Beca

Takitimu North Link

Tolling Study

Prepared for Waka Kotahi NZ Transport Agency - Tauranga
Prepared by Beca Limited

7 May 2024

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Revision History

Revision N°		Description	Date
1.0	s 9(2)(a) [redacted]	2022 Draft for client review and comment	16/09/2022
1.3	[redacted]	2023 Draft for client comment following modelling to incorporate revised network assumptions and added sensitivity tests.	16/09/2023
.5	[redacted]	Version for client review following response to client comments and added section on tolling the New SH29 4 lane highway	17/11/2023
2.0	[redacted]	Section added for alternate tolling scenarios.	21/12/2023
3.0	[redacted]	Version after addressing client comments on version 2.0. Update of the preferred option VKT and emissions estimates, and commentary on the crash costs predictions and their sensitivity to input assumptions.	07/05/2024

Document Acceptance

Action	Name	Signed	Date
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Executive Summary

Purpose and Background

Takitimu North Link Stage One (TNL) will provide a new strategic connection in the northern (SH2) corridor between Tauranga and Te Puna via a new expressway and shared path. Its objectives are to improve safety, ease congestion and provide greater travel choice. It is being delivered as part of the NZ Upgrade Programme with construction currently underway and a planned completion date of 2026. Stage 2 involves a further extension north to Omokoroa but is not committed for delivery through the NZUP Programme.

State Highway 2 (SH2) is currently the sole route through the northern corridor with a poor safety record and extensive periods of congestion due to vehicle demands exceeding the corridor capacity. Takitimu North Link stage one will significantly improve safety and accessibility, build resilience, support growth and provide more transport choice for communities. The project is a key part of the region's SmartGrowth strategy.

Through the NZUP Programme the Government has decided that Takitimu North Link Stage Two will be progressed to route protection but has not committed funding to its delivery. Delivery of Stage 2 will therefore likely require funding through the National Land Transport Programme at some future date. Tolling of the corridor has the potential to generate revenue that could be considered to bring the construction of TNL Stage 2 forward.

This report presents an assessment of tolling on TNL Stage 1 and TNL Stage 2, consistent with the Waka Kotahi policy to consider tolling suitability of all new state highways and significant upgrades to existing state highways.

Under section 46 of the LTMA[1], revenue from tolling may be used to contribute towards the 'planning, design, supervision, construction, maintenance, or operation of a new road'. It is Waka Kotahi policy to assess all new roads for tolling, utilising a multi-layer assessment process to determine tolling feasibility. This report provides technical input to inform such an assessment by Waka Kotahi.

Scope and Objectives

Waka Kotahi has determined that the TNL project meets the criteria to progress through to a full tolling assessment and subsequently has commissioned Beca Ltd to investigate the effects of tolling TNL on the transport network, to assist in recommending a suitable toll strategy and estimated revenue. The scope of the study included:

- the selection of a suitable toll strategy in collaboration with Waka Kotahi, including collection points and toll levels
- estimate revenue from tolling including a risk analysis
- assessment of network impacts from tolling of the corridor
- assessment of the safety implications of tolling of the corridor
- assessment of the impact of tolling of the corridor on enabled emissions

The scope did not include engineering, planning or implementation feasibility and does not make a recommendation on whether or not TNL should be tolled.

[1] The tolling of new roads comes under Section 46 of the LTMA and requires that an Order in Council process be completed before the road is opened. The Minister of Transport holds legislative power to recommend a road for tolling to the Governor-General, provided the Minister is satisfied the requirements of the LTMA have been met, including being satisfied with the level of community support for the proposed tolling scheme.

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Methodology

The assessment follows a similar process as previous studies on Ōtaki to North of Levin, Puhoi-Warkworth and Penlink projects. It comprised the following key tasks:

- Liaison with the Client Group on key project outcomes, objectives, network assumptions and engagement developing and assessing various toll strategies
- Liaison with the independent peer reviewer
- Assessment of a long list of potential toll gantry location strategies, with a short-listing for detailed modelling assessment
- Analysis of the emerging preferred options under a range of toll levels, including consideration of direct impacts on revenue, road safety, traffic diversion and vehicle emissions on different user groups of TNL
- Review of the outcomes and selection of a preferred 'balanced network' strategy that sought to find a balance between revenue implications, network effects and maintaining the core project objectives
- Explicit consideration of risks and uncertainties in the toll forecasting to provide risk-adjusted traffic flow and revenue estimates

The TNL study included assessment of a Stage 1 only strategy and also a Stage 1 and Stage 2 strategy. This allowed development of a preferred toll strategy that was flexible and optimised for scenarios with and without Stage 2. The existing toll at the southern end of Takitimu Drive is also expected to be removed within the next decade as the debt is repaid. The Stage 1/2 strategies were therefore developed to remain valid in that future scenario when existing north-south movements between Tauriko and the city centre are no longer tolled.

Toll Strategy Options

The study considered an initial list of toll strategies for Stage 1 that were developed using a set of guiding principles. The strategies included options to toll different movements, and different combinations of movements of the TNL route. In conjunction with Waka Kotahi, a set of emerging preferred strategies were selected to be taken forward to a more detailed assessment.

A Stage 1 tolling strategy was identified that balanced the need to generate sufficient revenue and maintain acceptable levels of diversion to the alternative routes, whilst also providing reductions in vehicle kilometres travelled, enabled emissions and crash costs by suppressing some vehicle travel.

Assessment of Stage 2 tolling was then undertaken adopting the initial Stage 1 toll strategy. Consideration of the cumulative impacts of the two tolls led to the investigation of a discount on the through movement toll and/or or implementation of a time-varying toll. Given the relatively high commuter demand on this northern corridor a time-varying toll was considered an appropriate strategy. This allowed use of higher tolls during commuter-dominated peak periods when other suitable options were available (such as public transport), and lower tolls during interpeak/off peak periods that reduced diversion rates to the alternative routes. For the purposes of this analysis, the ratio of heavy vehicle toll to light vehicle toll of 2.6 was adopted from the existing Takitimu Drive toll system. The recommended short and longer-term strategies were therefore as follows:

The Stage 1 preferred tolling strategy comprises:

- *A gantry on TNL between Minden Interchange and Takitimu Drive*
- *A light vehicle commuter peak toll of $3.10 and off-peak toll of $2.10*
- *A heavy vehicle commuter peak toll of $8.15 and off-peak toll of $5.50*

The Stage 1 and 2 preferred tolling strategy comprises:

- *A gantry on TNL between Minden Interchange and Takitimu Drive (Stage 1)*
- *A gantry on TNL between Minden Interchange and Plummers Point Road (Stage 2)*

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- *A light vehicle commuter peak toll of $3.10 and off-peak toll of $2.10 for users using only the Stage 1 section or the Stage 2 section*
- *A heavy vehicle commuter peak toll of $8.15 and off-peak toll of $5.50 for users using only the Stage 1 section or the Stage 2 section*
- *A discount for users of both Stage 1 and 2*
  - *A light vehicle commuter peak toll of $4.10 and off-peak toll of $3.10 for users of both Stage 1 and 2 sections*
  - *A heavy vehicle commuter peak toll of $10.80 and off-peak toll of $8.15 for users of both Stage 1 and 2 sections*

The toll of using both sections of the TNL results in toll costs much higher than present in the existing toll roads in NZ, especially for heavy vehicles. Given the potential cumulative impact of multiple journeys per day, daily caps could be considered, especially for heavy vehicles[2].

Traffic Flow and Revenue Forecasts – Preferred Tolling Strategy

The Tauranga Strategic model (TTSM) was used to predict traffic volumes on TNL as well as impacts on traffic levels across Tauranga and Western Bay of Plenty. A range of risks and uncertainties in the forecasting were sensitivity tested, including revocation assumptions, willingness-to-pay parameters, growth assumptions etc, then combined via Monte-Carlo simulation to obtain 5th, 50th and 95th percentile traffic flow estimates.

The forecast average daily flow on the Wairoa Bridge is very slightly above the desired threshold of 20,000 vehicles per day in 2031 in the Stage 1 Only scenario with the preferred toll, and the 2048 Stage 1 and 2 scenarios with the preferred toll. The volume on State Highway 2 west of the Minden interchange remains near or below 10,000 vehicles per day in both 2031 and 2048 regardless of whether the toll is in place.

The forecast average daily flows on TNL in the preferred toll strategy are presented in Table A below for the three possible movements. It is to be noted that a significant proportion of the trip demands are end-to-end, as shown by the relativity large number of users of Stage 1 and 2 in the Stage 1 and 2 scenarios.

Table A Preferred toll strategy - Forecast average daily flows on TNL by Movement (50%ile)

Year	Forecast average daily flows by Movement		
	Users of Stage 1 Only	Users of Stage 2 Only	Users of Stage 1 and 2
2031 (Stage 1 toll only scenario)	15,400	-	-
2031 (Stage 1 and 2 scenario)	2,400	2,000	14,500
2048 (Stage 1 and 2 scenario)	3,000	2,900	19,300

The total flows on each section are assessed by adding the relevant movements, as indicated in Table B.

Table B Preferred toll strategy - Forecast average daily flows on TNL by Section (50%ile)

Year	Total Flow on Stage 1	Total Flow on Stage 2
2031 (Stage 1 toll only)	15,400	-
2031 (Stage 1 and 2 toll)	16,900	16,500
2048 (Stage 1 and 2 toll)	22,300	22,200

[2] Daily toll caps have not been considered in the flow and revenue estimates presented elsewhere in this report.

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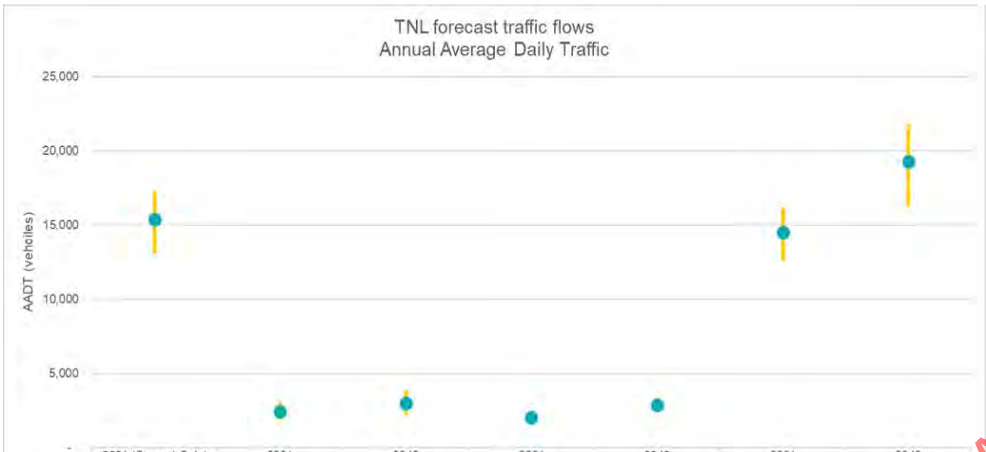
The above forecasts are 50th percentile average daily flows. The 5th percentile, 50th percentile and 95th percentile forecast average daily flows are presented in Figure A below.



