within the charged area, including around15% of vulnerable industries and 31% of businesses in the charged area potentially vulnerable.** • Potential impacts on the city centre as with Option 1c, and impacts on nationally significant logistics and good routes due to motorway charge.
Option 2b	• **Consistent with Option 2a, but allows for uncharged through movements on motorway network – area of caution identified.**
Option 2c	• 21% of all businesses in Auckland inside the cordon but same extent of potential impact to the other Option 2 Category as many trips uncharged (but likely far less significant for many businesses). • Significant impacts most likely on businesses just inside the cordons. • Likely to require greater accommodation for local economy impacts. • Brings in more border impacts potential from wider cordon on more similar inside/outside areas.
Option 3a	• **Area of caution identified as all businesses are likely to be in the scope of impact for this option, including Port of Auckland access and nationally significant goods and logistics routes.**
Option 3b	• Potential impact on Port of Auckland access, as well as impact on some central Auckland goods and logistics routes.
Option 3c	• Around 7% of all businesses in Auckland are located within the charged area, including around 4% of vulnerable industries. • Potential impact on Auckland's central business district (key role in the regional and national economy) as well as the Port of Auckland. • As with Option 1b this option brings major goods and logistics routes into consideration – with potential impacts on motorway journeys.
Option 3d	• Impacts likely to be focused on hyper-local businesses within the Isthmus with disproportionate negative impacts for these businesses potentially making it harder for them to compete. • Also potential for local logistics and goods re-routing.
Option 3e	• Charge points located on nationally significant logistics and goods routes.

Local Economy performance and prosperity

Businesses value time saving highly, and some sectors will benefit disproportionately from reductions in congestion. However, the impact of charges on contributing factors, such as the labour market, needs to be further explored.

In general, larger scale options (2a, 2b, and 3a) impact the greatest number of businesses, including impacting nationally significant goods and logistics routes. However, others such as Option 1b, 3c and 3e would increase the financial costs, but decrease the time costs, for users undertaking journeys on key freight routes. At this level of analysis, it was not possible to determine whether this impact is positive or negative for any given trip or business type.

Options which create distortions within local economies – notably Option 3d – have the potential to create hyper-local impacts where customers switch from one small business to another as a result of the charge.

Key findings

- Some sectors will benefit disproportionally from reductions in congestion due to the value of travel time saving – however the impact of a charge on contributing elements such as the labour market needs to be further explored.
- Larger scale scheme options impact a greater number of businesses, and a greater number of vulnerable sectors, as well as nationally significant goods and logistics routes.
- Some options create distortions within local economies – with potential hyper-local impacts as customers switch from one small business to another as a result of the charge.

5.2.4 User experience and understanding assessment

The User Experience and Understanding assessment considered the following criteria informed by global benchmarking of similar schemes and a qualitative assessment of boundary complexity:

1. Public Interpretability and Understanding
2. User Experience (no differentiators at this stage)

Analysis relating to this criterion consider tariff complexity, boundary complexity, and a coarse assessment of likely trip frequency [4].

A summary of findings for each option is outlined in Table 12 below.

Table 12: Stage A User Experience and Understanding assessment

	Public interpretability and understanding
Option 1a	• Boundary complexity was assessed as being simple (clearly defined existing boundary). • Tariff complexity was assessed as being simple (tariff only comprises one scheme type). • Frequency was assessed as likely skewing low. • Comprehension was therefore assessed as being likely medium.
Option 1b	• Boundary complexity was assessed as being complex (both cordon and motorway). • Tariff complexity was assessed as being medium (due to two scheme types). • Frequency was assessed as being likely skews medium. • Comprehension was therefore assessed as being likely low-medium due to combination of two scheme types.
Option 1c	• Boundary complexity was assessed as being high • Tariff complexity was assessed as being simple (tariff only comprises one scheme type) • Frequency was assessed as likely skewing low • Comprehension was therefore assessed as being likely medium. • **Area of caution was applied to this option due to challenges articulating why some city fringe locations are charged and others are not.**
Option 2a	• Boundary complexity was assessed as being medium • Tariff complexity was assessed as being simple (tariff only comprises one scheme type) • Frequency was assessed as likely skewing medium-high • Comprehension was therefore assessed as being likely medium.
Option 2b	• Consistent with Option 2a.
Option 2c	• Boundary complexity was assessed as being complex. • Tariff complexity was assessed as being medium (due to two scheme types). • Frequency was assessed as likely skewing medium. • Comprehension was therefore assessed as being likely medium-complex. • **Area of caution was applied to this option due to challenges articulating why some roads are charged and others are not.**
Option 3a	• Boundary complexity was assessed as being simple. • Tariff complexity was assessed as being simple (tariff only comprises one scheme type). • Frequency was assessed as likely skewing higher. • Comprehension was therefore assessed as being likely good.
Option 3b	• Boundary complexity was assessed as being medium. • Tariff complexity was assessed as being simple (tariff only comprises one scheme type). • Frequency was assessed as likely skewing higher. • Comprehension is likely medium.
Option 3c	• Boundary complexity was assessed as being complex (both cordon and motorway). • Tariff complexity was assessed as being medium (due to two scheme types). • Frequency was assessed as likely skewing medium. • Comprehension was therefore assessed as being likely low-medium due to combination of two scheme types.
Option 3d	• Boundary complexity was assessed as being unclear. • Tariff complexity was assessed as being simple. • Frequency was assessed as likely skewing medium-high. • Comprehension was therefore assessed as being likely low.

[4] More frequent use would allow users to familiarise themselves with scheme components more rapidly mitigating complexity to some extent.

	Public interpretability and understanding
	• **Area of caution was applied to this option due to challenges articulating why some roads are charged and others are not.**
Option 3e	• Boundary complexity was assessed as being medium. • Tariff complexity was assessed as being simple. • Frequency was assessed as likely skewing higher. • Comprehension was therefore assessed as being likely medium.

Public Interpretability and Understanding

Areas of caution were applied to both Option 1c, 2c and Option 3d, reflecting the perceived challenge of articulating a clear rationale for the specific definition of the roads selected for charges in each case.

User Experience

No differentiation was identified for User Experience at this stage of option development – more detailed analysis will provide a better indication of specific user experience issues.

Key findings

- It is more challenging to articulate a clear rationale for some schemes than others (particularly those which charge some areas or roads not aligned with an established boundary or congestion hot-spot, and not others).

5.2.5 Practicality, social licence, and affordability assessment

The Practicality, social licence, and affordability assessment considered the following criteria:

1. Flexibility, privacy, integrity, and deliverability
2. Stakeholder perspectives
3. Public perspectives
4. Capital costs, lifecycle costs, and revenue [5]

This assessment drew on a number of factors including Local Board feedback, global benchmarking of scheme implementation and operation, and a high-level consideration of costs.

A summary of findings for each option is outlined in Table 13 and Table 14 below.

Table 13: Stage A Practicality and affordability assessment

	Flexibility, privacy, integrity and deliverability	Capital costs, lifecycle costs and revenue
Option 1a	• Highly flexible for future expansion, compliance likely high but enforcement in urban setting more complex. • Most cost-effective option to deliver.	• Very low cost, low revenue. • Payback period = moderate
Option 1b	• **Highly flexible for future expansion, more risk of confusion, two regimes and two asset owners, more complex to deliver – area of caution identified.**	• Low cost, moderate revenue • Payback period = fast

[5] This was a very high level assessment which considered:

- Charge rates and number of charge-payers,
- Technology and roadside assets required for each option (ANPR at roadside, power and comms, and back office system), and
- Operations and maintenance.

This exercise was focused on establishing the relative lifecycle cost differences between the various options, rather than determining an accurate cost baseline which would be very challenging at this early stage, particulary due to the unconfirmed approach to roles, assets, technology, and operations and maintenance.

	Flexibility, privacy, integrity and deliverability	Capital costs, lifecycle costs and revenue
Option 1c	• Less flexible than Option 1a with greater confusion risk, urban setting complicates enforcement, complexity increases delivery and operations cost.	• Low cost, moderate revenue • Payback period = moderate
Option 2a	• Significant infrastructure requirements limit ability to flex footprint. • Potential concern with scale of data collection. • Very challenging to enforce. • Two regimes and two asset owners, more complex to deliver. • Costly and time-consuming - **area of caution identified.**	• Very high cost, very high revenue • Payback period = moderate
Option 2b	• Low flexibility due to significant infrastructure investment. • Potential concern over data. • **Challenging to enforce, costly and time-consuming to deliver - area of caution identified.**	• Very high cost, high revenue • Payback period = slow
Option 2c	• Less flexible than Option 1a. • More confusion risk and broader urban setting complicates enforcement. • Complexity increases the delivery and operational costs.	• Moderate cost, moderate revenue • Payback period = moderate
Option 3a	• Moderate flexibility due to major infrastructure investment. • Potential user concerns regarding data. • Easier to enforce and moderate deliverability	• High cost, very high revenue • Payback period = moderate
Option 3b	• Moderate flexibility due to major infrastructure investment. • Potential user concerns regarding data. • Easier to enforce and good deliverability.	• Moderate cost, moderate revenue • Payback period = moderate
Option 3c	• Moderate flexibility due to major infrastructure investment. • Potential user concerns regarding data. • **Complex to enforce with two regimes and somewhat complex to deliver and operate - area of caution identified.**	• Moderate cost, high revenue • Payback period = fast
Option 3d	• Relatively flexible due to modest infrastructure requirements, complex to enforce in urban area. • Cost effective to deliver but slightly higher operational costs.	• Very low cost, very low revenue • Payback period = moderate
Option 3e	• Very flexible, straightforward to enforce and likely high compliance, cost-effective to deliver and operate.	• Very low cost, moderate revenue. • Payback period = fast

Flexibility, privacy, integrity and deliverability

All options assessed would be technically and financially feasible over time. However, the flexibility, privacy, integrity and deliverability become increasingly complex for larger schemes, or those which capture different elements of the road network (i.e. local roads and motorways).

Capital costs, lifecycle costs, and revenue

Options with physically greater amounts of infrastructure are costlier to implement, and less flexible, especially Option 2a and 2b. Options which affect more people also tend to generate higher revenue – these are sometimes, but not always, the ones which require more infrastructure.

Table 14: Stage A Social Licence assessment

	Stakeholder perspectives	Public perspectives
Option 1a	• Good public transport mitigates Local Board concerns around alternatives. • Largely a higher income group affected which mitigates equity concerns also raised by Local Boards. • Local groups and businesses may raise concerns relating to potential impacts on local businesses.	• Around 20k charge payers (AM), with good PT options. • Charge-payers are a small % of a very wide area • Likely among lowest social licence risk options and potentially least 'surprising' option.
Option 1b	• Good public transport mitigates Local Board concerns around alternatives; however, motorway journeys are less well supported. • Motorway journeys also bring in a wider range of payers – which may raise concerns from advocacy groups.	• Consistent with Option 1 but brings in Motorway traffic less well catered to by PT, and a larger population overall (30k charge payers in the AM), though impacts are still widely spread. • Social licence risk appears moderate.

	Stakeholder perspectives	Public perspectives
	• Local Boards have also raised concerns relating to the impact of diversionary traffic on local streets and communities.	
Option 1c	• Good public transport mitigates Local Board concerns around alternatives. • Largely a higher income group affected which mitigates equity concerns also raised by Local Boards. • Local groups and business associations may raise concerns relating to potential impacts on local businesses.	• Similar to 1a with good PT (though 30k charge payers in AM) but picks up hospital and more schools –origins still dispersed. • Access to hospital for patients is likely to be a concern. • Relatively low social licence risk.
Option 2a	• Likely strongly triggers concern around PT alternatives. • Equity concerns likely triggered by full-spectrum charge. • Local groups and business associations concerns likely echoed by others across Isthmus.	• Very large number of charge payers (105k AM charge payers), including almost all trips from affected areas. • PT unlikely to adequately serve many affected trips. • **Social licence risk appears high, and an area of caution has been identified.**
Option 2b	• Likely strongly triggers concern around alternatives. • Equity concerns likely triggered by full-spectrum charge. • Local groups and business associations concerns likely echoed by others across Isthmus.	• Very large number of charge payers (89k AM charge payers), including almost all trips from affected areas. • PT unlikely to adequately serve many affected trips. • **Social licence risk appears high, and an area of caution has been identified.**
Option 2c	• Good PT across both cordons likely mitigates concern around alternatives. • Potential equity concerns as wealthier residents within the cordon would face fewer charges than others but have the gains of decongestion. • Local groups and business associations may raise concerns around impacts on businesses.	• Estimated 47k charge payers in AM peak. • Good PT across cordons mitigates risk to some extent. • Social licence risk appears moderate.
Option 3a	• Likely strongly triggers concern around PT alternatives, including Northern Busway where Park and Ride capacity is constrained (as raised by Local Boards). • May trigger equity concerns due to cross-section impact. • Local Boards have also raised concerns relating to the impact of diversionary traffic on local streets and communities (particularly relevant for 3a and 3b.	• Very large, affected number of charge payers (100k AM charge payers). • PT unlikely to be viable for significant numbers of affected trips. • **Social licence risk appears high, and an area of caution has been identified.**
Option 3b	• Consistent with Option 3a.	• Around 45k AM charge payers including >20% of several Local Board areas. • PT unlikely to be viable for significant numbers of affected trips. • **Social licence risk appears high, and an area of caution has been identified.**
Option 3c	• Consistent with Option 3a.	• 53k AM charge payers, >10% of several Local Board Areas. • PT unlikely to be viable for significant numbers of affected trips. • Social licence risk appears moderate.
Option 3d	• Good North / South public transport mitigates concern around alternatives raised by Local Boards. • Local groups and business associations concerns may be echoed by businesses on affected routes. • Equity concerns somewhat triggered.	• Very small population affected (2k AM charges), small % of a handful of Local Board Areas. • Rat-running impact potentially unpopular. • Fairness concern likely for local area. • Moderate social licence risk.
Option 3e	• Could trigger concerns around PT alternatives due to motorway demographic. • Local Boards have also raised concerns relating to the impact of diversionary traffic on local streets and communities.	• Moderate population affected (35k AM charges), >10% of 4 Local Board Areas, moderate diversion onto local routes. • PT unlikely to be viable for significant numbers of affected trips. • Moderate social licence risk.

Stakeholder perspectives

Given current public transport provision, options which impact more people and are further from the city centre are likely to trigger the concerns flagged by Local Boards around the need to ensure access to good public transport alternatives. Local Boards have also raised concerns around the impact of potential rat running on local communities, and the need to mitigate impacts on more vulnerable communities.

Public perspectives

Articulating a clear rationale for who is impacted, and why, is critical for reducing social licence risk. Options which impact more people are likely to pose higher social licence risk, as are those options which disproportionately impact low-income groups, particularly Option 2a, 2b, and 3a.

Key findings

- All options would be technically and financially feasible over time – however complexity and cost increases as scheme scale increases.
- Early feedback from Local Boards highlighted key concerns around equity, safety, and access to public transport. Options which have a disproportionate impact on lower-income groups, create significant diversionary impacts, or are lacking in / hard to complement through public transport are likely to create a greater social licence risk.
- Articulating a clear rationale for who is impacted, and why, is critical for securing social licence.

5.2.6 Secondary outcomes: environmental, sustainable travel and wider economic impacts assessment

Across the secondary assessment areas of Environmental, Sustainable Travel, and Wider Economic Impacts, there were few differentiators identified.

A high-level summary of findings relating to secondary outcomes is provided in Table 15.

Table 15: Summary of secondary outcomes findings for Stage A assessment

	Summary of findings
Environment	• GHG emission reductions (only considering CO_2 at this point int time) vary a little across options, however this is not a differentiator at this level of scheme design and analysis.
Sustainable Travel: Public Transport	• The potential for mode shift to public transport differs due to the presence of existing viable alternatives – with greater mode shift forecast where impacted journeys are well served by public transport. • Results for city centre schemes indicate a proportionally higher shift to public transport. • Forecast mode shift is lower for schemes which charge motorways or arterials where the impacted journeys are typically between a more diverse set of origins and destinations for which public transport journeys are less competitive with private car journeys.
Sustainable Travel: Active Transport	• Scheme options which charge motorways are likely to impact longer distance trips which cannot be easily replaced by active transport.
Wider Economic Impacts	• Travel time savings vary across options, however this is not a differentiator at this level of scheme design and analysis.

5.3 Outcomes and recommendations

A high-level summary of Stage A Assessment Findings is provided in Figure 19 below, focusing on where the impact of options highlighted a concern (area of caution), represented with a warning sign.

Broadly speaking, the more warning signs an option has, the harder it would likely be to mitigate the challenges, and the less viable it is considered as an option.

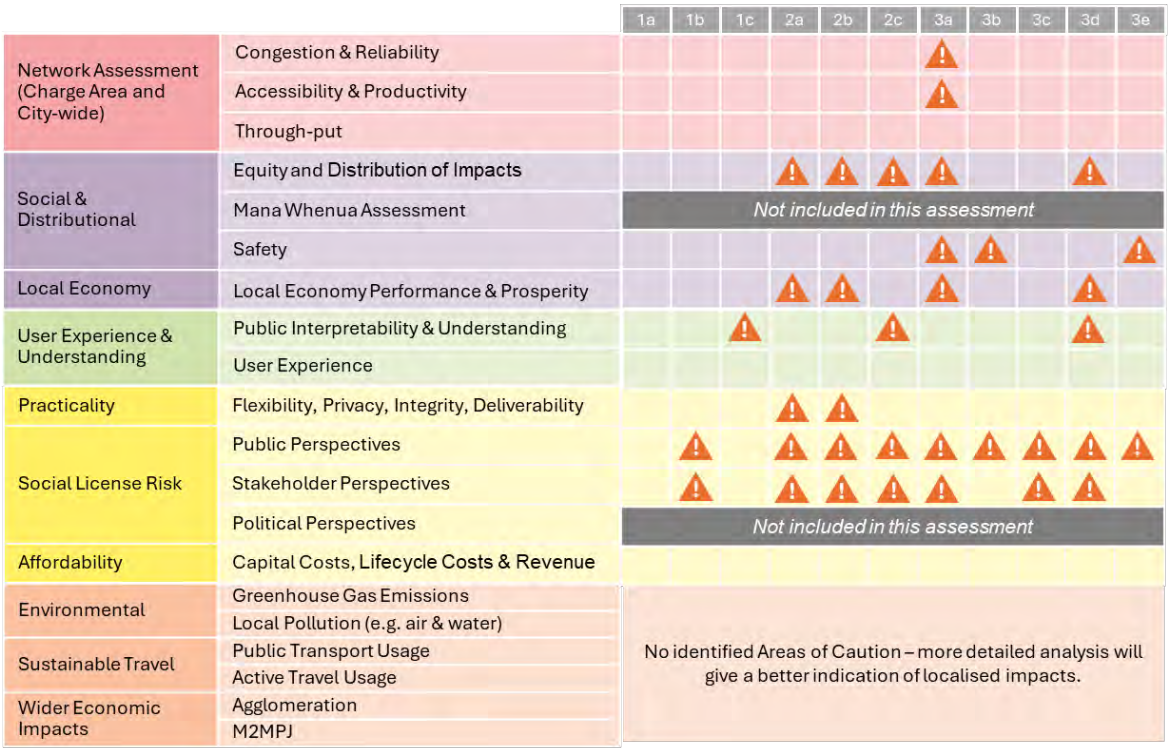


Figure 19: Summary of Stage A assessment findings

Recommendations

On the basis of the assessment carried out, workshop attendees agreed that the **following options should be deprioritised** and not taken forward for subsequent stages of assessment. This recommendation was supported by the project's Governance.

Inner isthmus area charge Options 2a and 2b

- These options have impacts on a very significant scale (around one in five road trips in Auckland, and 95% of trips from affected areas would be charged). This was apparent in the significant equity and feasibility challenges they raised.
- These options would have a significant impact on the local economy with 21% of businesses in Auckland situated within the charged area, and around 31% of those potentially vulnerable to the impacts of a charge.
- The congestion relief benefits they offered, while significant, were not considered proportionate to the additional number of trips affected and complexities they brought.

Extensive motorway, Option 3a

- Significant congestion relief that comes with large trade-offs given the scale of the scheme.
- Diversion from motorways onto local roads.
- Impacts more trips from lower socio-economic areas with 31% of trips from Henderson-Massey Local Board Area and 28% of trips from Māngere-Ōtāhuhu Local Board Area charged.
- Affects all business trips that rely on movement.
- Provides limited public transport alternatives.

Limited congested hotspots, arterials only, Option 3d

- Results in reduced congestion on the charged links themselves but increases traffic volumes and congestion on uncharged alternatives in the local area.
- Challenging to explain the rationale which could affect feasibility.
- Likely to have hyper-local impacts on the local economy and residents. This includes disbenefits relating to diversionary traffic on local roads (air quality, safety, amenity, noise) and customers switching from one small business to another as a result of the charge.

Workshop attendees agreed that the following four options should proceed for further detailed assessment:

- City centre cordon (1a)
- City fringe cordon (1c)
- Inner isthmus cordon (2c)
- Core Motorways (3b)
- Targeted motorway hotspots (3e)

Workshop attendees further agreed that the following two options should be combined and should proceed for further detailed assessment:

- Core motorways combined with the city centre cordon (combining options 1b and 3c, taken forward as Option 3c).

This resulted in a total of six options that were recommended for further consideration. These were entered into the partial Stage B Assessment process which was initiated immediately following the endorsement of Stage A findings.

Option 2c was not immediately incorporated into the partial Stage B assessment, however this assessment will progress through future work.

6. Stage B Assessment (partial)

6.1 Stage B assessment purpose and overview

The purpose of the Stage B Assessment was to undertake a deeper dive into the performance of the remaining geographical charge options. Work was undertaken to explore the charging tariff, complementary measures, and mitigations, including a high level understanding of what these could mean in each scenario.

It was agreed that part of the Stage B Assessment would be progressed in this phase of the ToU programme. This 'partial' Stage B assessment serves as a first step of a more detailed analysis of the five options taken forward from the Stage A Assessment, focused on Social and Distributional and Local Economy impacts.

To do so, SMEs in Transport Planning and Modelling, Economics, and Social Impact Assessments undertook both a more detailed technical analysis of the options, and a global benchmarking exercise considering the impacts of various schemes across the globe. Where possible this analysis was supplemented with feedback from early engagement with stakeholders.

Option 2c was not included in this partial Stage B assessment, due to its late inclusion in the options assessment. However, it has been recommended that this assessment should occur at a later date.

6.2 Stage B assessment (partial) findings

The Stage B Assessment enabled more detailed analysis and provides a further degree of granularity relating to the impacts on businesses, employees, and the community.

6.2.1 Social and distributional impact assessment

The Social and Distributional Impact Assessment drew on insights developed through global benchmarking and analysis of the outputs of the option development and modelling (i.e. ABM) to understand the potential scale of impact on different segments of the community.

The Social and Distributional Impact Assessment considered the following user groups:

1. People on low-incomes
2. Shift workers
3. Disabled people and carers
4. Residents within charged areas
5. Boundary residents
6. Older and younger people
7. Ethnic and religious minorities
8. Women

It is important to note that some groups within the community are more likely to be impacted by a ToU scheme because of intersections between one or more demographic characteristics that makes them systematically more exposed or vulnerable to undesirable impacts.

An overview of the findings of the Social and Distributional Impact Assessment is presented by option in Table 16.

Table 16: Social and distributional impact assessment by option

	Option 1a	Option 1c	Option 3b	Option 3c	Option 3e
Low-income	Limited impacts, and where impacts do occur, they are highly localised and easier to mitigate.		Impacts dispersed across Auckland and harder to mitigate. Modelling suggests that low-income drivers without viable alternatives are paying the charge. Low levels of mode shift, but where it does occur public transport journey times are increasing.		
Shift workers	Charging in the peak, and by peak direction only, considerably reduces risk of negative impacts on shift workers	This remains true, although the presence of the hospital increases the risk.	Greater impact on low-income communities (which is likely to include a significant proportion of shift workers), and it is more difficult to mitigate impacts through scheme design choices such as direction of charge.		
Disabled people and carers	Least impact expected due to small number of trips impacted, including fewer trips made by low income drivers and fewer escort trips.	Greater impact than Option 1a due to the inclusion of the Hospital and Blind Low Vision NZ.	Modelling indicates that more 'everyday' trips are brought in scope, including more escort trips, and more trips by lower income drivers. This suggests a possible greater impact for disabled people, as well as a highly dispersed impacted population.		
Residents within zone	Low likelihood of making chargeable journeys as unlikely to be travelling in charged direction at charged times (i.e. into the city centre at AM peak). Will likely benefit from improved amenity, public and active transport options, as well as related factors including local road safety and transport-related emissions.		Not relevant.		
Boundary residents	Little evidence of boundary impacts such as diverting traffic. Some risk of severance but many community facilities are not located in city centre.	Little evidence of diverting traffic, slightly greater risk of severance due to inclusion of healthcare and community facilities in the charged area.	Evidence of traffic diverting onto less appropriate roads bringing risk of negative impacts on amenity, noise, road safety etc...		High risk of diverting traffic causing negative impacts on boundary residents.
Age	All options show a similar pattern for older and younger travellers, with longer public transport journey times, a low-level shift to public transport, and improved car journey times.				
Māori [6]	Slightly lower proportion of charged trips appear to be made by Māori under Option 1a and 1c in particular, but more work is required to better understand these impacts.		The three link scheme options appear to have the greatest impact on Māori populations, based on number affected only, but more work is required to better understand these impacts.		
Gender and Escort Trips	Across all options, men are more likely to make charged trips, reflecting the tendency for men to make fewer, longer trips and have higher willingness to pay. This may also reflect the proportion of men in jobs dependent on a vehicle (tradies etc). More escort trips are made under the link scheme options, which may indicate greater impacts on women but more work is required to understand this.				

Further detail on the technical analysis and global benchmarking examples used to assess potential scale of impacts across user groups is presented below.

[6] Impacts on Māori population have been calculated by an overlay of Māori population distribution from 2018 census data onto Agent Based Model outputs to give a highly representative quantitative measure of impact at an individual level. Currently similar analysis has not been completed for other ethnic groups but at more detailed stages of development the same technique could be applied to other ethnic groups.

People on low-incomes

The cost implications of a charge will impact people differently depending on their income level and socio-economic situation.

Where low-income people are car-dependent (e.g. where public transport is unavailable or not viable), charging schemes can make journeys less affordable for low-income groups. This potentially forces people to forgo journeys, reducing their ability to engage in regular activities.

To understand the implications of each option for people on low incomes, the proportion of daily trips originating from each Statistical Area 2 (SA2) unit being charged was mapped – shown in Figure 20 for each option [7].