	2031 (Stage 1 Only)	2031	2048	2031	2048	2031	2048
		Stage 1 Only		Stage 2 Only		Stage 1 + 2 (Through)	
5th %ile	13,100	1,900	2,200	1,680	2,360	12,500	16,300
50th %ile	15,400	2,400	3,000	2,030	2,870	14,500	19,300
95th %ile	17,300	3,000	3,900	2,270	3,360	16,200	21,800

Figure A Forecast average daily flows on TNL

These traffic flows are estimated to generate annual gross revenue[3] of

- $16.6m in 2031 (Stage 1 Only Scenario)
- $26.8m in 2031 (Stage 1 and 2 Scenario)
- $35.7m in 2048 (Stage 1 and 2 Scenario)

With a 50th percentile toll transaction cost of 80c per journey[4] (as advised by Waka Kotahi), the 50th percentile net revenue of the preferred toll strategy is estimated to be:

- *$12.1m in 2031 (Stage 1 Only Scenario)*
- *$21.2m in 2031 (Stage 1 and 2 Scenario)*
- *$28.1m in 2048 (Stage 1 and 2 Scenario)*

The 5th percentile, 50th percentile and 95th percentile forecast net revenue from tolling with the preferred strategy is presented in Figure B below.

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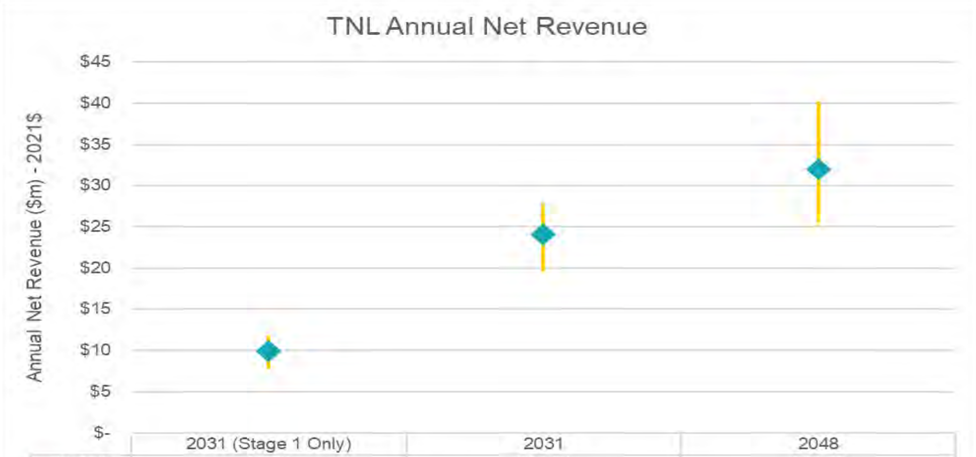
[3] The 50th percentile estimate of gross revenue includes a reduction to account for 'revenue leakage' of 3% for light vehicles and 2% for heavy vehicles.

[4] All revenue forecasts presented in this report exclude the impact of taxes (such as GST) on net revenue.



	2031 (Stage 1 Only)	2031	2048
5th %ile	$7.80	$19.51	$25.49
50th %ile	$9.93	$24.08	$31.98
95th %ile	$11.80	$28.03	$40.24

Figure B Forecast annual net revenue from tolling (Stage 1 only in 2031)

The key risks to the forecasts are related to land use, and the forecast changes in users' value of time.

Other Key Outcomes - Preferred Tolling Strategy

The tolled scheme, compared to the no tolled scheme is expected to reduce Vehicle Kilometres Travelled (VKT) by 21.4 million kilometres in 2031 for Stage 1 Only or 44.8 million kilometres for Stage 1 and 2, and by 42.9 million kilometres in 2048 for Stage 1 and 2. This reduced VKT impact is expected due to a travel suppression effect of tolling as well as some vehicles being diverted back to shorter (but slower) routes.

The tolled scheme, compared to the no tolled scheme is expected to reduce CO_2e by 5,000 tonnes in 2031 for Stage 1 Only or 9,600 tonnes for Stage 1 and 2 and by 4,900 tonnes in 2048 for Stage 1 and 2.

Tolling is predicted to have a relatively small / neutral impact on crash costs and deaths and serious injuries (DSIs).

Alternate Tolling Strategy

Alternate tolling scenario tests were undertaken based on the preferred tolling strategies to investigate if revenue from tolling could be increased. It assumed lower tolls for heavy vehicles (2 times the light vehicles toll rather than 2.5 times the light vehicle toll). The alternate toll scenarios were also tested with updated revocation assumptions on the existing SH2 as provided by Waka Kotahi. The scenarios are as follows:

- **Scenario 1 (S1)**: Lower tolls for heavy vehicles. The toll charges for light vehicles are the same as preferred scenario.
- **Scenario 2 (S2)**: All day tolls rather than time varying tolls. Lower tolls for all traffic.

The strategies were therefore as follows:

For S1, The Stage 1 alternate tolling strategy comprises:

- Same gantry location
- A light vehicle commuter peak toll of $3.10 and off-peak toll of $2.10
- A heavy vehicle commuter peak toll of $6.20 and off-peak toll of $4.20

The Stage 1 and 2 alternate tolling strategy comprises:

- Same gantry locations
- A light vehicle commuter peak toll of $3.10 and off-peak toll of $2.10 for users using only the Stage 1 section or the Stage 2 section

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- A heavy vehicle commuter peak toll of $6.20 and off-peak toll of $4.20 for users using only the Stage 1 section or the Stage 2 section
- A discount for users of both Stage 1 and 2
  - A light vehicle commuter peak toll of $4.10 and off-peak toll of $3.10 for users of both Stage 1 and 2 sections
  - A heavy vehicle commuter peak toll of $8.20 and off-peak toll of $6.20 for users of both Stage 1 and 2 sections

For S2, The Stage 1 alternate tolling strategy comprises:

- Same gantry location
- A light vehicle commuter toll of $2.00 for both peak and off-peak
- A heavy vehicle commuter toll of $4.00 for both peak and off-peak

The Stage 1 and 2 alternate tolling strategy comprises:

- Same gantry locations
- A light vehicle commuter toll of $2.00 for both peak and off-peak for users using only the Stage 1 section or the Stage 2 section
- A heavy vehicle commuter peak toll of $4.00 for both peak and off-peak or users using only the Stage 1 section or the Stage 2 section
- A discount for users of both Stage 1 and 2
  - A light vehicle commuter toll of $3.40 for both peak and off-peak toll for users of both Stage 1 and 2 sections
  - A heavy vehicle commuter toll of $6.80 for both peak and off-peak toll for users of both Stage 1 and 2 sections

In the Stage 1 Only scenario both alternate tolling scenarios (S1 and S2) have less diversion on the existing SH2 compared to the Preferred Toll scenario and similar trend follows for the Stage 1 and 2 scenario. This is due to the combination of speed reduction on the lower existing SH2 and lower tolls for trucks.

With both ***Stage 1 and 2***, the scenarios see minor changes in daily flow on both the existing SH2 and TNL compared to the Preferred Toll scenario. This implies that the impact of reduced tolls on flow is minimal compared to the influence of an increased speed on the existing SH2 from Omokoroa to Loop Road.

The VKT results of the alternate tolling scenarios are quite similar to the Preferred Toll scenario. However, there is increase in crash costs and reduction in the toll revenue observed for S1 and S2 scenarios, respectively, compared to the Preferred Scenario.

Tauriko network plan - New SH29 Tolling Test

A sensitivity test was undertaken in relation to the long-term emerging preferred Tauriko network plan. The test evaluated the impact of a toll on the proposed 4-lane corridor which is proposed alongside the existing SH29 from Redwood Lane to Takitimu Drive (referred to in this report as “New SH29”).

The tolling strategy for the sensitivity test was detailed as follows:

The Stage 1 preferred tolling strategy comprises:

- A gantry on the New SH29 would be between the Redwood interchange and the Takitimu Drive interchange.
- A light vehicle commuter toll of $2.10 for both peak and off-peak
- A heavy vehicle commuter toll of $5.40 for both peak and off-peak

The toll proposed for the sensitivity test diverts approximately 40% of traffic off the new SH29. It has been demonstrated to be a localised shift from the New SH29 to Existing SH29 and parallel corridor of SH36, there is little to no impact in other areas.

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Tolling the New SH29 results in a slight decrease in network VKT and CO_2e emissions mostly likely due to distributional effects where people choose destinations closer to their trip origins as a result of higher travel costs with the toll. However, there is an increase in crash cost and DSI due to diversion of traffic from the motorway (which has lower cents/km of crash cost compared to other road categories) to alternative route on the existing SH29.

Limitations

This analysis is based on the existing TTSM traffic model and driver willingness to pay (WtP) parameters calibrated to local conditions. Detailed market research into WtP has not been undertaken specifically for this work, however the effects of uncertainties in WtP and other key inputs and assumptions have been estimated via sensitivity tests and risk-profiling. While this work provides estimates of traffic volumes and revenue suitable for network planning, the revenue estimates are not considered 'investment grade' such as might be required for private-sector investment.

The purpose of this report is to assess the transport network impacts and revenue of the preferred tolling strategy in accordance with the parameters of our agreed scope as set out in our proposal. Further analysis may be required in order to support more detailed financial analysis.

Although in this report, Beca offers professional advice and may express opinions on likely or possible outcomes, we cannot guarantee any particular outcome and any decision to proceed with the next phase of investigation is a commercial decision for Waka Kotahi.

It should be noted that the toll revenue estimates provided as part of the Services are not a statement of absolute revenue suitable for detailed investment decisions, rather they will have an accuracy range commensurate with various factors such as the extent of relevant information provided, the certainty of data and assumptions and the level of detail available at the time of preparation.

Assessment of the transport network impacts is limited to the following outcome measures:

- Traffic flows
- Travel times
- Safety – as measured by the social crash cost difference between a tolled and un-tolled scenario
- Emissions – as measured by the change in vehicle CO_2e emissions between a tolled and un-tolled scenario
- Revenue

This assessment has included the transport system effects noted above and has not included a wider assessment against Waka Kotahi or other Government policies or frameworks. Forecasting traffic flows contains inherent uncertainty. While this report has attempted to quantify the potential scale of the key uncertainties, the risks associated with traffic forecasts should be considered in design and policy decisions for this project.

In preparing this assessment we have relied on the inputs and assumptions provided by or agreed with Waka Kotahi as outlined in this report, including:

- TTSM model
- Design of TNL project
- Land use inputs
- Wider network project assumptions regarding any SIP and revocation works
- Toll system transaction costs
- Waka Kotahi's Vehicle Emission Prediction Model

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1 Study Purpose

Waka Kotahi has determined that TNL (Stage 1 and Stage 2) project meets the criteria to progress through to a tolling assessment and subsequently commissioned Beca Ltd to investigate the effects of tolling TNL on the transport network, to assist in recommending a suitable toll strategy and estimate revenue from tolling for the preferred toll strategy.