These maps highlight the difference in distribution of impacts between the cordon options (1a and 1c) and the link options (3b, 3c, and 3e).

When compared to Figure 21, which maps the New Zealand Index of Deprivation, the impact of link options on low-income communities dispersed across Auckland becomes apparent. This demonstrates that under these options low-income drivers without viable alternatives are paying the charge.

It would be more challenging to provide viable public transport alternatives under link options due to the diversity of origin and destination points. This is discussed further in Section 9.4.

Under all options assessed, high-income earners transfer to public transport more often than low-income earners.

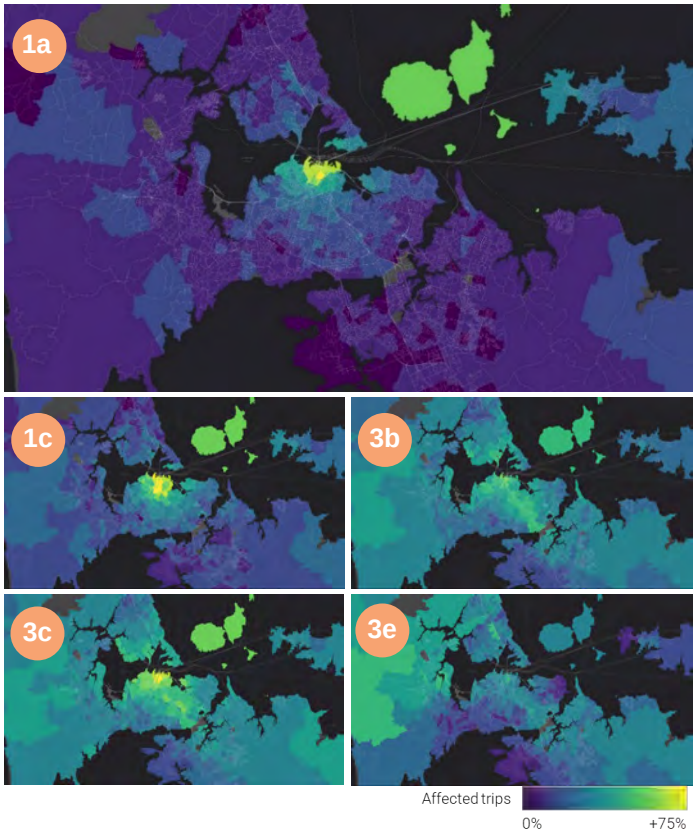


Figure 20: Proportion of trips originating from each SA2 being charged.

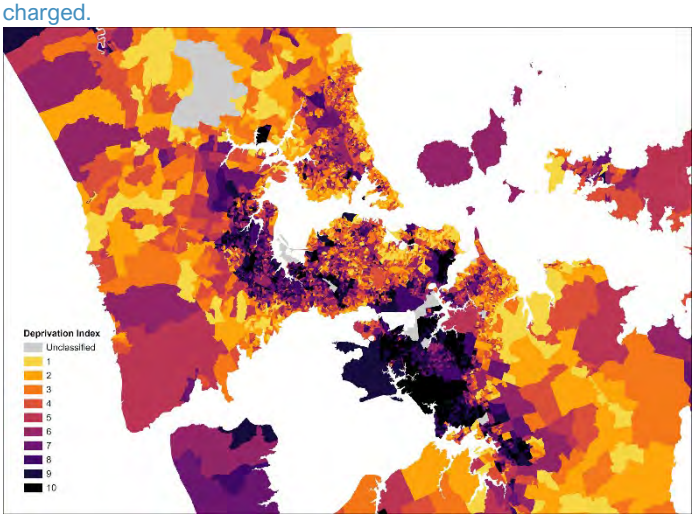


Figure 21: NZ Index of Deprivation

Low-income groups are less likely to transfer away from vehicle journeys in the AM/PM to avoid a charge. This implies the availability of alternative public transport options may be lower for low-income groups.

[7] SA2 units, as defined in Stats NZ's Statistical Standard for Geographic Areas (2023), are geographies of 1,000 to 4,000 residents that represent communities that are connected socially or economically (e.g. areas that share the same community facilities, or are socio-economically similar), and are of similar land use. SA2 units, which were adopted in the Agent Based Model used for this analysis, provide a pragmatic level of spatial granularity for visualising differences in social and distributional impacts across Auckland.

Case Study: Edinburgh Low Emission Zone (LEZ) [8]
A study of the Edinburgh LEZ identified that a charge may make journeys unaffordable for some passenger groups, forcing them to forgo their journey. As a result, it is likely that the charge affected some people's ability to engage in regular activities, therefore impacting on their well-being.

Shift workers

Shift workers may find it more difficult to avoid charges by travelling by modes other than the car, because they may have to travel at irregular times when services might not be available or perceived as safe. In addition, shiftwork is often low paid, making some shift workers potentially more vulnerable to negative impacts from charging. Charging in peak hour/peak direction only will substantially mitigate the risk for this group since they are less likely to be travelling in the same patterns as other commuters.

The impact on shift workers is not likely to be uniform across all options. For example, the presence of Auckland Hospital within the Option 1c cordon is likely to increase the number of shift workers subject to charges, compared to Option 1a.

The link options are expected to have a greater impact on shift workers given that these options affect a higher proportion of the low-income population which is likely to include a significant proportion of shift workers.

Case Study: London Congestion Charge Zone (CCZ) [9]
Prior to the introduction of the CCZ, concerns were raised about the potential impacts on shift workers. In practice, it was found that car use was lower than expected and fewer than one in twenty shift workers reported changing their mode of travel to work as a result of the scheme. Nevertheless, shift workers are a group that should be considered in any scheme design and negative impacts avoided.

Disabled people and carers

Further analysis will be critical to better understand the impact of a charging scheme on some user groups. For example, some people with mobility impairments may be less able MRto shift to alternative modes such as public transport.

In Auckland, disabled people and their carers may be more likely than other users to access the Auckland Hospital and healthcare facilities such as Blind Low Vision NZ foundation which are located within the Option 1c cordon.

On the other hand, the link options are expected to bring in more 'everyday' trips including a greater number of escort trips which may possibly generate a greater impact for disabled people.

Case Study: London CCZ [10]
Research found that disabled people found it more difficult to travel by public transport for a number of reasons, including accessibility of stations, a lack of announcements / visual displays, and not being able to find a seat, and many found travelling by car the best or only option. Although the 100% discount had limited any negative impacts on their travel, they did report that it had become more difficult for carers, friends and family to visit them and provide them with support.

Residents within zone and boundary residents

The impact on residents living within a charged area is likely to be positive in terms of benefiting from reduced traffic and congestion, and associated noise, pollution and road safety improvements.

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[8] Edinburgh's Low Emission Zones – update (2019)
[9] Central London Congestion Charge Third Annual Impacts Monitoring Report
[10] Central London Congestion Charge Third Annual Impacts Monitoring Report

Residents living within the Option 1a and Option 1c zones are expected to benefit from any associated public transport and active travel improvements.

However, there is a risk of negative impacts in boundary areas or where traffic is diverting – potentially affecting traffic and congestion, noise, pollution and road danger. These effects can be particularly harmful for vulnerable groups including older (>65 years) and younger (<30 years) people, and people with disabilities. While Options 1a and 1c are not expected to generate significant boundary impacts, traffic diversions are expected under the link options, suggesting negative impacts on boundary residents may be significant.

There is a further risk that low-income residents who live on the edge of the boundary could be negatively impacted by both having to pay a charge and the impacts on their local road network. In contrast higher-income residents who live within these charged areas do not have to pay and experience the benefits of reduced congestion. This will be particularly relevant for future analysis of larger scheme options, such as Option 2c.

Case Study: London CCZ [11]
Local residents of the CCZ reported improvements to their area as a result of traffic reductions and generally felt it was easy for them to travel in the zone (noting that they receive a 90% discount on the charge). Many did report that family and friends found it more difficult to visit them. This impact was most keenly felt by older and disabled people. Qualitative research found that they were more likely to report feeling lonely after the scheme was introduced, as a result of changes to visitor behaviour. On balance, equal numbers felt that they had gained and lost as a result of the scheme, with the largest group (43%) saying it had made no difference to them.

Analysis found that traffic reduced on routes approaching the CCZ, while remaining fairly stable on other local roads in the boundary area. Overall, very limited impacts (positive or negative) were found in the boundary area. However, this reflected the impracticality of diverting and the lack of previous through trips – any scheme which led to substantial diverting traffic would be expected to experience greater negative impacts.

Overall, boundary residents were as likely to think the scheme had improved their local area as made it worse – partly due to different attitudes to the same intervention (such as traffic management schemes). The scheme was supported by local traffic management schemes and the implementation of controlled parking zones to prevent unintended consequences.

Age

Older and younger people are typically disproportionately affected by poor air quality and road safety. As a result, they could stand to benefit more significantly from the outcomes of a charge. However, charges also have practical implications for these groups which could result in disproportionate negative effects.

Average public transport journey times for trips made by older and younger people generally increase by a small margin (less than 1%). This is a result of the charges driving older and younger people to use public transport for more longer distance trips.

Case Study: GLA Boundary Charge Study [12]
It was identified that a charge could affect the cost and attractiveness of undertaking social or caring visits to older people. For younger people, a charge could reduce access to hobbies, leisure and social engagement. These groups often benefit from concessionary public transport travel such as student or Gold Card discounts, making public transport more attractive, but they are also more likely to face public transport and active travel accessibility barriers.

[11] Central London Congestion Charge Third Annual Impacts Monitoring Report
[12] Confidential report (2021)

Ethnicity

Benchmarking has revealed concerns among religious and cultural communities regarding the implications of a charge on increasing the cost of making journeys for religious or culturally significant purposes.

Similarly, some minority faith and ethnic groups may be disproportionately likely to need to travel using charged routes to access places of worship and culture.

The lowest proportion of Māori are charged under Option 1a, reflecting the relatively lower proportion of Māori that live within and travel to the city centre. However, it is important that further analysis be carried out to better understand the impact on Māori.

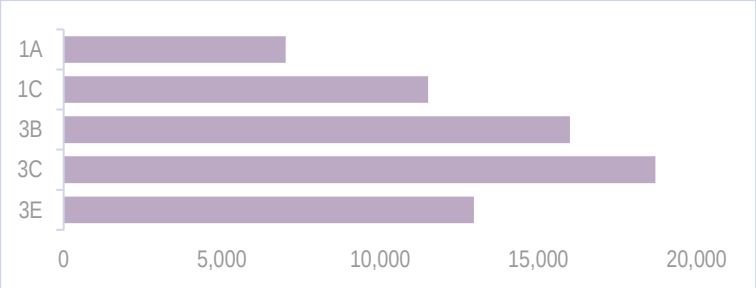


Figure 22: Number of charged trips made by Māori people

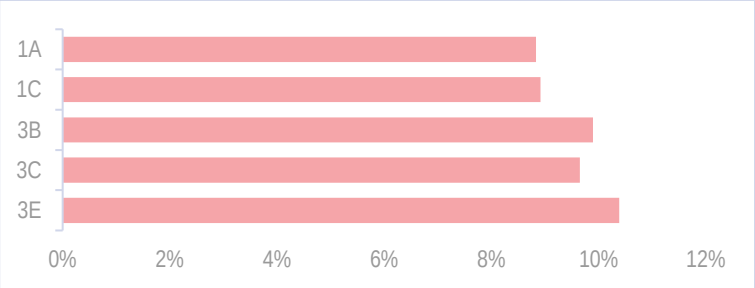


Figure 23: Proportion of charged trips made by Māori people

Case Study: London CCZ and Edinburgh LEZ [13]
Religious institutions in these cities have expressed concerns over the impacts of charges due to the financial burden imposed on visitors who rely on road transport to reach their places of worship. The added expense could deter attendance, particularly among financially vulnerable congregations.

Gender and escort trips

When considering gender, men typically make fewer, longer trips whilst women are more likely to make more, shorter trips and to have more complex journeys across the day. Some of these trips may be defined as 'Escort Trips' where the primary purpose of the trip is to 'escort' someone else, for example dropping children at school.

Modelling of the Auckland ToU scheme options indicated:

1. A higher proportion of charged trips are undertaken by men than women across all options (Figure 24).
2. As shown in Figure 25, the highest proportion of total Escort Trips occur under the link scheme options, suggesting there are few viable alternatives for these trips.

It is important to note that within the modelling undertaken for the Partial Stage B Assessment, Escort Trips cannot be broken down further. As

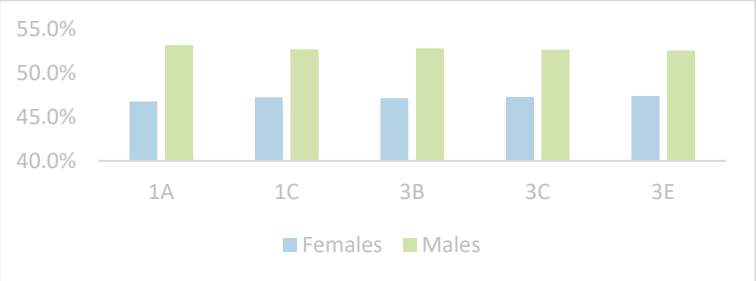


Figure 24: Proportion of charged trips by gender (%)

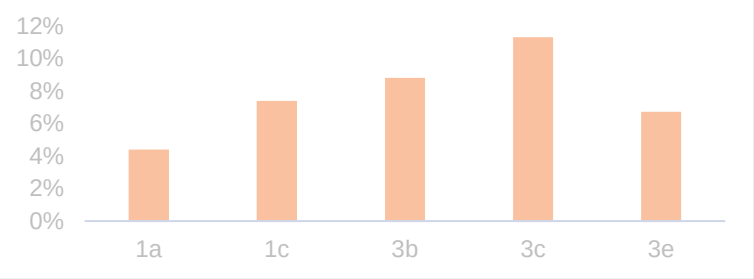


Figure 25: Proportion of total Escort Trips (%)

[13] Edinburgh's Low Emission Zones – update (2019)

result this definition encompasses a broad range of trip reasons such as car-pooling to work, school drop off, and healthcare related journeys.

Case Study: GLA Boundary Charge Study[45]
This study concluded that because women are more likely to travel with others and to provide care (particularly to children, older and disabled people) they may find it more difficult to change mode, and also to afford the charge, potentially constraining their activities and those of others. In contrast, men are more likely to benefit from reduced journey times on the road network and to be able to afford the charge. However, men are also more likely to work night shifts and to be professional drivers and therefore are at risk of negative impacts.

Key findings

- It is likely to be more straightforward to mitigate the impact for low-income groups under the cordon options. In these instances lower income groups impacted by the charge are more concentrated in areas with better public transport, providing viable alternatives to paying the charge. Under the link scheme options, the effect of a charge on low-income groups is significantly less concentrated in specific geographic areas.
- Younger and older people are less likely to shift modes to public transport but are more likely to experience longer public transport journey times as a result of the charge.
- The proportion of charged trips by gender is similar across all options – there are no immediately obvious distributional implications for gender groups across any option.
- The highest proportion of total escort trips (as a % of total charged trips) occurs under Option 3c. Escort trips refers to trips made for the purpose of escorting someone else (e.g. school drop off, carers, carpooling to work).

6.3 Local economy assessment

The Local Economy Assessment drew on insights developed through global benchmarking alongside analysis of the outputs of the option development and modelling (i.e. MSM) to understand the potential scale of impact on the local economy.

The Local Economy Impact Analysis through the Partial Stage B Assessment has focused largely on understanding the different types of trips being charged. Future more detailed phases of work should consider nuances in travel behaviour, such as trip chaining or frequency of trips, which may impact the local economy.

The Local Economy Impact Assessment considered the types of trips:

1. Impacts on retail (shopping trips),
2. Impacts on business trips (not including commuting), and
3. Impacts on freight trips.

An overview of key findings of the Local Economy Impact Assessment is presented by option in Table 17.

[14] Central London Congestion Charge Third Annual Impacts Monitoring Report

Table 17: Local economy impact assessment by option

	Option 1a	Option 1c	Option 3b	Option 3c	Option 3e
Impact on shopping trips	A relatively low number of shopping trips are charged under the cordon options. Due to the city centre location key destinations see a significantly bigger impact under cordon options but the overall impact remains small. Evidence of mode shift potential for shopping trips, particularly in the city centre.		A relatively high number of shopping trips are charged under this option but change in shopping trips accessing a key destination is minimal, including during the AM and PM peak. Evidence of mode shift potential for shopping trips, particularly in the city centre.	A relatively high number of shopping trips are charged under this option and key destinations see a significantly bigger impact under this option compared to the others in the Option 3 Category. Evidence of mode shift potential for shopping trips, particularly in the city centre.	A relatively high number of shopping trips are charged under this option but change in shopping trips accessing a key destination is minimal, including during the AM and PM peak. Evidence of mode shift potential for shopping trips, particularly in the city centre.
Impact on business trips	Slight reduction in VKT of business-based trips and the most significant reduction in business trips accessing the city centre. Average Journey Time (JT) of business-based trips decreases.	Slight increase in VKT of business-based trips across Auckland, but the reduction in trips accessing a key destination is significant, particularly in the city fringe east. Average JT of business-based trips decreases.	Largest increase in VKT of business-based trips across Auckland with a relatively small reduction in business trips accessing a key destination. Average JT of business-based trips decreases.	Significant increase in VKT of business-based trips across Auckland but significant reduction in business trips accessing a key destination, particularly in the city centre. This option generates the most significant reduction in average JT of business-based trips.	Slight increase in VKT of business-based trips across Auckland with a marginal change in business trips accessing a key destination. Average JT of business-based trips decreases.
Impact on freight trips	Freight trip journey times reduce in the AM peak, corresponding with an increase in average freight speed in the AM peak.				This is the only option where freight journey times in the AM period increase, corresponding with a reduction in AM peak average speed.

Trip types paying the charge

This analysis has highlighted key differences between link and cordon schemes, as illustrated in Figure 26. Cordon options (1a and 1c) are more targeted at charging Commuting and Business based trips, while a higher proportion of 'Other' trips (education, leisure, health-based trips etc [15]) are charged under link options.

Historical analysis and international experience indicate that commuting trips tend to be more routine and less complex relative to other trip types. As such it often more straightforward to encourage these trips to shift modes through complementary measures.

Conversely, these trips are more often time inflexible (many people must be at work or at school at a specific time), so may have less ability to shift their timings to avoid charges.

[15] A proportion of these 'Other' trips have the potential to be discretionary. Some, such as education-based trips, require a particular arrival time and would not be discretionary. However, some trips (e.g. leisure) are more discretionary and even some of the less discretionary trips (e.g. healthcare) may have greater potential to be re-timed

Further detail on the technical analysis and global benchmarking examples used to assess potential scale of local economy impacts across trip types is presented below.

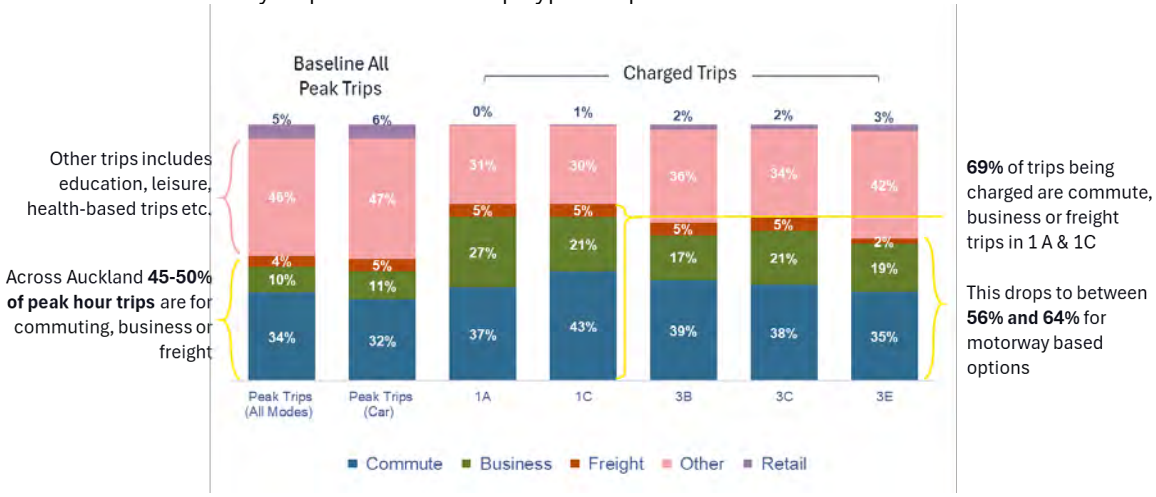


Figure 26: Which trip types are being charged?

Impacts on shopping trips

In most instances where a ToU scheme has been introduced or trialled globally there is no long-term negative effect on overall business spend levels that can be directly attributed to the scheme. Instead, change in consumer spending levels are generally aligned with wider economic trends (see below case studies from London and Stockholm).

The perceived impact of ToU schemes on businesses is often highlighted by local businesses or advocacy groups when consulted about a potential scheme. Despite the evidence of minimal direct impact on spend from similar schemes a charging scheme can often be seen to be accelerating existing trends that are already hindering businesses (e.g. businesses already struggling to compete with online retail or changing consumer preferences).

It is critical to be mindful of these existing trends and how businesses are being impacted by them to understand to what degree those impacts may be accelerated and how might they be mitigated.

Scheme design can be utilised to further mitigate or reduce impacts on local businesses. For example, research found that the Newmarket area typically 'wakes up' at 10am, with retail and leisure activities peaking on Thursday – Sunday evenings, and throughout the day on weekends. As a result, a charge that avoided impacting these discretionary trips is perceived as likely having a more minor impact on the area.

Introducing a ToU scheme could potentially make it harder to stay competitive against nearby areas without such a scheme. This was echoed through early engagement with concerns raised over the relative competitiveness of different retail precincts around Auckland. A London study found minimal impact from the charge despite competition from outside retail hubs, though further analysis would be needed to draw firm conclusions for Auckland [16].

[16] London-wide ULEZ Integrated Impact Assessment (ULEZ Scheme IIA) (cleanair.london)

A relatively small number of shopping trips are charged under the area options. Key destinations see a significantly bigger impact than for the link options however **the overall impact remains quite small**. Figure 27 illustrates that there is no more than a 2% reduction in 24-hour shopping trips to the city centre under any option.

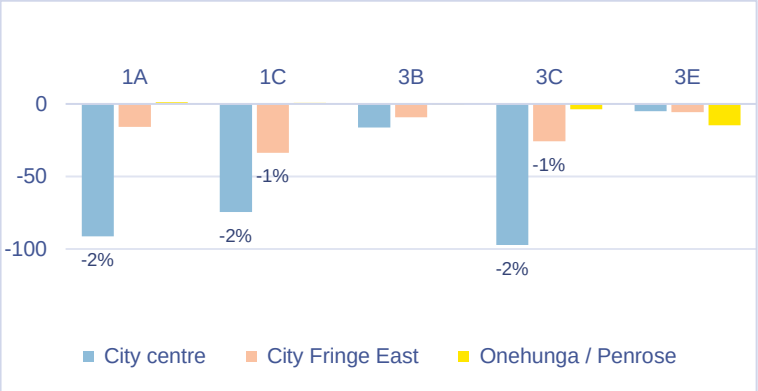


Figure 27: Change in shopping trips accessing a key destination (24-hour day)

Figure 28 shows that under the link options, the **total number of shopping trips charged increases significantly.** This is likely as there is a greater reliance on cars when users are expecting to buy bulky goods, and therefore the charge is less of a deterrent to drive when making these trips.

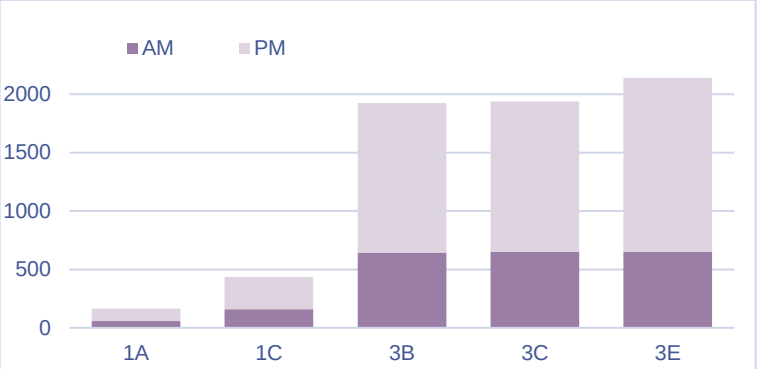


Figure 28: Number of shopping trips charged by option

Shopping trips (other than the weekly grocery shop) may be less routine and more 'one-off' than daily commutes to work or regular freight routes. Users might be less sure of the public transit route and might favour the flexibility of driving and mentally be more comfortable with a more infrequent charge.

Changes in shopping trips accessing key destinations are relatively small, with the exception of Option 3e for which the reduction in trips to the city centre and city fringe east is more significant.

Finally, there is evidence of **mode shift potential** for shopping trips particularly in the **city centre**, likely due to the presence of viable public transport alternatives already servicing this destination.

Case Study: London CCZ [17]
A 2003 survey of London traders found that 76% reported reduced incomes, blaming the Congestion Charge. However, the study indicated that the economic downturn, reduced tourism, and the Central Line train closure were far more significant factors in sales declines.

An impact assessment prior to the expansion of London's Congestion Charge zone indicated that there was a very marginal impact on local retail; retail spending within the zone reduced by 0.2% to 0.4% and the associated loss of retail employment was no more than 0.1%.

Monitoring following the introduction of the Congestion Charge found that the central zone had a minimal impact on overall business spend levels. Further, there was little evidence to suggest an 'anticipation' effect where business spend, and location choice was affected negatively by the announcement of the charge.

Case Study: Madrid LEZ [18]
This LEZ scheme was effective in both reducing congestion, emissions (32% reduction), and creating new pedestrianised spaces (22,000m^2). Crucially, it identified that among users who visit the area to shop, there was an increase in spend after the LEZ became operational.

[17] impact-of-congestion-charge-on-retail.pdf
[18] The impact of Low Emission Zones on retail activity.pdf

Impacts on business trips

Figure 29 indicates that under all options, **business trips made by car are faster following the implementation of the scheme**. Option 3e (targeted motorway links) shows the smallest journey time reduction of all the options. This is likely due to rat-running around charged links causing overcapacity and localised congestion on surrounding residential roads.