The scope of the study included:

- the selection of a suitable toll gantry location strategy in collaboration with Waka Kotahi
- estimate revenue from tolling including a risk analysis
- assessment of network impacts of tolling of the corridor
- assessment of the safety implications of tolling of the corridor
- assessment of the impact of tolling of the corridor on enabled emissions

The scope did not include engineering feasibility, planning implications, implementation assessment, or a recommendation on whether or not TNL should be tolled. The report does not address the level of tolling that is appropriate to recover the costs, as this will be the subject of separate consideration by Waka Kotahi.

This report presents the study methodology and outcomes.

2 Context

Introduction

The Takitimu North Link (TNL) is part of the NZ Upgrade Programme. TNL is intended to provide residents, freight and visitors to the Bay of Plenty with safer, more resilient access to one of New Zealand's highest-growth areas. The TNL project is a 14km four-lane corridor between SH29 Takitimu Drive and SH2 Omokoroa intersection. TNL is being designed as a four-lane expressway, with one lane in each direction operating as a managed lane. Two stages of TNL are currently planned, although only Stage 1 has been committed for delivery at this time. The two stages are:

- Stage 1 – A 6.8km four-lane expressway between Takitimu Drive that links into the SH2 alignment north of Te Puna. A full interchange will be constructed at Minden Road.
- Stage 2 – Extends the expressway a further 7km to the SH2 / Omokoroa Intersection.

Tolling

Tolling is a funding mechanism Waka Kotahi may establish under the Land Transport Management Act 2003 (LTMA), which enables users of a road to contribute to its cost over time.

Under section 46 of the LTMA, revenue from tolling may be used to contribute towards the 'planning, design, supervision, construction, maintenance, or operation of a new road'. It is Waka Kotahi policy to assess all new roads for tolling, utilising a multi-layer assessment process to determine tolling feasibility. The TNL project meets the criteria for full tolling assessment, and this study is in response to that policy. Not only is the TNL a new corridor, but it also links into an existing toll road, Takitimu Drive. Should this toll still be in operation once TNL has been opened (in part or full) there is an issue of equity that needs to be considered i.e., some users of TNL could get access to Takitimu Drive for free.

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3 Scheme

Two stages of TNL are currently planned, which are detailed in this section. At this point, only Stage 1 has been committed for delivery.

The Takitimu North Link is expected to:

- improve safety to reduce deaths and serious injuries
- improve access with more reliable travel times for local people, and regional freight to the Port of Tauranga from Western Bay of Plenty and Coromandel
- support greater travel choice through public transport prioritisation and shared path which will improve mode shift options
- support economic development and population growth in the Western Bay of Plenty in line with the Urban Form and Transport Initiative
- improve resilience to the road network

3.1 Stage 1

The New Zealand Upgrade Programme has provided funding to build Stage One, the new 6.8km four-lane road connecting SH29 Takitimu Drive through to SH2 west of Te Puna.

Takitimu North Link will provide an alternative route to SH2, moving trucks away from local roads and supporting urban growth. It is a key part of the region's Connected Centres programme developed by the Urban Form and Transport Initiative.

Stage One will have a separated walking and cycling path along the entire length. The project includes a new bridge crossing at Wairoa Awa (river), an overbridge interchange at Minden Road / Te Rangituanehu, underpasses at Cambridge Road and Wairoa Road, a new west-bound single lane connection from Fifteenth Avenue to Takitimu Drive Toll Road, and a northbound flyover and southbound bypass lane at the SH29 interconnection/interface.

The works include the construction of eight bridges, three million cubic metres of earthworks, 29 culverts, eight stream diversions and seven wetland areas.

An interchange overbridge at Minden Road and underpasses at Cambridge Road and Wairoa Road will help improve safety and efficiently manage the forecast traffic growth.

Figure 3-1 shows a schematic of TNL Stage One.

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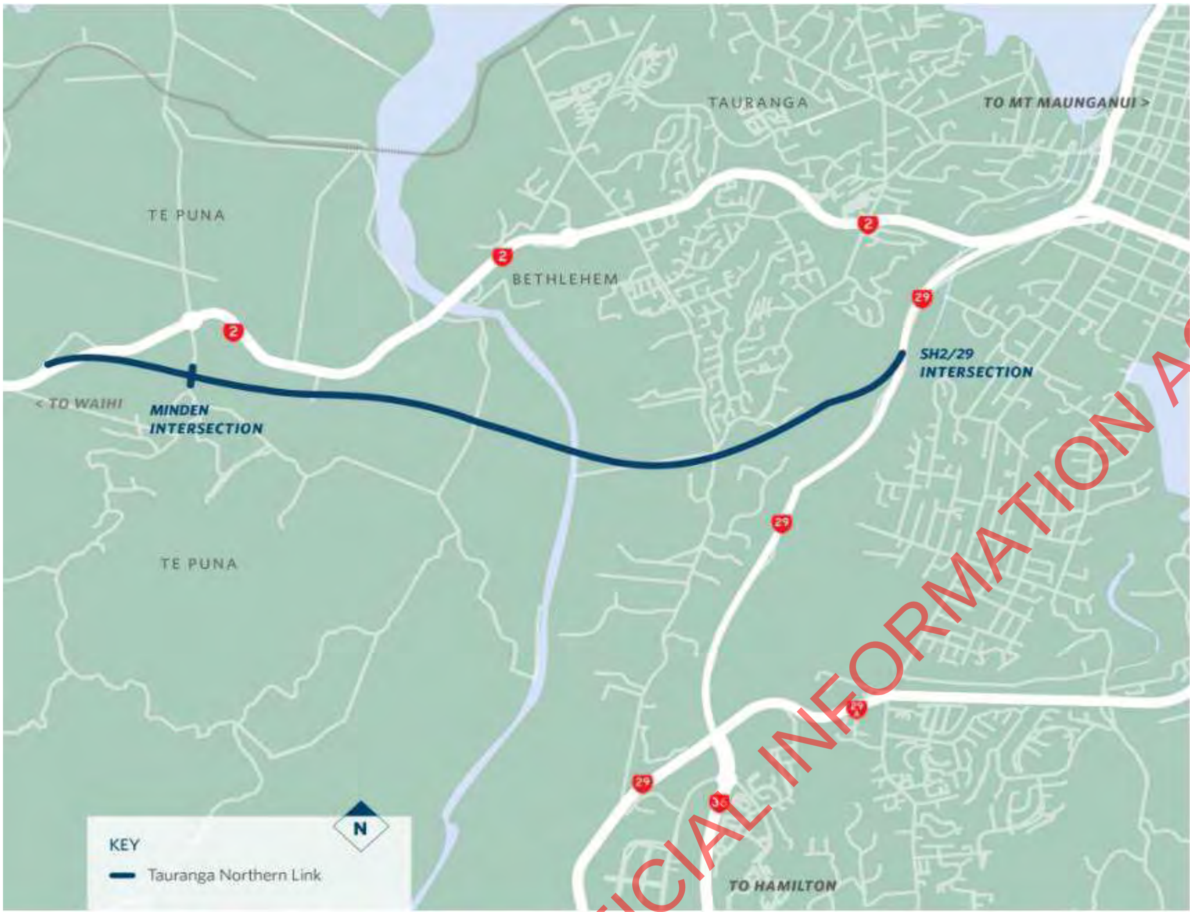

Figure 3-1: TNL Stage One Schematic

3.2 Stage 2

Stage Two of the project will connect Te Puna and Omokoroa through continuation of Stage One. This will include interchanges at Minden Road and Omokoroa Road, as well as a north facing westbound ramp at Plummers Point Road.

Further work beyond route protection, including construction, is unlikely within the next 10 years unless tolling can provide an additional funding mechanism to bring this forward.

3.1 Assumptions along the existing SH2 route

For the 2031 TNL Stage 1 scenario, the existing SH2 route has the following characteristics:

- A speed limit of 80km/hr on SH2 from Omokoroa to TNL Stage1
- A speed limit of 60km/hr on SH2 between Loop Road and 300m east of Te Puna Road
- A speed limit of 70km/hr on SH2 from 300m east of Te Puna Road to Taniwha Place
- A speed limit of 50km/hr on SH2 for Bethlehem town area (from Taniwha Place to 400m east of Bethlehem Road)
- A speed limit of 80km/hr on SH2 from 400m east of Bethlehem Road to 15th Avenue.
- The one-lane capacity of SH2 between Omokoroa and Taniwha Place is 1400veh/hr
- The one-lane capacity of SH2 within Bethlehem town is 1200veh/hr
- The one-lane capacity of SH2 from 400m east of Bethlehem Road to 15th Avenue is 1800veh/hr
- 4 lanes on SH2 between 400m east of Bethlehem Road to 15th Avenue is 1800veh/hr

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For TNL Stage 1 and 2 scenarios the existing SH2 route has the following characteristics:

- A speed limit of 70km/hr on SH2 from Omokoroa to Loop Road
- The remaining characteristics are the same as the TNL Stage1 scenario

In terms of changes from the base scenario, the only differences are:

- For TNL Stage 1 only scenarios, the free speed on the existing SH2 goes down from 90km/hr to 80km/hr between Omokoroa and Loop Road before the Minden interchange.
- For the TNL Stage 1 and 2 scenarios, the free speed on SH2 is reduced to 70km/hr from Omokoroa to Loop Road.

4 Tolling Study

4.1 Overview

A series of toll strategies for TNL Stage 1 and Stage 2 were developed following a set of guiding principles.

The guiding principles are as follows:

- The strategy must raise revenue
- It should be efficient, by minimising the need for new gantries and avoiding very low tolls (<$1)
- Existing through movement (users of Takitimu Drive only) don't have a material increase in toll
- Payment for each movement is either proportional to the benefit gained or based on equal payment for access
- Avoids over-complex systems that would make safe and effective signage difficult to achieve
- Does not compromise TNL / Takitimu Drive operation
- Does not significantly undermine objectives of the project (including both the new element and the receiving project)
- Contributes to wider-network goals (e.g., cross-harbour vs. round-harbour)
- All movements can be captured by a two-gantry system (Stage 1) or three gantry system (Stage 1 and Stage 2)

The toll strategies were then assessed against user perception, revenue, network impacts, safety implications and enabled emissions, utilising the Tauranga Transport Strategic Model (TTSM) for a single forecast year (2031) for TNL Stage 1. From the initial set of toll strategies a short list of emerging preferred strategies was selected in conjunction with Waka Kotahi. The emerging preferred strategies were run through the TTSM for both 2031 and 2048 forecast years. Based on the outcomes of the emerging preferred strategies, a preferred scenario was selected by balancing a number of outcomes. With a preferred strategy for TNL Stage 1 developed, a set of strategies that incorporated TNL Stage 2 were assessed. Following this assessment, a final toll strategy for TNL Stage 1 and Stage 2 was agreed. The strategy was designed such that it could be implemented either in stages (Stage 1 first, followed by Stage 2 once constructed) or at once (either if Stage 2 construction is brought forward or tolling of Stage 1 is delayed until Stage 2 is open).

This process is further described in the following sections.

4.2 Assessment of toll strategies

4.2.1 Development of short list strategies

Figure 4-1 graphically represents the TNL Stage 1 with the existing and potential gantry locations:

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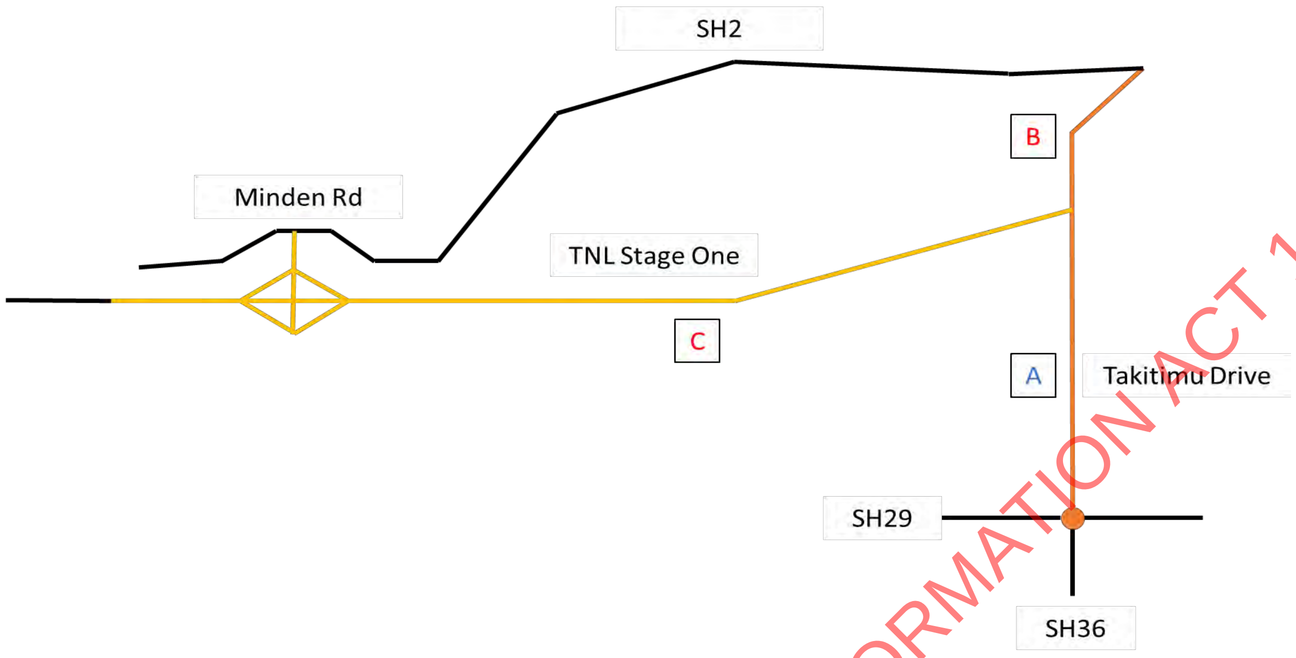

Figure 4-1: TNL Stage One Network

Considering the guiding principles above, four approaches to pricing TNL Stage 1 have been considered:

- A+$C cross-harbour
  - This strategy attempts to encourage drivers to travel across the harbour, using the 15th Ave bridge, if they are travelling east / west
- A+$C round-harbour
  - This strategy attempts to encourage drivers to travel around the harbour, using Takitimu Drive and SH29A, if they are travelling east / west
- Equal Access
  - This strategy is based on accessing the TNL / Takitimu Drive corridors at a fixed price, regardless of the distance travelled or movements made
- A/B+$C
  - This strategy splits the Takitimu Dr toll evenly north and south of the TNL interchange and adds an incremental toll for use of TNL

Therefore, the following set of strategies have been developed, as detailed in **Table 4-1**:

Table 4-1: TNL Initial Scenarios

Movement	Current Gantry	A+$C (cross-harbour)			A+$C (round-harbour)			qual Acces	A/B+$C			
	Existing	Opt1	Opt2	Opt3	Opt4	Opt5	Opt6	Opt7	Opt8	Opt7	Opt10	Opt11
		$C=$0.95	$C=$1.50	$C=$1.90	$C=$0.95	$C=$1.50	$C=$1.90	$C=$1.90	$C=$0	$C=$0.95	$C=$1.50	$C=$1.90
A<->B	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90	$1.90
A<->C	$1.90	$2.85	$3.40	$3.80	$0.95	$1.50	$1.90	$1.90	$0.95	$1.90	$2.45	$2.85
B<->C	$0.00	$0.95	$1.50	$1.90	$2.85	$3.40	$3.80	$1.90	$0.95	$1.90	$2.45	$2.85

4.2.2 Short List Analysis

The above strategies were modelled in the TTSM in the forecast year 2031 and compared back to the existing toll strategy.

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User Perception

User perception used a simple scoring system of -1 (perceived poorly), 0 (neutral) and 1 (perceived well) to rate each option against three different criteria:

- Free access – do users get any section of TNL (Stage 1) for free?
- Pay per distance – are users paying approximately similar tariffs per kilometre?
- Communication simplicity – how easily can the toll strategy be communicated to users?

Table 4-2shows the scoring for each option (including the existing strategy):

Table 4-2 Scoring results for each option

	Existing	Opt1	Opt2	Opt3	Opt4	Opt5	Opt6	Opt7	Opt8	Opt7	Opt10	Opt11
Free access	-1	1	1	1	1	1	1	1	1	1	1	1
Pay per distance	-1	-1	-1	-1	-1	-1	-1	0	1	0	1	1
Communication Simplicity	0	0	0	0	0	0	0	1	0	1	0	0

For the free access criteria, the existing strategy scores poorly as users of the northern section of Takitimu Drive and TNL (Stage 1) do not get charged. The remaining options score favourably as they are all designed to ensure there is no free access to the existing Takitimu Drive and TNL (Stage 1).

For pay per distance, Option 8, 10 and 11 score the highest as they are the closest options to paying tolls directly proportional to the distance travelled for the TNL movements (i.e., movements north or south). The remaining options have a more significant differentiation in the toll paid per distance, and hence score less favourably.

For communication simplicity, Option 7 scores well as all movements have the same toll, therefore making it easy for users to understand.

This simple assessment indicated that a strategy that splits the Takitimu Drive toll evenly north and south of the TNL (Stage 1) and adds an incremental toll for use of TNL (Stage 1) scores the highest (i.e., Option 7 – Option 11)

Revenue

The net revenue presented in **Figure 4-2** is the additional revenue generated from the toll strategy compared to the existing strategy. Net revenue has been measured as the gross revenue, less the transaction costs. As advised by Waka Kotahi in 2022, the transaction cost has been set at 70 cents per journey (i.e., if the same vehicle passes through multiple gantries, this only amounts to a single transaction). Note that this was later updated to 80 cents per journey in the assessment of the preferred strategy.

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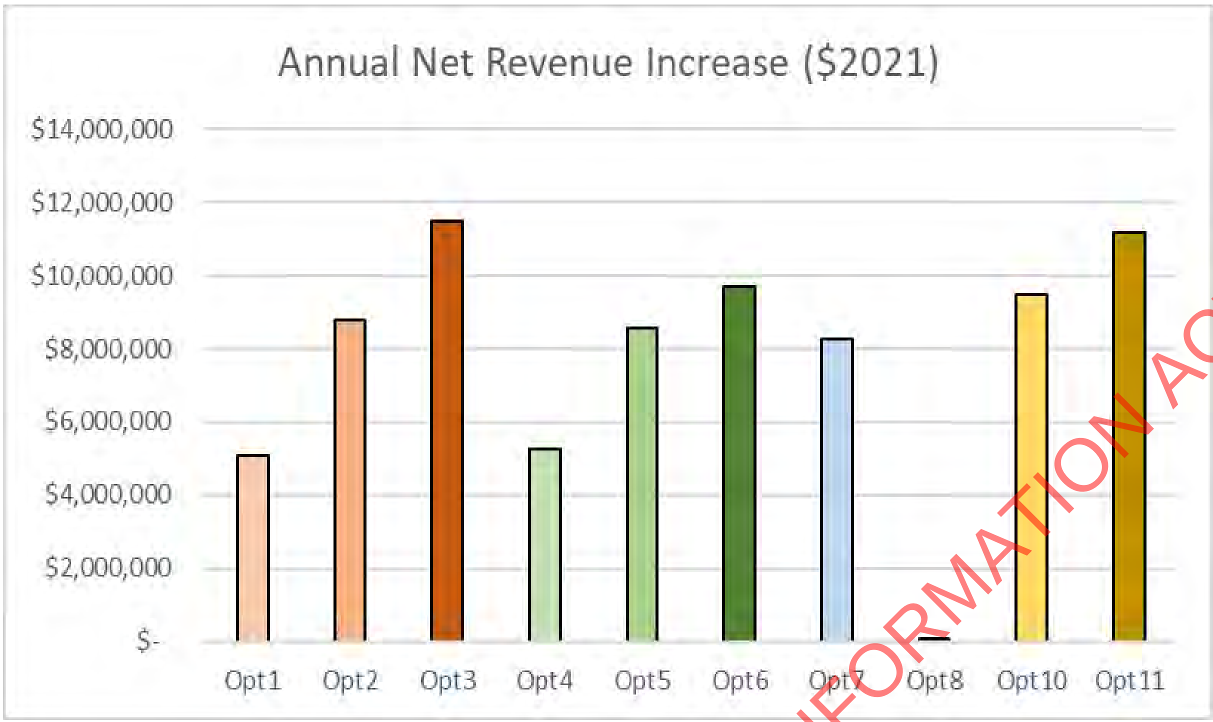

Figure 4-2: TNL Stage 1 Only scenario Net Revenue Change

The figure shows that all options generate additional revenue over the existing strategy. However, Option 8 generates a negligible net revenue increase. Additional revenue ranges from ~$5 million to $11.4 million annually.

Significant additional revenue can be generated through tolling TNL Stage 1

Network Impacts

Several measures have been used to assess the network impacts of the toll strategies. This included the following:

- TNL Stage 1 movement volumes
- Key location volumes
- Network level of service
- Flow difference plots

Figure 4-3 shows the annual average daily traffic (AADT) movement volumes for the toll movements in the TNL system.