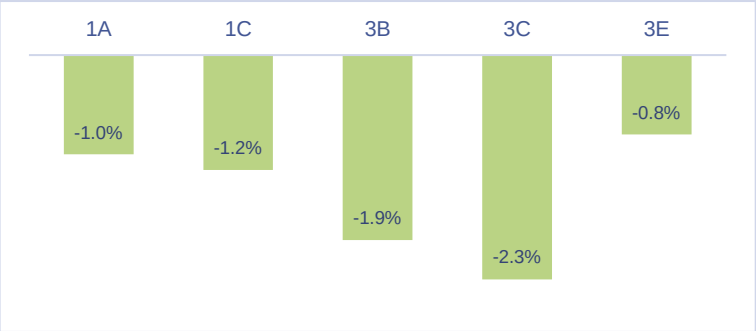


Figure 29: Average journey time of business trips – Auckland-wide

Under options 1a, 1c, and 3c there is a potentially significant reduction (8-10%) of the number of business trips made into the city centre. Figure 30 shows a notable difference in impact of these options compared to 3b and 3e. Further analysis is necessary to understand what is happening to these trips.

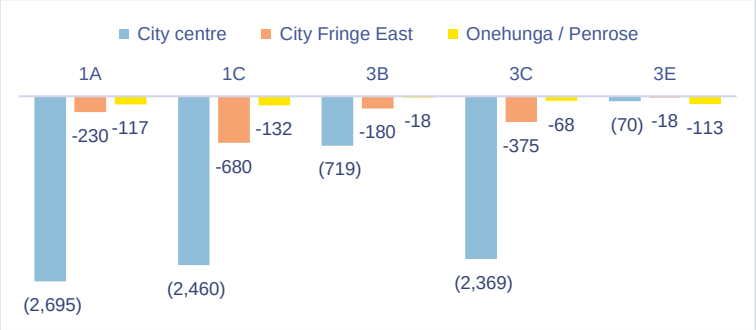


Figure 30: Change in the number of business trips accessing a key destination (24-hour day)

All options lead to an increase in the car Vehicle Kilometres Travelled (VKT) of business trips across Auckland, except for 1a where there is a minor decrease (0.4%). This suggests that schemes are reducing the cost of business travel.

Case Study: London CCZ [19]
A monitoring report from London suggested that the introduction of a charge created a more pleasant working environment for employees in the area.

Impacts on freight trips

To understand the impact on freight trips heavy goods vehicle (HGV) journeys were reviewed in detail. While this does not represent the totality of freight journeys (recognising some are made by smaller vehicles that would be captured as business trips) this does provide a good representation of how most larger freight journeys are impacted.

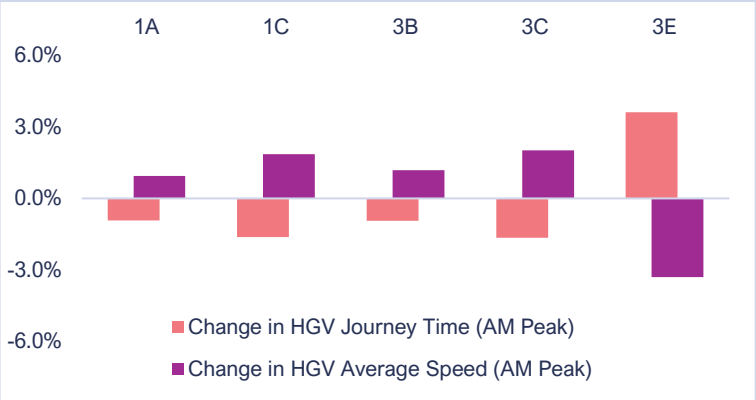


Figure 31: Change in HGV journey times and average speeds during the AM peak

Figure 31 shows that overall HGV journeys are improving—faster and shorter—under all options except for Option 3e.

[19] Central London Congestion Charging Impacts Monitoring, Third Annual Report (tfl.gov.uk)

Under Option 3e freight trip journey times in the AM period increase, since the charges at targeted hotspots encourage rat-running to arterial roads, especially on routes between key freight origins and destinations. The impact of this diversion is illustrated in Figure 32 which highlights the decrease in vehicle traffic on motorways (blue line) and increase in vehicle traffic on slower arterial roads (orange line).

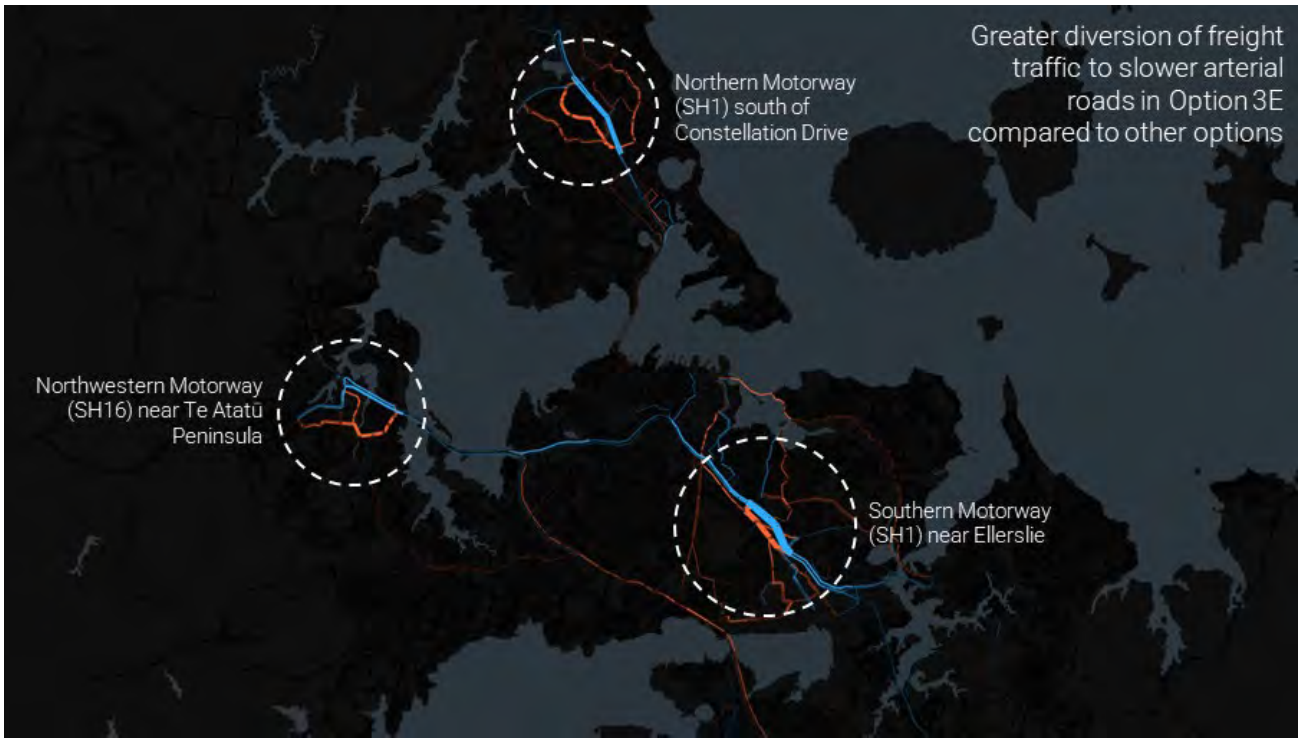


Figure 32: Option 3e freight routes

Key findings

- A significant majority of trips being charged in all scenarios are commuting, business or freight trips. This is particularly true for cordon schemes (1a and 1c) where these categories are roughly 70% of all charged trips.
- Many more shopping trips are charged under Options 3b, 3c, and 3e than the cordon options. However, the overall number of shopping trips accessing key destinations is largely unchanged in a 24-hour daily period (<2% change).
- There are significant potential journey time benefits under all schemes for Business trips. This is particularly true when considering corridor schemes that capture a large extent of the motorway network (e.g. 3b and 3c).
- There is a potential reduction in Business trips into key destinations. However, this needs further analysis particularly when considering Option 1a and 1c.
- Freight journeys are faster under all options except option 3e, where significant diversionary impacts are observed.
- Option 3e tends to show the least significant evidence of effectiveness in reducing congestion and does show some particular areas of concern from the Local Economy Assessment.

6.4 Outcomes and recommendations

Options and key areas of impact are beginning to bifurcate

Through the partial Stage B Assessment, it has become apparent that there are clear thematic differences between the cordon and link options, as well as shared areas of interest, as illustrated in Figure 33.

These clear distinctions between the two different scheme types (cordon and link) are likely to remain consistent regardless of the nuances of the scheme option, but the scale of impact may change.

For example, a city centre cordon will have similar characteristics and impacts as an Isthmus cordon. However, the scale of the area within the cordon, and the number of trips and individuals impacted, will vary depending on the scale of the scheme. Regardless of scale cordon schemes are more likely to have more concentrated impacts as these schemes target destinations. As a result, these impacts can be more easily mitigated by providing greater public transport choice.

Similarly, an extensive link option will have similar characteristics and impacts as a smaller motorway scheme, but the scale of the impacts, and diversity of groups impacted, will vary. Regardless of scale link options will have more geographically dispersed impacts, capturing a broader geographic spread of trips and individuals. This means it is harder to use the existing public transport network to mitigate impacts – particularly impacts on lower income groups as evidenced in Section 6.2.1.

Two policy discussion papers relating to mitigations and complementary measures have been developed in parallel to this assessment (Appendix C and Appendix D). These papers have informed understanding of potential responses to the impacts created by different scheme types, summarised in Figure 33, and the emerging recommendations that follow.

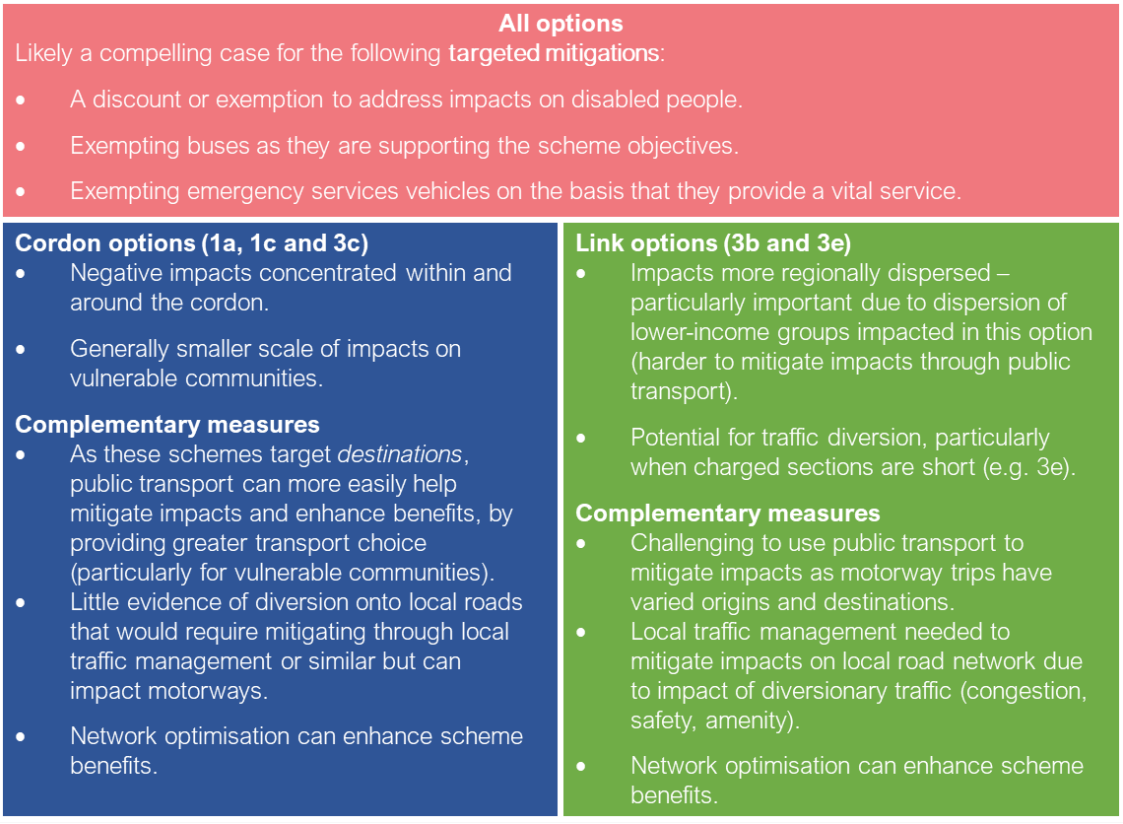


Figure 33: Options and key areas of impact are beginning to bifurcate

Emerging recommendations

On the basis of the partial Stage B Assessment, it is recommended that the optioneering process starts to think quite distinctly about cordon and motorway scheme options.

- For cordon scheme options it will be critical to:
    - Gain a deeper understanding of the impacts on groups on the cordon boundary, as well as the potential effect these impacts could have on a scheme's social licence, and appropriate approach to mitigating these impacts on particular groups.
    - Better understand the natural 'competitors' to the charged areas, and the influence time and price level of charge is likely to have on discretionary trips.
    - Better understand the appropriate mix of complementary measures, and how these could work in, around, and to / from key impacted areas (for example, the city centre and Newmarket).
    - Undertake more analysis to better understand the impacts of a cordon charge on the city centre, taking account of the impacts of the COVID-19 pandemic and ongoing construction.
    - Incorporate 2c into the Stage B Assessment.
- For link scheme options it will be critical to:
    - Review in greater detail the diversionary impacts associated with this scheme type.
    - Better understand the degree to which these could be mitigated, and the resulting impact on the options effectiveness. This will be particularly important for Option 3e and any other potential hotspot options.
    - Undertake a more robust assessment of the Origin – Destination patterns of motorway trips alongside a mapping of the public transport network to better understand public transport that could provide viable alternatives to motorway journeys.

7. Localised Impacts Assessment

7.1 Understanding localised impacts for all options

Additional analysis was completed to understand the localised impacts for all short-listed options based on the MSM modelling used to identify overall network impacts.

This analysis took the following approach:

- Network impact analysis focused on points on the network where the charges apply across the shortlisted options (Figure 34).
- These points include motorways and arterials in close proximity to each other to test the potential impacts of diversions.
- The city centre was analysed as one cordon.

Figure 34: Points on the network where localised impact analysis has been carried out

7.1.1 Localised changes in vehicle volumes

Localised changes in vehicle traffic volumes and public transport demand for each option are summarised in Figure 35 below [20].

Of particular note:

- Some options have a greater impact on neighbouring parts of the road network due to diversionary traffic than others. For example, under Option 3e, SH1 at Constellation Drive shows a 41% reduction in traffic volume. However, there is a forecast increase in traffic on nearby arterials due to traffic diverting to these routes from SH1. This increase in traffic results in an increase in congestion on impacted arterials.
- There are significant traffic reductions forecast for city centre cordon options, with a notable increase in public transport demand for travel towards the city centre. This is reflective of the existing good public transport service to this area which enables greater mode shift.
- In some cases, the reduction in volume is potentially greater than necessary to remove congestion, indicating further work will be needed to optimise the charge level.

[20] It is important to note that the MSM is a strategic model and has limitations in specific intersections analysis. Additional work on local impacts is required.

AM two-hour Vehicle Traffic Volume inbound to City Centre

Location	Type	Baseline	1A City centre cordon	1C City fringe cordon	3B Core mways	3C Core mways + city centre	3E Targeted mway hotspots
SH1 - between Constellation Dr and Tristram Ave	Motorway	6,792	0%	0%	+4%	+4%	**-41%**
East Coast Road (North Shore)	Arterial	2,196	-2%	-4%	-5%	-5%	**+23%**
SH1 Harbour Bridge	Motorway	14,910	-2%	-2%	-5%	-5%	0%
SH16 east of Te Atatu	Motorway	10,914	+1%	+1%	0%	0%	-12%
SH20 Waterview Tunnel	Motorway	8,844	-4%	-4%	-4%	0%	-11%
SH16 west of St Lukes	Motorway	13,033	+2%	-1%	**-14%**	**-12%**	-7%
Great North Road	Arterial	3,709	-3%	-3%	**+9%**	**+4%**	+2%
Dominion Road	Arterial	1,224	-5%	-11%	+3%	-2%	0%
SH1 west of Gilles Avenue	Motorway	13,342	0%	-1%	-13%	-7%	-1%
SH1 north of Ellerslie Interchange	Motorway	12,359	-1%	0%	**-12%**	**-13%**	**-23%**
Great South Road south of Rockfield Road	Arterial	2,198	-7%	-6%	**+15%**	**+14%**	**+17%**
Lake Road	Arterial	3,182	0%	0%	-1%	-1%	+1%
Pakuranga Hwy (Waipuna Bridge)	Arterial	6,453	0%	0%	0%	0%	+1%
Panmure Bridge	Arterial	4,609	0%	-1%	-2%	-3%	-3%
Fanshawe St near Victoria Park	Arterial	2,420	**-26%**	**-20%**	-12%	-9%	-6%
City Centre Cordon	Cordon	30,464	**-20%**	**-30%**	-7%	**-31%**	-1%

Under option 3E, SH1 at Constellation shows a 41% reduction in traffic volume, however the nearby arterial suffers from an increase in diversionary traffic.

AM two-hour Public Transport Demand inbound to City Centre

Location	Type	Baseline	1A	1C	3B	3C	3E
City Centre Cordon (PT)	Cordon	60,103	+4%	+5%	+2%	+4%	+1%

There are significant traffic reductions under the city centre cordon options, with a notable increase in PT demand towards the city centre

Figure 35: Localised changes in vehicle volumes.

7.1.2 Localised changes in LOS

Overall, all schemes improve the LOS close to charged points however for schemes with motorway link charges there are often associated diversion impacts to arterial or local roads. City centre cordon schemes improve LOS on some arterials in the Isthmus. However, at a regional scale the impact on individual links is typically smaller and the improvement is not of a magnitude that moves it to a different LOS category.

AM two-hour Vehicle levels of service* inbound to City Centre

Location	Type	Baseline	1A City centre cordon	1C City fringe cordon	3B Core mways	3C Core mways + city centre	3E Targeted mway hotspots
SH1 - between Constellation Dr and Tristram Ave	Motorway	F	F	F	F	F	⇩ C
East Coast Road (North Shore)	Arterial	D	D	D	⇩ D	⇩ D	⇧ E
SH1 Harbour Bridge	Motorway	D	D	D	⇩ D	⇩ D	D
SH16 west of Te Atatu	Motorway	F	F	F	F	F	⇩ E
SH20 Waterview Tunnel	Motorway	D	D	D	D	D	⇩ D
SH16 west of St Lukes	Motorway	F	E	E	⇩ D	⇩ D	⇩ F
Great North Road	Arterial	E	E	E	⇧ E	⇧ E	E
Dominion Road	Arterial	D	⇩ D	⇩ D	D	D	D
SH1 north of Gilles Avenue (Newmarket)	Motorway	E	D	D	⇩ D	⇩ D	D
SH1 north of Ellerslie Interchange	Motorway	D	D	D	⇩ D	⇩ C	⇩ C
Great South Road south of Rockfield Road	Arterial	E	⇩ D	⇩ D	⇧ E	⇧ E	⇧ E
Lake Road	Arterial	F	F	F	F	F	F
Pakuranga Hwy (Waipuna Bridge)	Arterial	E	E	E	E	E	E
Panmure Bridge	Arterial	E	E	E	E	E	E
Fanshawe St near Victoria Park	Arterial	D	⇩ C	⇩ C	⇩ C	⇩ D	⇩ D

*Based on volume to capacity ratio

Overall, all schemes improve the LOS close to the charge points, with some diversion onto the arterials, particularly with motorway focused schemes

⇩ Over 5% improvement in LOS

⇧ Over 5% deterioration LOS

City centre cordon schemes improve LOS on some arterials on the isthmus, but not on roads in the wider region

Figure 36: Localised changes in LOS

Additional limited assessment has been carried out both to understand the potential for a ToU trial, and to gain a better understanding of localised impacts as detailed in Chapter 8.

Key findings

- Different charging options realise benefits in different ways.
    - Motorways and arterials: Significant changes in localised areas.
    - Cordon: Small changes across a wider area accumulating to significant change at cordon.
- Where a charge is present, there is significant congestion relief on the targeted road.
- Where parallel routes offer an alternative to charge points, diversion with associated volume/level of service shift is likely.
- Depending on baseline conditions small changes in traffic volume may have a minor or major impact.

8. Time of Use Trials

Following feedback from Auckland Council and Auckland Transport governance, an additional assessment was carried out to understand possible ToU trials targeting congested links. At the time of writing this report an assessment of network impacts only has been completed for two potential trial options. This assessment involved the analysis of AFC MSM model outputs for both trial options.

8.1 Benefits and risks of a trial

Regardless of location or timing of a trial there are a number of potential benefits and risks that should be understand.

Benefits	Risks
• Demonstrates early progress. • Tests behavioural change and the public's response in a 'real world scenario.' • Demonstrates the benefits of a charge to the public, possibly building support for a full scheme. • Enables testing of different policy settings.	• Delays implementing a full scheme • An unsuccessful trial will make it harder to achieve public acceptance and/or government approval for a permanent scheme. • Residents in areas affected by trials may express fairness concerns. • Trials provide only a partial view of what a full scheme would look like. • An accelerated trial risks public acceptability due to: o Insufficient time to educate the public o Limited ability to mitigate potential negative consequences. • Sunk costs of a trial (e.g. establishing a back office system) which may not outweigh the benefits.

8.2 What is needed for a trial to take place?

In order to implement a trial in advance of a potential full scale ToU scheme in Auckland there are a number of key considerations which will need to be considered through future phases of work.

1. Identification of trial opportunities for scheme options.
    - A trial should ideally be part of an intended long-term scheme to ensure that relevant lessons are learnt which can inform scheme design. This will also ensure that the public will see clear and evidenced links between a trial and the implementation of a long-term scheme.
2. Legislation is needed to enable a trial of a full ToU scheme.
3. Development of a back-office.
    - Implementation of a trial with charging would require a full back-office system due to the need for necessary privacy and security features. In combination with legislative

change, this means that a trial is likely to be 12-18 months away (no quicker than a full time ToU scheme).

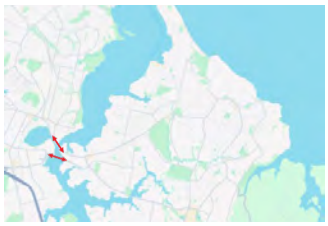
4. Cost estimates would need to be developed.
5. A possible alternative option that does not require legislation or a back-office system, and can be put in place quickly with lower risk, is an incentive-based scheme. This would likely take the form of a trial that uses a sample of the population to test behaviour change, though it could not fully reflect the range of real-world responses since it would essentially be 'opt-in'. It could however be useful in informing further design and design and could be progressed relatively quickly (likely utilising AT's existing technology platform).

8.3 Potential trial options on congested links

Two trial options were identified by AT and AC, targeting known congested links in Auckland which had limited diversion alternatives. As a result, they can be identified as chokepoints in the road network.

The trial options assumed the same nominal $3 charge as the Stage A and B assessment.

Table 18: Potential trial options on congested links

Option	Description and rationale	Image
3f: Lake Road link charge	Single Lake Road link (assumed between Hart Road and Ewen Street). Link charged in both directions AM (0700-0900) and PM (1600-1800). Well known congestion hotspot. No diversionary routes. Tests the effect of charging a single local route.	
3g: Tāmaki River Bridges link charge	Charges on Panmure Highway Bridge and Waipuna Bridge. Links charged in both directions AM (0700-0900) and PM (1600-1800). Congestion hotspot. Only lengthy diversionary routes available. Tests the effect of charging individual key network links.	

8.4 Network assessment of 3f and 3g trial options

Key findings, and a summary of the network assessment focused on regional and localised changes in demand and congestion are outlined below.

Regional changes in demand

Analysis of options 3f and 3g resulted in relatively small reductions in regional demand compared to the full-scale scheme options assessed (Figure 37).

Options 3G captures more trips and therefore has a more significant impact on regional demand compared to 3F

Metric	3f: Lake Road Link Charge	3g: Tāmaki River Bridges link charge	1A: CBD Cordon	1C: CBD + Fringe Cordon	3B: Core Motorways	3C: Core Motorways + City Centre	3E: Targeted congested hotspots
AM peak charged vehicle trips	4,580 (1%)	10,863 (2%)	18,980 (3%)	30,651 (5%)	45,353 (7%)	53,247 (9%)	34,798 (6%)
AM peak change in vehicle trips	-257 (~0%)	-1,094 (~0%)	-3,631 (-1%)	-6,215 (-1%)	-3,271 (-1%)	-5,387 (-1%)	-3,817 (-1%)
AM peak public transport demand % change	+0.1%	+0.4%	+2.2%	+2.9%	+1.5%	+2.8%	+0.5%
AM peak public transport demand passenger change	137	455	2,351	3,082	1,574	2,954	577
Change in number of person trips made in AM and PM peak period	-450	-1,049	-5,714	-11,249	-7,190	-11,368	-8,149

Targeting congested links sees relatively small reduction in regional demand compared to full scale schemes

Figure 37: Regional changes in demand

Option 3g captures more trips, and therefore has a more significant impact on regional demand compared to Option 3f.

8.4.1 Localised changes in demand and congestion – Option 3f and 3g

Analysis indicated that both Option 3f and 3g would result in localised congestion reduction.

Option 3f

This option would result reduction in traffic largely within the Devonport peninsula, with limited impact on the wider network.

In the AM peak this includes:

- Improvement in Lake Road's Level of Service (LOS) – from F to E.
- 14% reduction in outbound traffic leaving the Devonport peninsula (200 fewer trips).
- 26% reduction in inbound traffic entering the Devonport peninsula (300 fewer trips).

Figure 38: Localised changes in demand and congestion – Option 3f

This is illustrated in Figure 38 representing the AM peak period where the thickness of blue lines represents decrease in vehicle movements which is particularly evident on Lake Road. The line thickness of orange lines represents minor increases in traffic compared to existing which are considered to be redistribution effects due to altered traffic conditions.

Option 3g

This option would result in significant reduction in trips on Tāmaki River bridges, with a proportion of traffic diverting south. The results indicate an increase in traffic in East Tāmaki, and a limited impact on the wider network.

In the AM peak this includes:

- Improvement in LOS on both Tāmaki River bridges – from E to D.
- 22% reduction in outbound traffic (1,250 fewer trips).
- 55% reduction in inbound traffic (1,400 fewer trips).

This is illustrated in Figure 39 where the thickness of blue lines represents decrease in vehicle movements which is particularly evident on the bridges and connecting routes.