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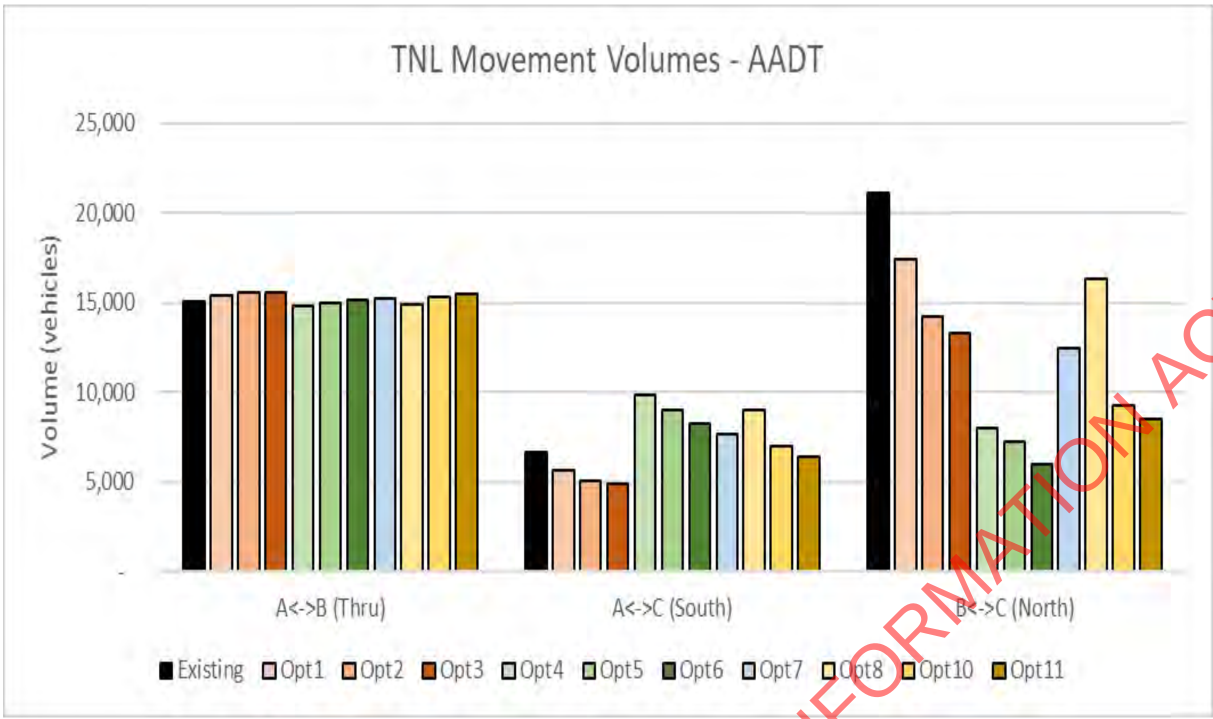

Figure 4-3: TNL Stage 1 scenario AADT Movement Volumes

The figure demonstrates the following:

- The Takitimu Drive through movement sees limited change in annual average daily traffic (by design)
- The southern movement sees a reduction in traffic volume for the “cross-harbour” strategy, while other strategies generally see an increase in volume (due to generally lower tolls for this movement compared to the existing strategy)
- The northern movement sees a reduction in traffic volume for all movements. This movement was not tolled in the existing strategy. The most significant reduction occurs in the “round-harbour” options, where drivers are encouraged to head south and use SH29A for trips to/from the east of Tauranga.

Figure 4-4 to **Figure 4-7** show the average daily traffic (ADT) at key locations in the study area.

Note the following section naming conventions are used in the figures:

- Section A: Takitimu Drive south of the TNL connection
- Section B: Takitimu Drive north of the TNL connection
- Section C: TNL Stage 1 section
- Section D: TNL Stage 2 section
- Wairoa Bridge: Existing SH2 at Wairoa Bridge

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Figure 4-4: TNL Section A (south Takitimu Drive) ADT

Figure 4-5: TNL Section B (north Takitimu Drive) ADT

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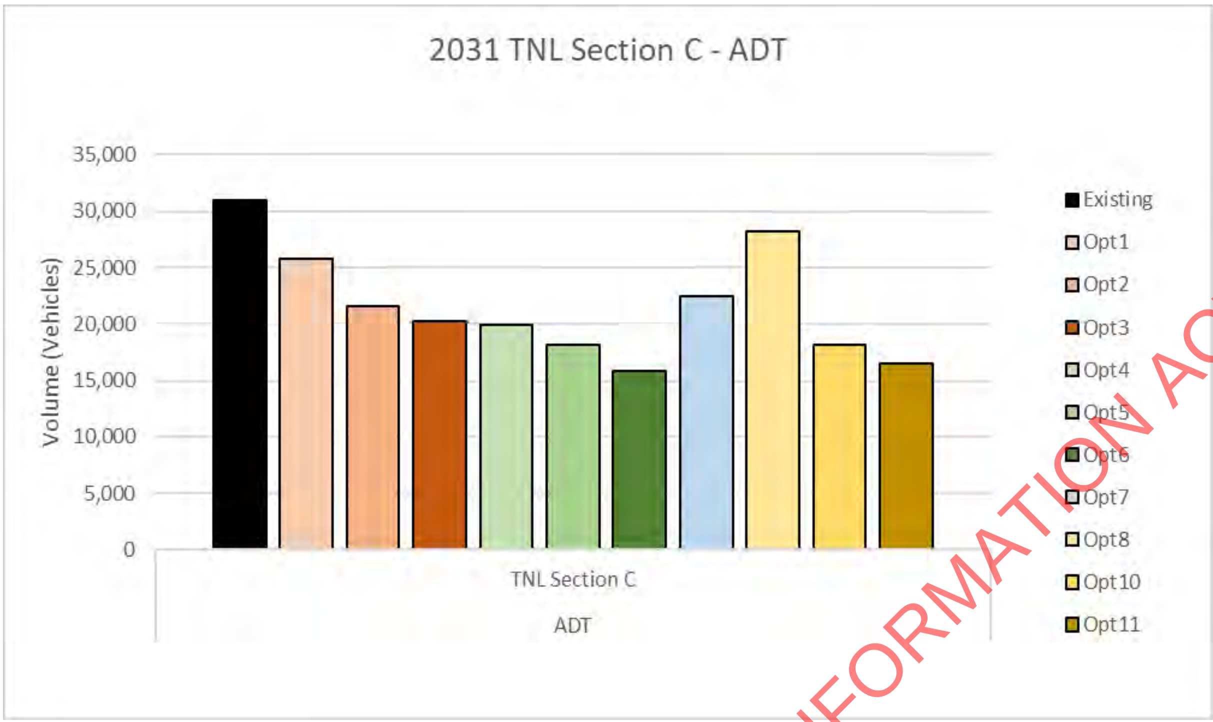

Figure 4-6: TNL Section C (TNL) ADT

Figure 4-7: Existing SH2 at Wairoa Bridge ADT

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The key observations from the figures above are as follows:

- The southern section of Takitimu Drive (TNL Section A) sees some variability in daily traffic depending on the strategy. This is particularly noticeable between the strategies that discourage the use of this section (cross-harbour) and those that encourage it (round-harbour). The difference to the existing strategy is typically within 5,000 vehicles per day.

- The northern section of Takitimu Drive (TNL Section B) sees a more significant change in traffic volume with the toll strategies tested. This is primarily driven by the fact that this movement is not tolled at all in the existing strategy.
- On TNL itself (TNL Section C) there are similar levels of reduction in traffic volume as the northern section of Takitimu Drive, again, this is primarily due to the introduction of a toll, where previously not all movements were tolled.
- Existing SH2 at Wairoa Bridge generally sees significant increases in traffic volume (increases up to 12,000 vpd). Maintaining daily traffic flows below approximately 20,000 vpd would be desirable.

The network impact outcomes have demonstrated the following:

- *Diversion from the TNL Stage 1 onto Wairoa Bridge is a risk item and therefore toll strategies progressed should attempt to limit the total daily flow at this location to 20,000 vehicles per day to avoid both significant traffic through this location and to limit the degradation in level of service*

Flow difference plots for the Short List Options are included in **Appendix A**. The same key observations can be made from the flow difference as the daily traffic volume plots.

Level of service plots for the Short List Options are included in **Appendix B**. The following observations have been made regarding level of service:

- All options have a poor level of service on the State Highway west of TNL Stage 1
- Strategies with higher diversion deteriorate the level of service along the existing State Highway through Wairoa Bridge
- With very high levels of diversion, some improvement can be made to the level of service on TNL Stage 1
- Strategies that encourage the use of the southern section of Takitimu Drive (Options 4 – 6) cause a deterioration in level of service along Takitimu Drive
- Option 7 limits the diversion to the alternative route and therefore limits the degradation in level of service along SH2

Vehicle Kilometres Travelled

The vehicle kilometres travelled (VKT) can be influenced by several elements, including:

- Difference in length between the tolled route and the alternative route
- Suppression / re-distribution of trips due to the change in travel cost of the new toll strategies

Figure 4-8 shows the change in annual VKT for the toll strategies compared to the existing strategy.

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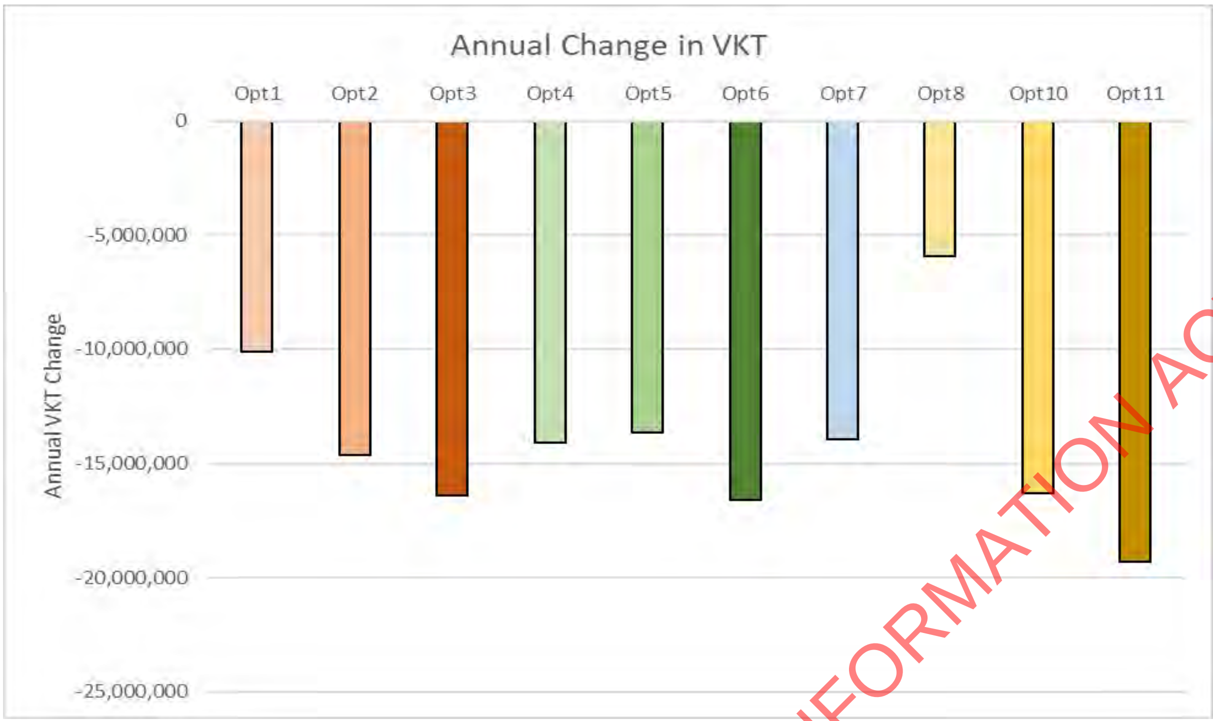

Figure 4-8: Change in Annual in VKT relative to an untolled TNL Stage 1 in 2031

For many journeys on TNL Stage 1, diverting them back to the free alternative on the existing SH2 results in a shorter trip length. This, combined with some suppression as a result of the increased travel cost imposed by tolling creates a reduction in VKT for all strategies tested.