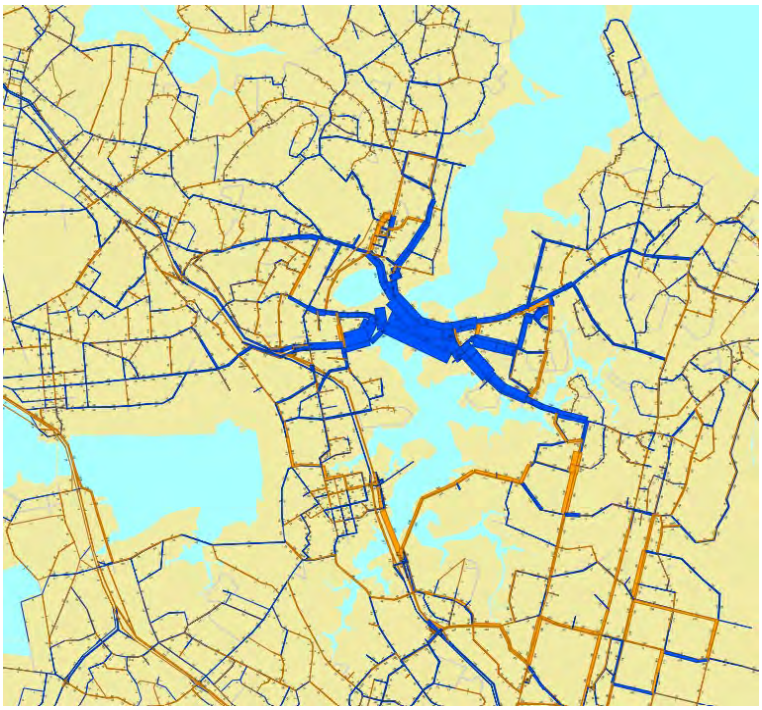


Figure 39: Localised changes in demand and congestion – Option 3g

The thickness of orange lines represents increases in traffic compared to existing which are most significant for north-south arterial routes through East Tamaki.

8.4.2 Key takeaways

Key takeaways relating to the assessment of Options 3f and 3g as potential ToU trials are as follows:

- With the exception of the Eastern Busway, these options generally have limited PT alternatives making them inconsistent with policy principles.
- Putting a point charge at a natural “choke point” means there are limited options to rat run.
- These options resolve congestion at a localised level, however there is very little impact on congestion beyond the immediate area.
- Whether they can be effective over a wider area is influenced by the number of choke points charged, the charged traffic volume, public transport alternatives, and availability of diversionary routes.
- These options are not comparable to the other “full scale” schemes considered.
- No analysis has yet been undertaken from the perspective of wider policy principles e.g. fairness and simplicity.
- Modelling results show that these schemes can have potential localised net benefits to upstream locations. In aggregate a number of schemes of this scale could be comparable to other options considered but with different distribution of impacts.

9. Pricing, Complementary Measures and Mitigations

As discussed in Section 2.3, the elements of an overall ToU scheme need to be developed together to minimise the disbenefits of a scheme, and maximise a scheme's benefits.

The project has explored each of these areas, building on the work undertaken in TCQ with additional international research and analysis of local Auckland context.

9.1 Hierarchy of scheme elements

While working in concert, there is a hierarchy to the deployment of each element as part of the scheme design approach which prioritises minimising the impacts and enhancing the benefits of any scheme.

This hierarchy adopts the following approach:

1. **In the first instance design out negative impacts or dis-benefits within the core scheme**, for example the adoption of the supporting policy principle to 'target locations and routes where users have viable alternatives and discourage lower value discretionary trips', or avoiding scheme options which target large numbers of trips from high deprivation areas.
2. **Complement the scheme in line with existing strategic direction to reduce the impacts and enhance the benefits**, for example increasing the capacity of the public transport network to respond to provide appropriate viable alternatives to private vehicle travel.
3. **Selectively reduce charge costs for targeted users or vehicles** to mitigate those impacts of the scheme which can't be appropriately designed out or addressed through complementary measures.

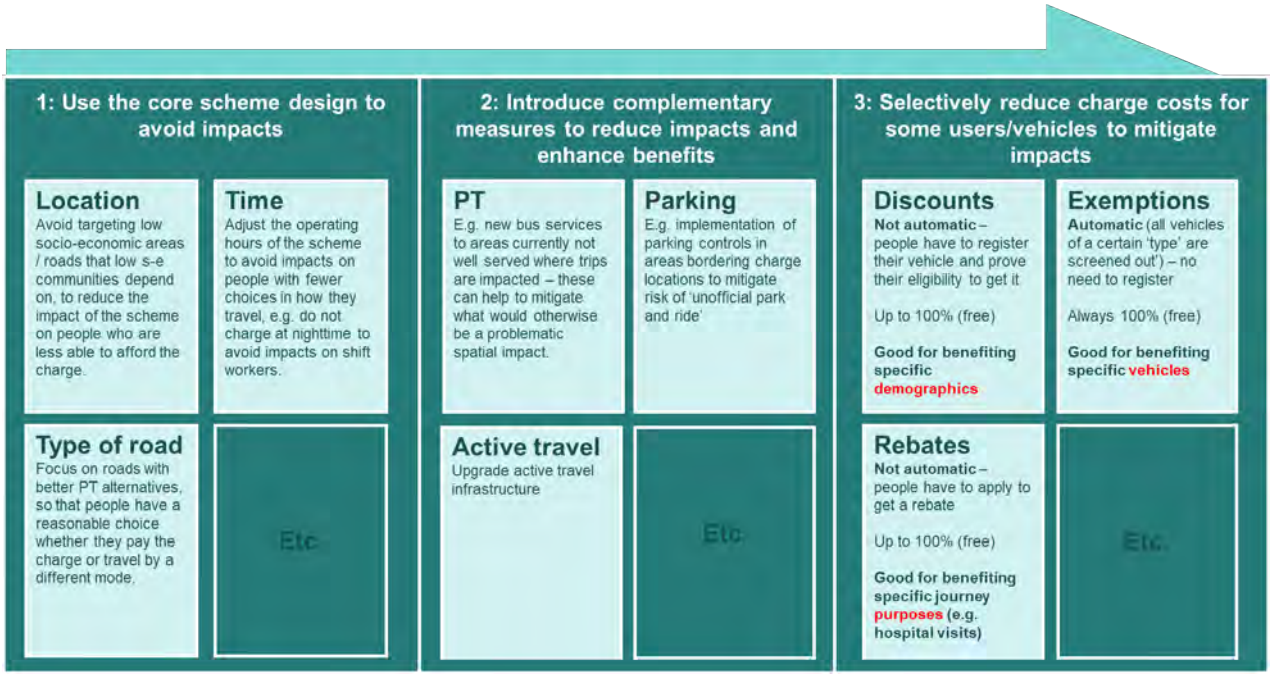


Figure 40: A hierarchical approach to designing out and mitigating impacts

Complementary measures

Alongside congestion pricing schemes, investments are often deployed in what are known as 'complementary measures'. This is a broad term covering a wide range of possible additional interventions that may help to mitigate any negative impacts arising from a charging scheme or enhance its benefits.

An example is increasing public transport frequency and capacity on key routes at appropriate times to provide viable alternatives to private vehicle travel. This would give those who cannot or do not want to pay the charge an improved set of transport choices, while also supporting a greater reduction in congestion for those who do choose to pay the charge.

Figure 41: Complementary measures considered in this ToU study

International benchmarking evidence suggests that complementary measures programmes very often represent the progression of existing organisational strategic direction. Frequently this includes specific programmes or projects that are already planned or underway, and that there is no one 'right' measure or mix of measures that would best complement all schemes.

This benchmarking-led approach has informed the list of complementary measures considered through this study (see Figure 41). This differs from TCQ which derived complementary measures as part of the long list process, many of which more obviously function as alternatives, rather than complements, to ToU charging.

Key relevant measures identified in TCQ (principally public transport and parking management) have been brought forward, alongside a number of other measures aligned with Auckland's strategic direction and international precedent.

Different measures are also more likely to best complement specific scheme types (e.g. cordon or link) than others. In particular it is generally challenging to use public transport to complement a link scheme due to the dispersion of the trips and individuals impacted, while public transport can significantly complement an area or cordon scheme as they target particular destinations.

The use of scheme revenue not required for core scheme operations (back office, infrastructure, etc.) to invest in complementary measures should consider the following hierarchy:

1. In the first instance, address any specific negative scheme impacts through investment in the appropriate complementary measures which support the scheme objectives,
2. Secondly, enhance scheme effectiveness and efficiency, including for those that pay, through network improvements in the general area of the scheme.
3. Progress other local priorities in line with Auckland's strategic direction.

Targeted mitigation

Targeted mitigation measures are typically deployed to ensure particular user groups do not experience significant residual disbenefits as the result of the implementation of a ToU scheme. In response to the impact on different user groups, different approaches to mitigation measures are deployed in different jurisdictions.

The approach to mitigations has a critical relationship with a scheme's social licence, and the real and perceived fairness of the scheme. The approach to targeted mitigations in this study builds on the TCQ conclusion that there may be a need to employ targeted mechanisms, such as discounts or rebates, to mitigate the undesirable social and spatial impacts associated with congestion charging.

Overseas schemes and TCQ provide precedent for the different user groups who may benefit from a mitigatory response including:

- Emergency services (exempt in all schemes reviewed),

- Disability (typically exempt or discounted),
- Buses (typically exempt), and
- Specific trip purposes such as hospital visits (sometimes rebated).

Mitigations take the form of different mechanisms in response to the needs of different user groups, and the context of the local jurisdiction, including:

1. Credits: 'Pre-loading' of a designated number of credits to a user's account which can be used to offset the costs associated with a charge.
2. Rebates: Enable eligible users / vehicles to claim back a portion (up to 100%) of charges imposed.
3. Exemptions: Identified users / vehicles are exempt from paying the charge in full. Databases, such as the NZTA Motor Vehicle Registration database, can be utilised to automatically apply exemptions to qualifying vehicle types.
4. Discounts: Reduce the congestion charge at the point it is incurred (by up to 100%) for eligible users / vehicles. Eligible users / vehicle owners would need to register in order to be eligible for a discount.
5. Charge caps: A maximum fee that a vehicle can incur in a given time frame.

This study recommends a number of user groups which appear to have a rationale for targeted mitigatory responses, without substantially undermining the efficacy of the scheme's objective to reduce congestion.

9.2 Approach to these issues

Three parallel studies were undertaken to explore these issues in more detail – one on Pricing, one on Complementary Measures, and one on Targeted Mitigation.

Taking TCQ as their points of entry, each study then explored the ways that different urban road pricing schemes around the world have approached their respective element, the reasons for the different approaches they have adopted, and the implications for Auckland in considering the development of a ToU scheme for Auckland aligned with the Policy Framework.

The findings are summarised below and reported in detail in the respective Policy Paper.

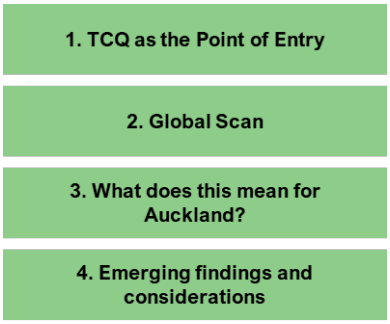


Figure 42: Common approach to all policy papers

9.3 Pricing

9.3.1 Relationship with the Policy Framework

Pricing bears directly on all three Core Policy Principles and connects directly to several of the scheme's nine Supporting Policy Principles (those with the clearest links are picked out in bold below).

Effective	Fair	Simple
Charges must be set in a way that reflects the specific context on the roads where charges are imposed and the different so as to balance decongestion, diversion, and other effects.	A charge that is excessively high might risk unfair impacts on those least able to avoid or afford the charge – at the very least, it would likely increase the requirement for complementary or mitigation measures to address those risks.	A complex tariff that is hard to understand, interpret, or rationalise will undermine simplicity.

1. **Be flexible in time, location, and pricing to achieve target congestion levels**
2. **Target travel in congested conditions**
3. **Target locations and routes where users have viable alternatives and discourage discretionary trips**
4. **Vary for different vehicle types according to the contribution they make to congestion**
5. **Improve accessibility for most people and businesses**
6. Be technologically achievable, adaptable, cost effective, and efficient
7. Avoid mitigations that undermine the efficacy of the scheme
8. Support ability to spatially extend and modify the scheme
9. **Avoid unwanted consequences, e.g. significant fiscal costs for vulnerable communities, diversions, community severance.**

Figure 43: Pricing's relationship to the Policy Framework

9.3.2 Elements of a charging tariff

While the definition of a specific ToU tariff is a superficially simple concept, the prices imposed through ToU charging may in fact vary in a wide variety of ways.

Some of the most common dimensions by which the charge is varied are set out below. The top row are those aspects which are primarily driven by traffic conditions and the road network context and bear on the effectiveness of the scheme. The bottom row are aspects which are primarily driven by other considerations, such as fairness and simplicity (though in practice the distinctions are not always completely clear-cut).

Driven primarily by effectiveness considerations and charging location	The time of day	The day of the week	The type of vehicle being driven	The direction in which the vehicle is being driven on a particular road
Driven primarily by other considerations (fairness, simplicity)	The mechanism by which charges are paid	How many times the vehicle drives on a charged road within a given span of time (capping)		

Figure 44: Elements of a charging tariff

9.3.3 Emerging findings

- The role of pricing: Pricing is a critical component of scheme design which has a fundamental impact on a scheme's effectiveness, fairness, and simplicity.
- Dimensions of a tariff: Charges may vary depending on time of day, day of week, direction of travel, vehicle used, but there is no 'right' answer.
- Context is everything: Global evidence shows that there is no one perfect approach, because different variables must be flexed to meet the objectives. Setting appropriate charges must be informed by specific context at the charging locations identified, and context-specific nuances such as user groups, traffic conditions etc, supported by modelling, analysis, and assessment. Additionally, different locations in Auckland may well have a different 'optimal' tariff.
- Charge levels: Despite the importance of context, all other things being equal, higher charges are likely to be needed at busier times of day/days of the week, and potentially in the 'shoulder' periods around those times to avoid simply passing the problem to another time of day.
- Vehicle type: Consideration of higher charges for bigger vehicles would be reflective of their 'first order' congestion impact, but careful consideration is required to minimise the risk of unintended consequences.