- *Tolling positively contributes to VKT reduction, with higher tolls generating proportionally higher VKT reductions*

Enabled Emissions

Emissions have been measured by applying Waka Kotahi's Vehicle Emission Prediction Model (VEPM) to the flows and speeds predicted by the TTSM for each toll strategy. The change in annual CO_2e is shown in **Figure 4-9**.

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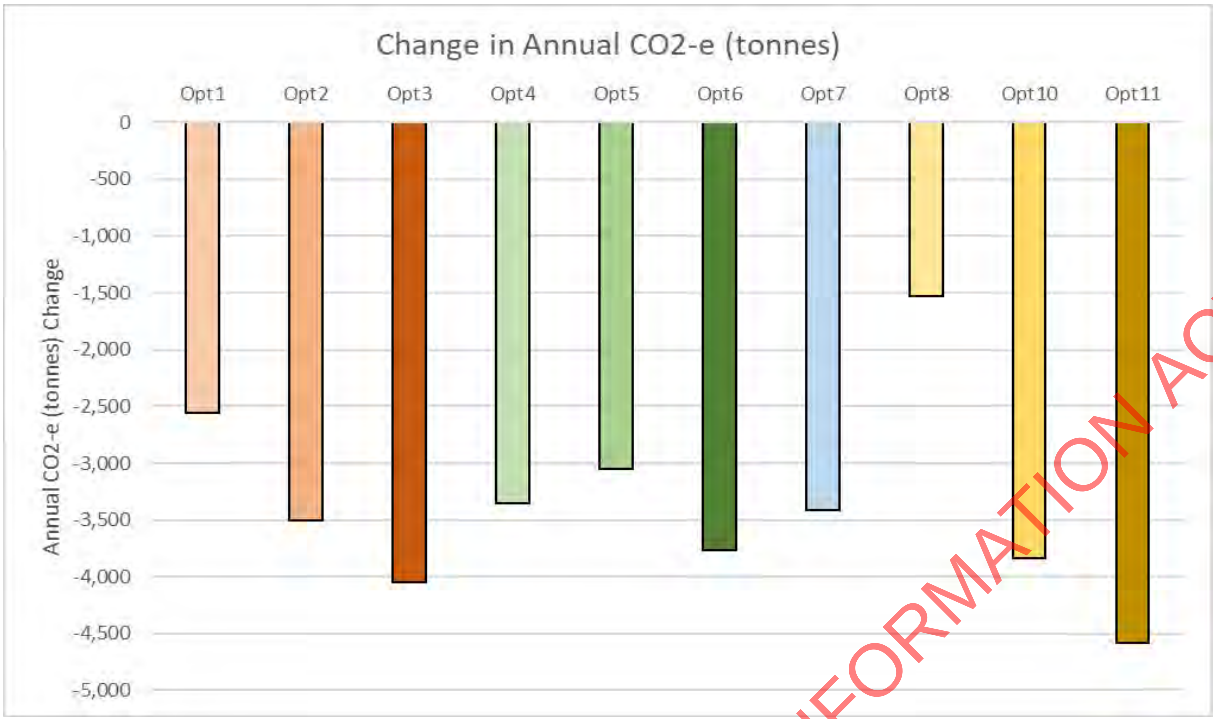

Figure 4-9: Change in Annual CO_2e relative to an untolled TNL Stage 1 in 2031

Unsurprisingly, the change in annual CO_2e very closely follows the VKT reduction trends. All tolled scenarios are predicted to reduce enabled emissions.

Tolling contributes to reductions in enabled emissions, with higher tolls generating proportionally higher reductions

Safety Implications

Traffic flows were measured on the toll road, roads in the vicinity of the toll road and the wider road network in the TTSM in order to estimate the potential social cost of deaths and serious injuries (DSIs). The crash costs and rates were based on crash rates calculated from existing crash history data.

Figure 4-10 shows the change in crash cost and DSI for the strategies tested compared to the existing toll strategy. The existing strategy has a total crash cost of $188 million per annum and DSIs of 136 for the full modelled network (Western Bay of Plenty).

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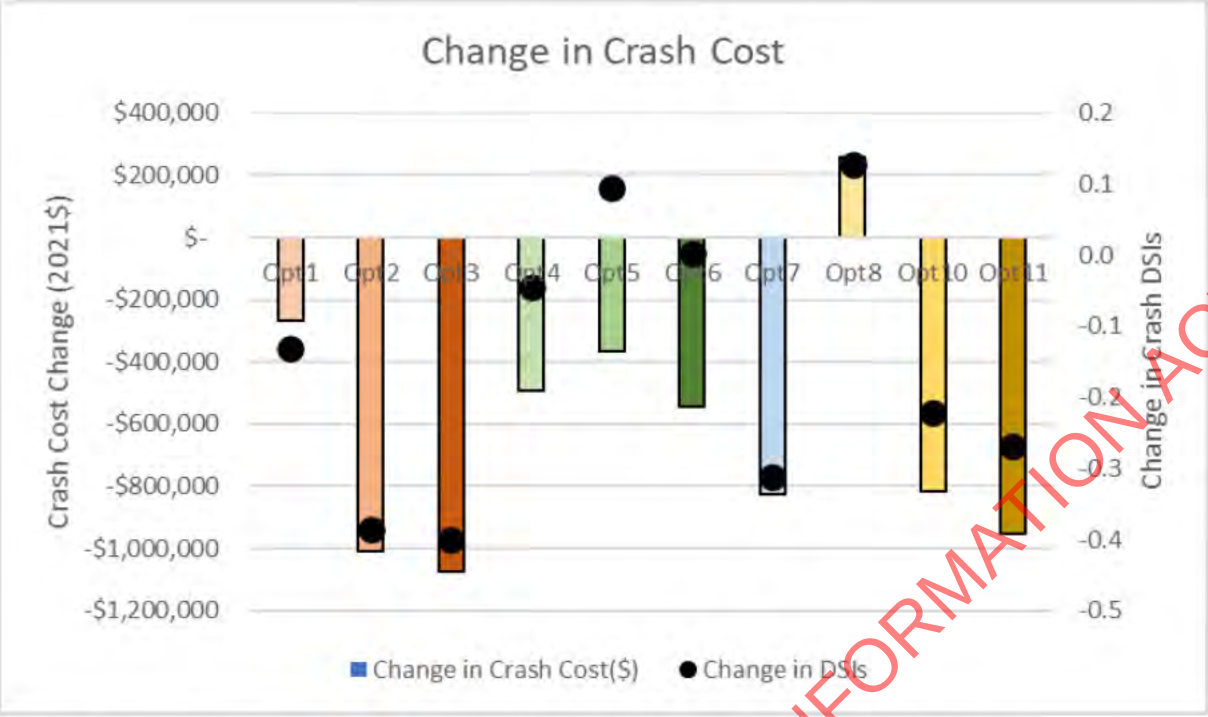

Figure 4-10: Change in Annual Crash Cost and DSI relative to an untolled TNL Stage 1 in 2031

The figure demonstrates that generally, some limited savings in annual social crash cost and DSIs can be made by introducing a new toll strategy. The main driver for the reduction in crash cost is likely to be due to the reduced VKT.

4.2.3 Selection of Stage 1 Emerging Preferred Options

Options 7 – 11 can typically produce just as good, if not better, network outcomes than the other strategies tested whilst also scoring well for user perception. Option 8 resulted in the worst outcomes from this subset of strategies and so was not considered further. It was agreed that Option 11 diverted too much traffic to the alternative routes, with traffic at the Wairoa Bridge reaching 21,400 vpd in 2031. Option 10 was right at the limit of being deemed acceptable for the level of diversion, with just over 20,000 vpd on Wairoa Bridge in 2031. From the set of strategies tested at this stage, Option 7 appeared to have the most balanced outcomes, with potentially some room to increase the toll to improve these slightly.

Therefore, the following set of emerging preferred options were developed, as shown in **Table 4-3.**

Table 4-3 Emerging preferred options

Movement	Current Gantry	A/B+$C			$C		
	Existing	**EPOpt1**	**EPOpt2**	**EPOpt3**	**EPOpt4**	**EPOpt5**	**EPOpt6**
A<->B (Thru)	$1.90	$1.90	$1.90	$1.90	$0.00	$0.00	$0.00
A<->C (S)	$1.90	$1.90	$2.10	$2.40	$1.90	$2.10	$2.40
B<->C (N)	$0.00	$1.90	$2.10	$2.40	$1.90	$2.10	$2.40

EPOpt4 – EPOpt6 represent the situation where the existing toll on Takitimu Drive has expired. For the emerging preferred testing, these were only run in 2048.

4.2.4 Stage 1 Emerging Preferred Results

The following sections describe the results from the emerging preferred scenarios for the forecast year 2048.

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Revenue

The additional revenue gained from the emerging preferred tolling strategies is shown in **Figure 4-11.**

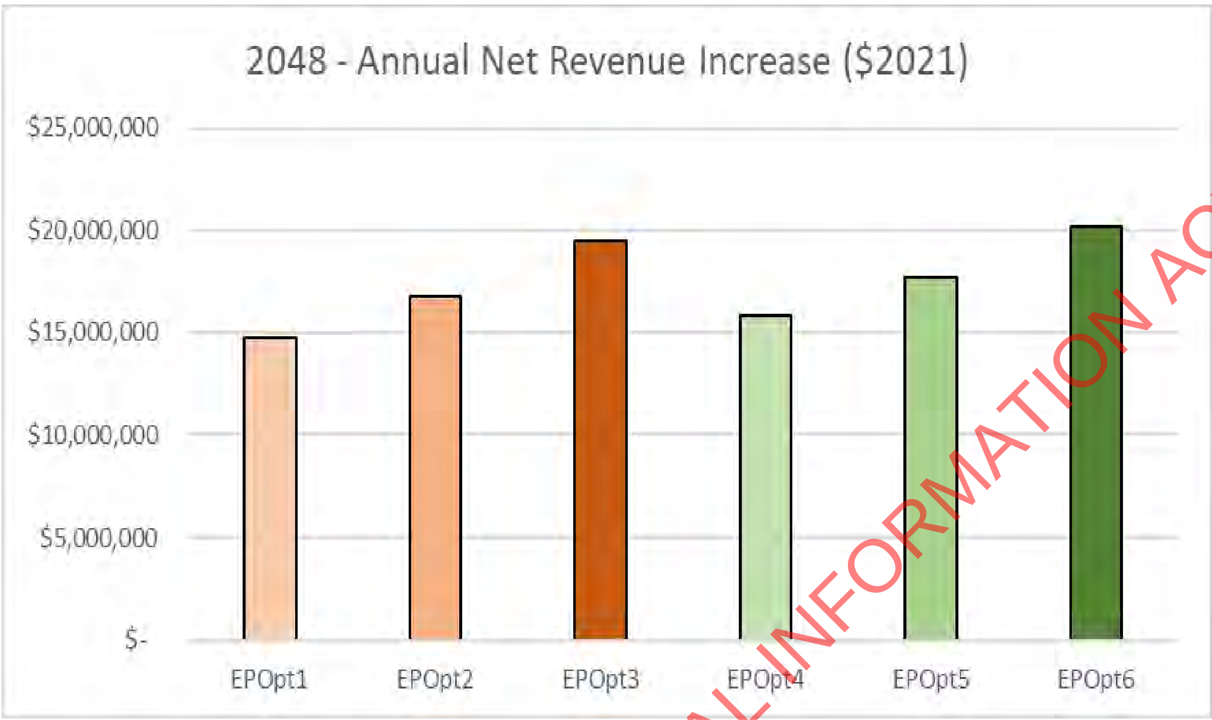

Figure 4-11: TNL Annual Net Revenue Increase - 2048

All options tested generate significant revenue of ~$15 million to ~$20 million per annum. The increase in revenue is broadly in line with the increase in toll.

All emerging preferred options generate additional revenue, with higher revenue for higher toll tariffs

Network Impacts

Figure 4-12 shows the annual average daily traffic (AADT) movement volumes for the toll movements in the TNL system.

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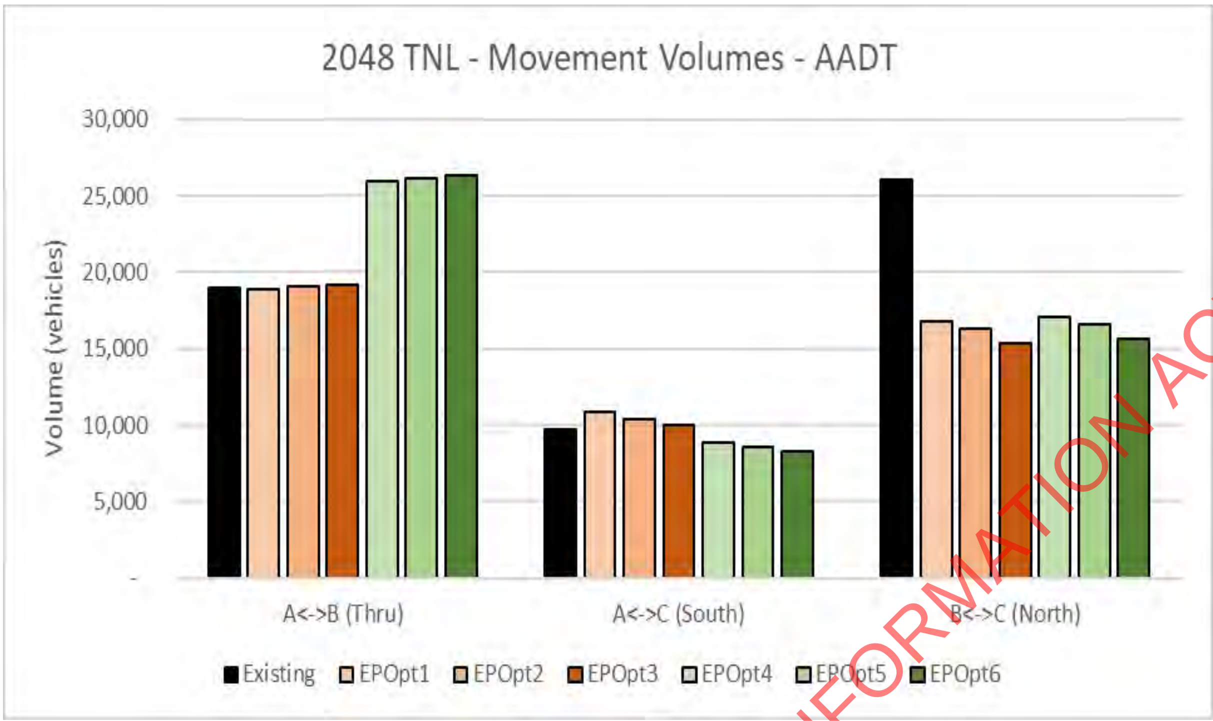

Figure 4-12: TNL Movement Volumes - 2048

The following observations have been made:

- There is limited change in volume for the Takitimu Drive through movement (by design) until this toll expires (EPOpt4 – EPOpt6)
- The southern movement (between TNL and south Takitimu Drive) can see some increase in volume as a result of the emerging preferred strategies, this is likely due to some change in route choice from the introduction of a toll for the northern movement. Most of the preferred options have similar or slightly lower volumes than the existing strategy
- The northern movement (between TNL and north Takitimu Drive) sees the greatest reduction traffic volume due to the emerging preferred options at approximately a 38% decrease in traffic volume. The existing strategy did not impose a toll on this movement, while a toll has now been introduced in the emerging preferred strategies

The following **Figure 4-13** shows the total screenline volume through TNL Stage 1 and Wairoa Bridge for each option. The volumes are an indication of the level of suppression occurring as a result of the toll strategy.

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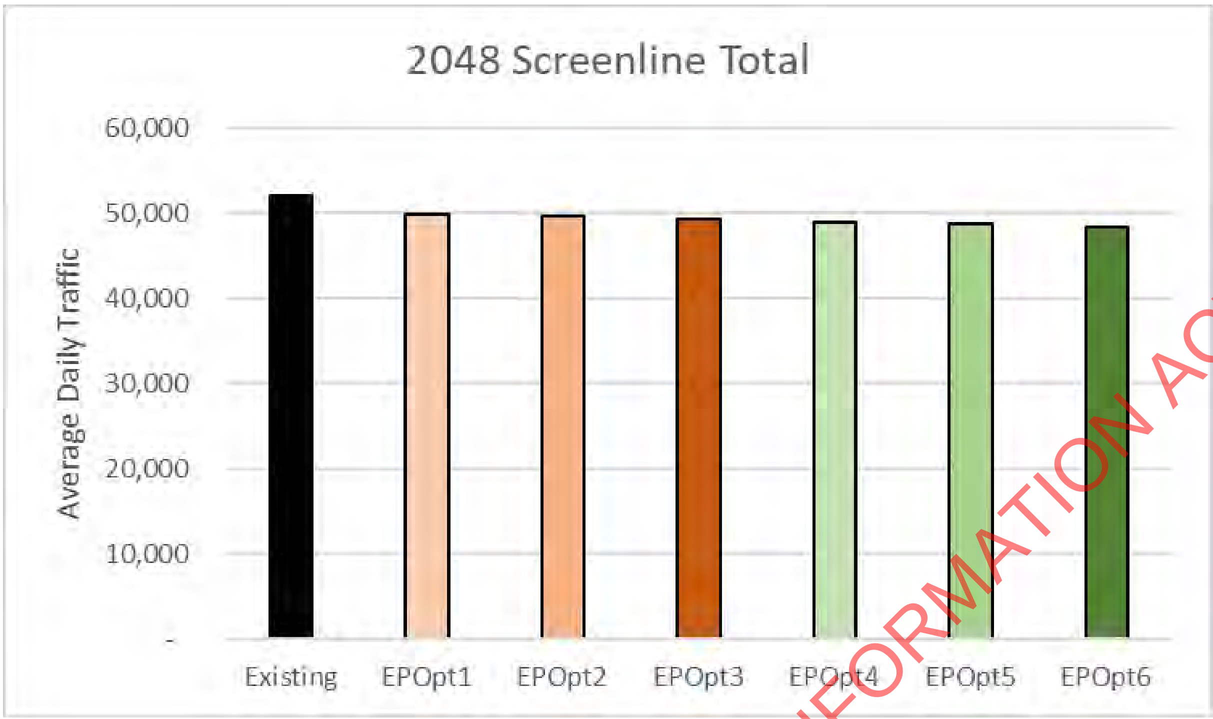

Figure 4-13: TNL Screenline Total Volume (ADT)

The figure demonstrates that there is a reduction in screenline total volume of approximately 2,500 vehicles per day. The options are broadly similar in the level of reduction.

The following **Figure 4-14** to **Figure 4-17** show the modelled volumes at key locations in the study area for the forecast year 2048.

Figure 4-14: TNL Section A (South Takitimu Dr) – 2048

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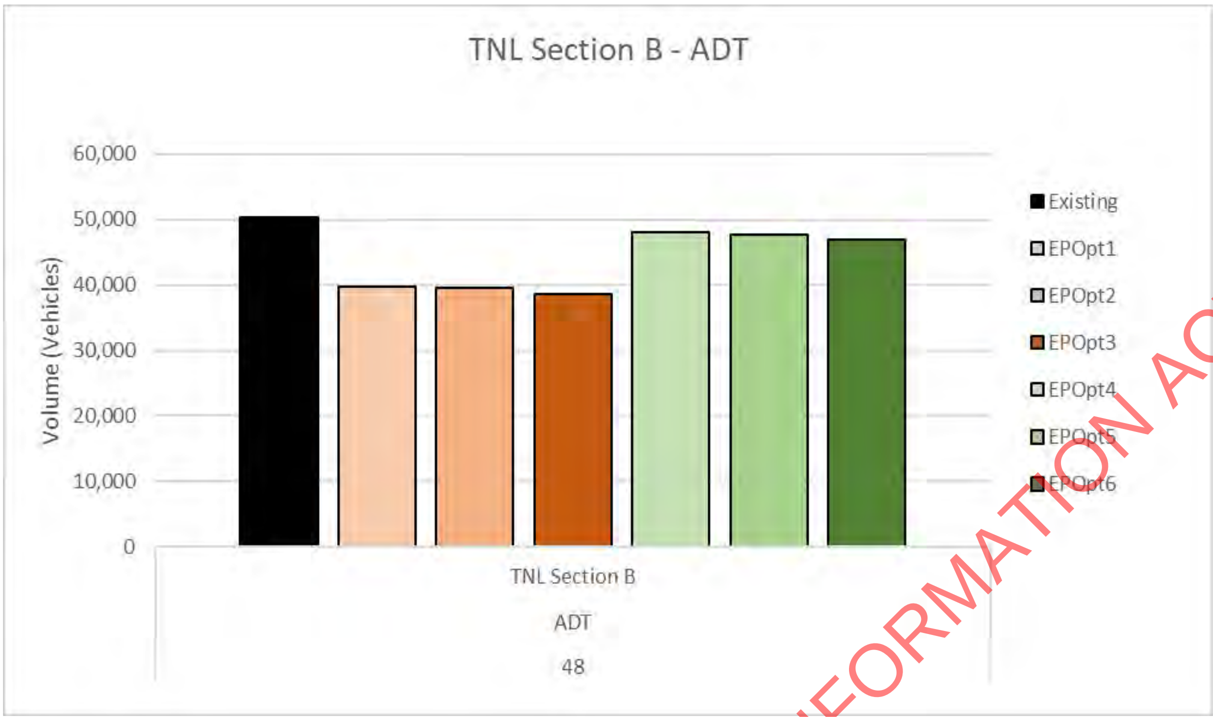