- **Objectives:** Being clear on the specific objectives of charging in terms of the outcome desired is important. Defining the area of benefit (and the area over which potential disbenefits are assessed) will be key to support effective monitoring.
- **Monitoring and review:** Charges will likely need to be reviewed over time. Preserving flexibility over when and how this is done will be beneficial – this could be supported by a framework of governance giving reassurance over the process by which this would be undertaken.

9.4 Complementary Measures

9.4.1 Relationship with the Policy Framework

Complementary measures bear directly on all three Core Policy Principles and connect directly to several of the scheme's nine Supporting Policy Principles (those with the clearest links are picked out in bold below).

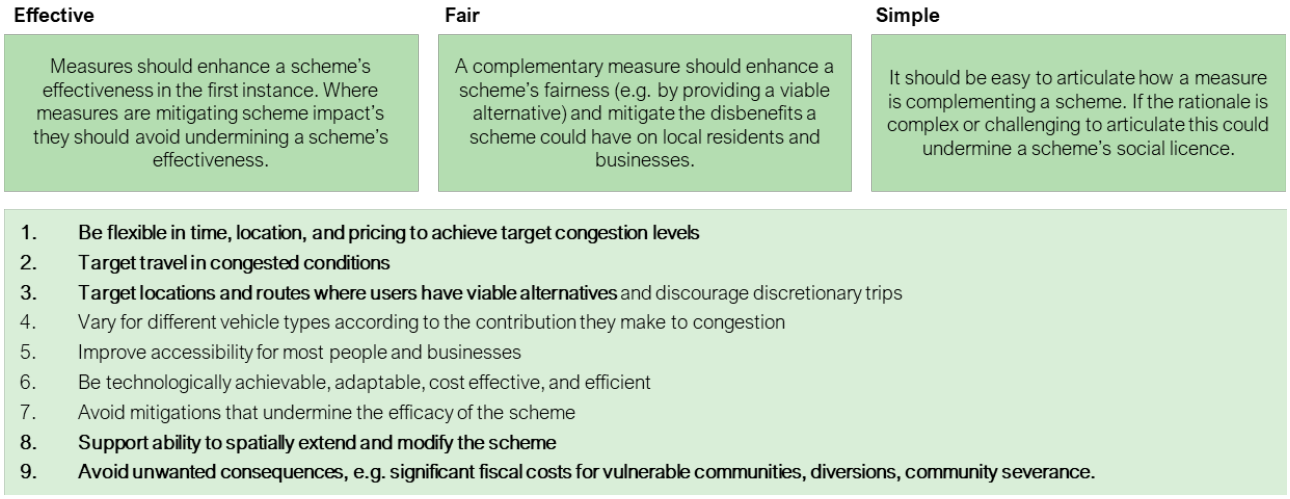


Figure 45: Complementary measures' relationship to the Policy Framework

9.4.2 Understanding complementary measures

Complementary measures are non-charging interventions that are implemented to support the realisation of the scheme's primary objective (reducing congestion), mitigate the impacts or enhance the benefits of a scheme. For example, providing additional public transport capacity to avoid overcrowding as demand grows or network optimisation to mitigate diversionary impacts.

Complementary measures work in concert with core scheme elements (location, pricing) and targeted mitigation measures (such as discounts, exemptions, rebates, credits) to ensure a scheme reduces congestion, whilst being effective, fair, and simple.

9.4.3 Emerging findings

Different complementary measures are likely to better suit different types of schemes

Complementary measures must respond to and enhance scheme design elements including charging location and charging tariff settings. For example, cordon schemes require complementary measures that respond to concentrated geographic impacts, like public transport. In contrast, public transport is unlikely to have a more than minor mitigating or complementary benefit to a link scheme implemented on the motorway network due to the geographically dispersed impacts this scheme type creates.

In all instances, network optimisation appears to have the potential to enhance a scheme's congestion reduction objective, by supporting the effective and efficient management of the road network.

Some measures are likely to be critical for scheme success from Day One

Both the ToU Policy Framework and global benchmarking have emphasised the criticality of providing viable alternatives alongside any ToU scheme.

It will be important to have an appropriate public transport response to support behaviour change, in advance of the scheme becoming operational. Further work should be undertaken to understand the amount of revenue generated from the scheme which can be used to invest in complementary measures, considering:

1. Addressing negative scheme impacts,
2. Enhancing scheme effectiveness and efficiency, to ensure charged users benefit from the scheme, and
3. Progressing other local priorities in line with Auckland's strategic direction.

Complementary measures would likely have a key role in a scheme's social licence

The most appropriate complementary measures for a scheme may be those that help to support the case that the scheme has been considerately designed, and that the right infrastructure is in place to support Aucklanders. Early engagement with Local Boards has already demonstrated the importance placed on improving public transport alongside or in advance of implementation of a scheme in Auckland, to ensure Aucklanders are provided with equitable transport choice.

Complementary measures should progress existing strategic direction and priorities

The broad spectrum of measures deployed internationally, and reflected on in this paper, highlight the fact that there is no one 'silver bullet' or 'correct' amount or mix of complementary measures for any given scheme. Instead, global evidence highlights the importance of tailoring the complementary measures response to the specifics of the scheme being promoted.

Nevertheless, measures that are 'badged' as complementary to a scheme typically represent the progression of an existing strategic direction and planned or underway programmes or projects, rather than being entirely bespoke.

In Auckland it will be important to consider which programmes or projects already underway could or should be brought forward to complement a scheme.

If there is a temporal aspect to scheme impacts, complementary measures may need to have a correspondingly critical temporal component

Deployment of some measures, particularly kerb zone management, parking management, and road space prioritisation could help to mitigate scheme impacts, however full-time implementation of such measures could potentially undermine a scheme's social licence if they cannot be shown to be necessary at all times. For example, if a charge is only applied in one direction at a particular period of the day, a complementary measure, such as a clearway, may only be required at or around that time, without necessitating full-time removal of parking.

9.5 Targeted Mitigations

9.5.1 Relationship with the policy framework

Mitigation measures bear directly on all three Core Policy Principles and connect directly to several of the scheme's nine Supporting Policy Principles. The principles with the clearest links are highlighted in bold below.

Effective	Fair	Simple
Measures should be targeted so as not to undermine the primary policy objective of reducing congestion.	Mitigation measures must be perceived as fair by the public, considering the vulnerability, travel options, and additional benefits for the user group.	Mitigation measures must be easy to administer and enforce, with clear identification of user groups and minimal risks of manipulation.

1. **Be flexible in time, location, and pricing to achieve target congestion levels**
2. Target travel in congested conditions
3. **Target locations and routes where users have viable alternatives and discourage discretionary trips**
4. **Vary for different vehicle types according to the contribution they make to congestion**
5. **Improve accessibility for most people and businesses**
6. **Be technologically achievable, adaptable, cost effective, and efficient**
7. **Avoid mitigations that undermine the efficacy of the scheme**
8. Support ability to spatially extend and modify the scheme
9. **Avoid unwanted consequences, e.g. significant fiscal costs for vulnerable communities, diversions, community severance**

Figure 46: Mitigation measures' relationship to the Policy Framework

9.5.2 Understanding mitigation measures

Targeted mitigations are designed to address the potential financial and social impacts on various user groups. These measures are essential to ensure that a scheme, **while effective in reducing congestion, does not disproportionately affect certain segments of the population or particular user groups**.

- There is likely to be a need to mitigate the impacts of a ToU scheme for selected vulnerable user groups that face an undue negative impact from the charge.
- It will be critical to ensure that any mitigation mechanism is feasible and does not create further fairness issues or significantly undermine the efficacy of a scheme (any mitigation will always somewhat reduce the direct benefits of charging – the question is one of scale).
- Any mitigation is likely to negatively impact the revenue raised by scheme, however this impact is likely to modest given the small proportion of individuals likely to be eligible for any given mitigation.
- Implementing many different types of mitigations, for different user groups, will increase a scheme's complexity.
- Robust assessment will need to be carried out to determine any mitigations that are warranted.

9.5.3 Emerging findings

- **The role of mitigations:** Mitigation measures are a necessary component of a scheme design, and depending on the way they are designed, can fundamentally support the scheme's effectiveness, fairness, and simplicity.
- **Targeted User Groups:** Identifying and defining user groups that require mitigation is an essential first step. Some users are easy to define (particularly when linked to vehicle type) while others are more challenging (particularly when linked to the user in the vehicle).
    - This paper has identified 14 user cohorts that have been targeted in overseas jurisdictions, and could apply in an Auckland context, depending on scheme design choices.
    - **Potential candidates:** Based on a desk-based assessment of each user group against the Policy Principles, three potential candidates have been identified: **emergency service vehicles, disabled people, and buses.**
    - A range of other potential user groups might be more or less relevant depending on scheme design and local conditions.

- Types of mitigation measures: The type of mitigation measures deployed is typically secondary to the above question of targeted group. Implementation of specific measures should align to the policy objectives and there is no 'one-size-fits-all' solution.
    - In general, price subsidies (exemptions, discounts, rebates) are preferable to income subsidies (withdrawable and non-withdrawable account subsidies) because they have stronger precedent overseas, are more targeted, and are easier to implement.
- Context matters: Global evidence reinforces that there is no single perfect approach to mitigation. The selection of appropriate mitigation measures must be informed by the specific context of the charging locations, user groups, and traffic conditions, supported by quantitative efforts (modelling and analysis) and qualitative judgements.
- Monitoring and review: Mitigation measures will likely need to be reviewed and adjusted over time. Preserving flexibility in when and how this is done will be beneficial. This can be supported by a governance framework that provides reassurance over the process by which reviews and adjustments are undertaken.

10. Conclusions and Next Steps

10.1 Conclusions

Over the course of this study the following conclusions have been developed for the Auckland ToU scheme, based on learnings from global evidence, initial modelling analysis, and early engagement with key stakeholders:

While the study is ongoing, the following conclusions are emerging from the work so far, based on learnings from global evidence, initial modelling analysis, and early engagement with key stakeholders.

1. Every scheme option assessed could reduce congestion to a greater or lesser extent, at least in the location where they operate.
2. Scheme location is key. Charges applied to *particular routes* could give rise to diversion on a large scale, creating unintended consequences.
3. Charging access to a destination (e.g. a town or employment centre) is likely to stimulate more mode shift as less diversion occurs, and public transport is better configured to serve major destinations.
4. It will be harder to define complementary public transport for charges covering large areas or motorway links.
5. Charging large areas, or very high-volume road networks, will bring greater trade-offs due to the higher number of people and trips impacted.
6. Some targeted mitigation is likely to be warranted but must be carefully considered to balance scheme effectiveness, fairness, and simplicity.
7. All scheme options considered would generate a revenue that exceeds the cost of implementing and operating the scheme – and should be used first to support scheme delivery and efficiency, before investment in complementary measures, and then to other local priorities.
8. A trial may provide useful information relating to behaviour change but will not demonstrate network effects or enable the testing of technology or systems.
9. The scheme that is right for Auckland will need to respond to Auckland's challenges as the context evolves and behaviours change.

10.2 Next steps

This report represents a 'point in time view', which will need to be further refined, developed and interrogated as this work progresses. The immediate next step will be to complete the remaining components of the Stage B assessment.

Additional next steps may involve:

- Carrying out mana whenua and Māori impact analysis and engagement.
- Carrying out Stage B Assessment of Option 2c.
- Undertaking more detailed analysis to better understand the impacts of a cordon charge on the city centre, taking account of the impacts of the COVID-19 pandemic and ongoing construction.
- Undertaking a more robust assessment of the origin-destination patterns of motorway trips, alongside mapping of the public transport network, to better understand public transport alternatives that could provide viable alternatives to motorway journeys.

- Gaining a deeper understanding of the impacts on groups adjacent to the cordon boundary, as well as the potential effect these impacts could have on a scheme's social licence, and appropriate approach to mitigating these impacts on particular groups.
- Better understanding the natural 'competitors' to the charged areas, and the influence time and price level of charge is likely to have on discretionary trips.
- Reviewing the diversionary impacts of link scheme types in greater detail – to better understand the degree to which these could be mitigated, and the resulting impact on the options effectiveness.
- Early economic modelling to understand economic costs associated with network performance, social and distributional impacts, environmental impacts, impacts to local businesses and wider economic impacts.
- Early financial modelling to understand capital costs, lifecycle costs and revenue associated with each of the shortlisted options.
- Engaging with SMEs, community, and stakeholders to better understand their concerns / needs and inform the refinement of complementary measures and mitigations.
- Progressing pricing work to more fully understand the factors to consider when setting a scheme charge. This should include:
    - testing and optimisation of the pricing level (charge),
    - removal of pricing on counter directional flow,
    - review of current willingness to pay values used in transport modelling to represent response to ToU charging. Consideration should be given to collecting new primary data which is specific to Auckland and the different user groups accounted for in transport models, and
    - testing of different pricing levels in different locations.
- Undertaking adjustments and optimisations of options where this could improve effectiveness or social licence.