Figure 4-15: TNL Section B (North Takitimu Dr) - 2048

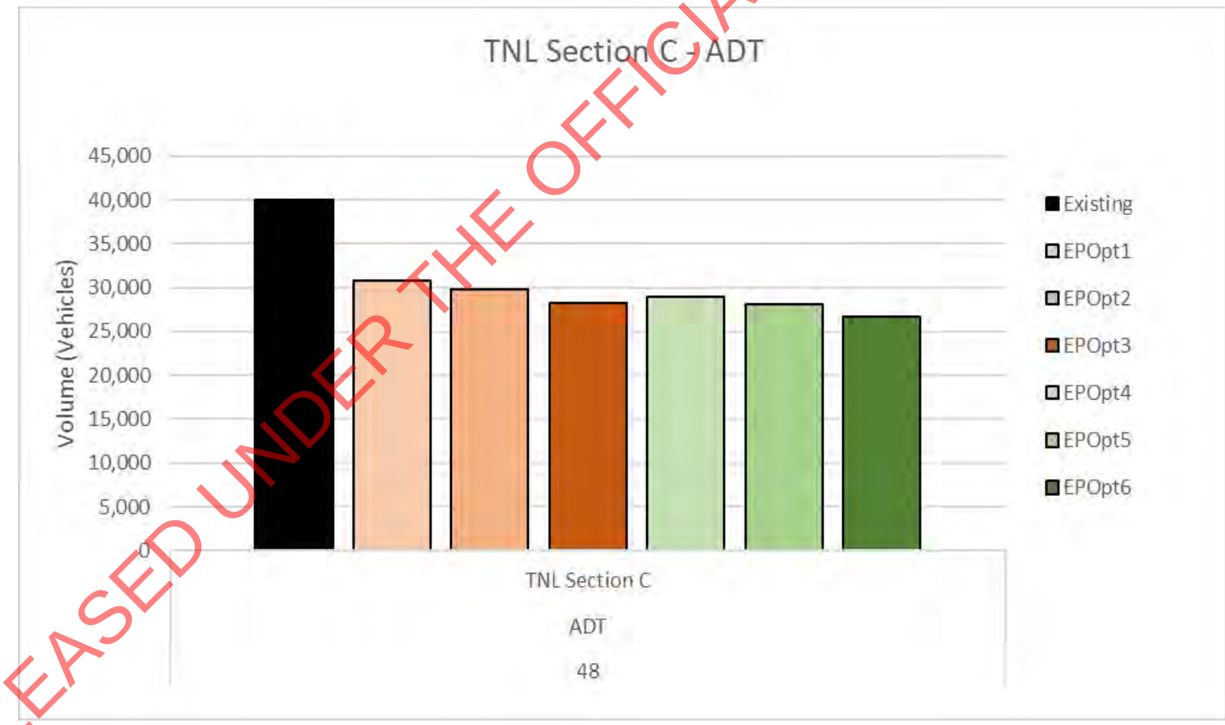

Figure 4-16: TNL Section C (TNL) - 2048

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Figure 4-17 Existing SH1 at Wairoa Bridge - 2048

The following observations have been made:

- The traffic volume on the southern section of Takitimu Drive remains stable until the expiry of the Takitimu Drive through toll, at which point the volume increases by approximately 6,000 vpd
- The traffic volume on the northers section of Takitimu Drive reduces by approximately 10,000 vpd with the toll strategies tested. Expiry of the Takitimu Drive toll limits this reduction to approximately 2,000 vpd
- The traffic volume on TNL Stage 1 reduces by approximately 10,000 – 13,000 vpd (~25%)
- Wairoa Bridge sees traffic volumes increase to approximately 20,000 vehicles per day in EPOpt2 ($2.10), or EPOpt4 ($1.90) with the toll on Takitimu Drive no longer in operation

Flow difference plots for the Emerging Preferred Options are provided in **Appendix C**. The same key observations can be made from the flow difference as the daily traffic volume plots.

- *The network impact outcomes have demonstrated that a toll for the TNL Stage 1 movements of $2.10 is at the limit of an acceptable level of diversion to the alternative route (measured at Wairoa Bridge)*
- *There is limited performance improvement on TNL Stage 1and Takitimu Drive with the lower volumes as a result of tolling*

Level of service plots for the Emerging Preferred Options are provided in **Appendix D**. The following observations regarding level of service have been made:

- Some degradation in the level of service through the existing State Highway 2 through the Wairoa Bridge
- Slight improvement in the level of service on the eastbound approach to the TNL Stage 1 and Takitimu interchange
- Slight improvement along the southern section of Takitimu Drive in the southbound direction

Vehicle Kilometres Travelled

Figure 4-18 presents the VKT change for each emerging preferred scenario. The scenarios have been compared to the existing toll strategy.

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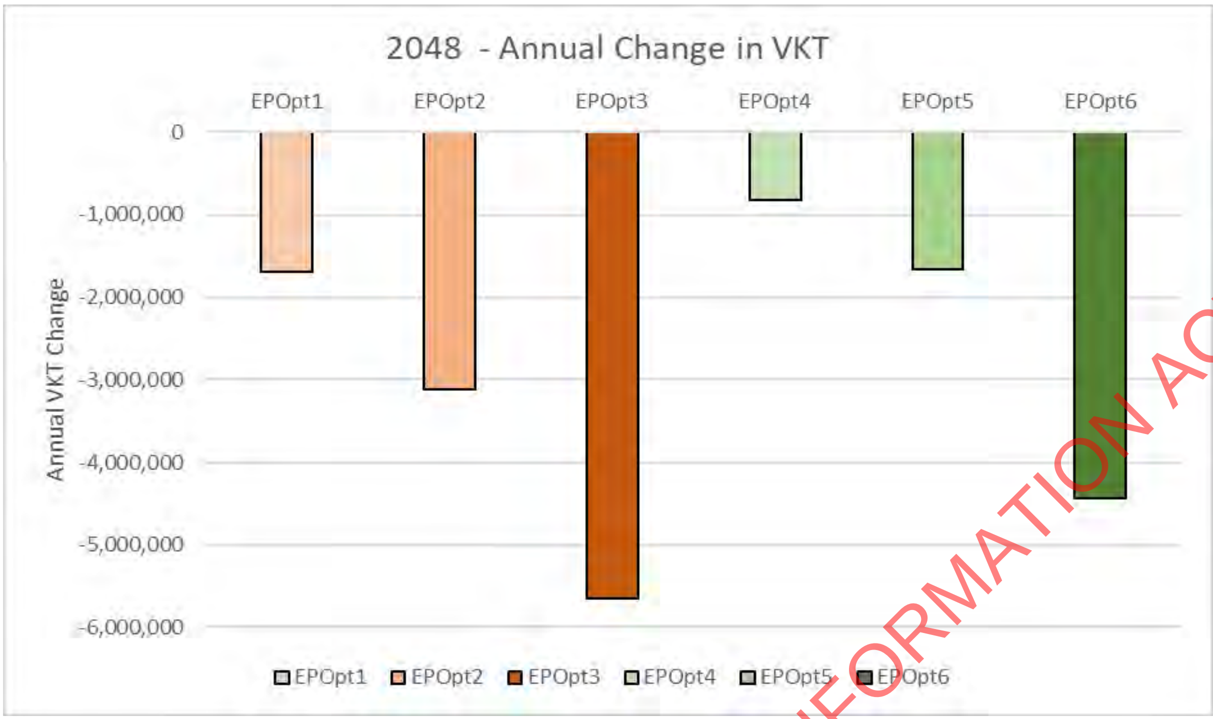

Figure 4-18: Change in Annual VKT relative to an untolled TNL Stage 1 in 2048

The figure demonstrates that as the toll on TNL Stage 1 increases, the level of VKT reduction also increases. The reduction in VKT ranges from 800,000 km to 5.6m km per year.

Enabled Emissions

Figure 4-19 present the change in enabled emissions (CO_2e) for each emerging preferred scenario. The scenarios have been compared to the existing toll strategy.

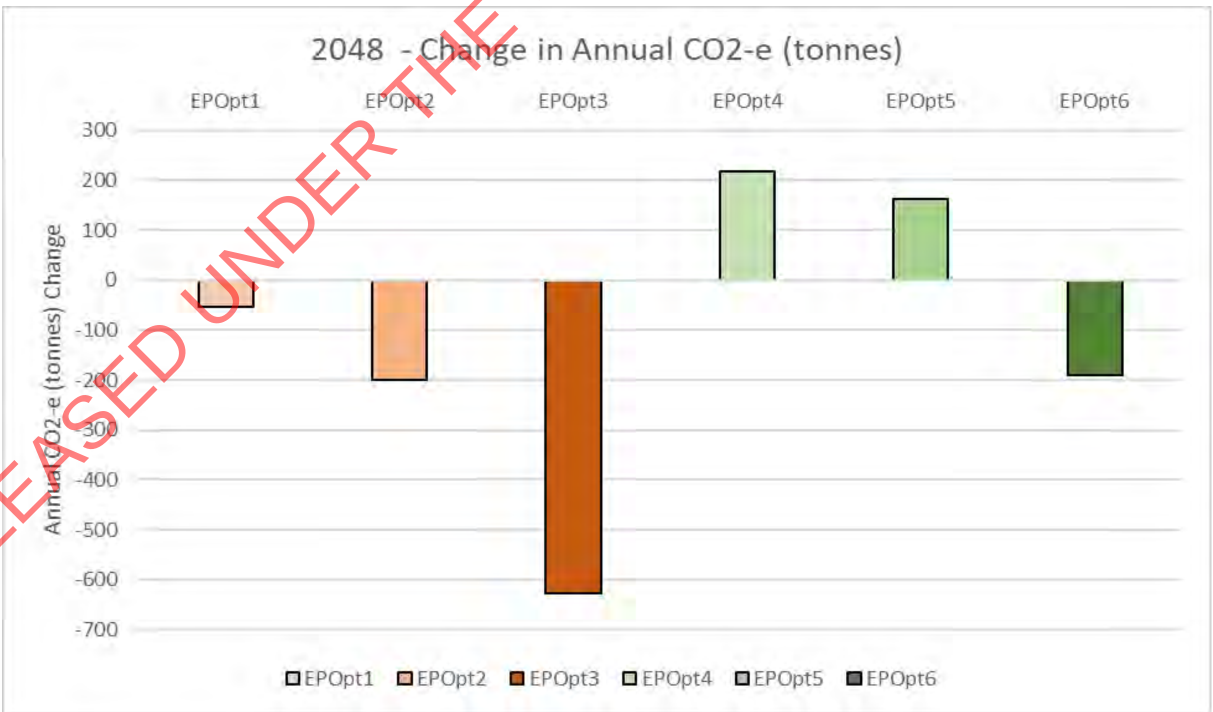

Figure 4-19: Change in Annual CO_2e relative to an untolled TNL Stage 1 in 2048

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The figure demonstrates that there is some potential to reduce emissions by introducing the emerging preferred toll strategy. However, the amount of CO_2e saved is fairly limited and there is somewhat limited differentiation between the strategies.

Safety Implications

Figure 4-20 presents the change in crash cost for each emerging preferred scenario. The scenarios have been compared to the existing toll strategy.

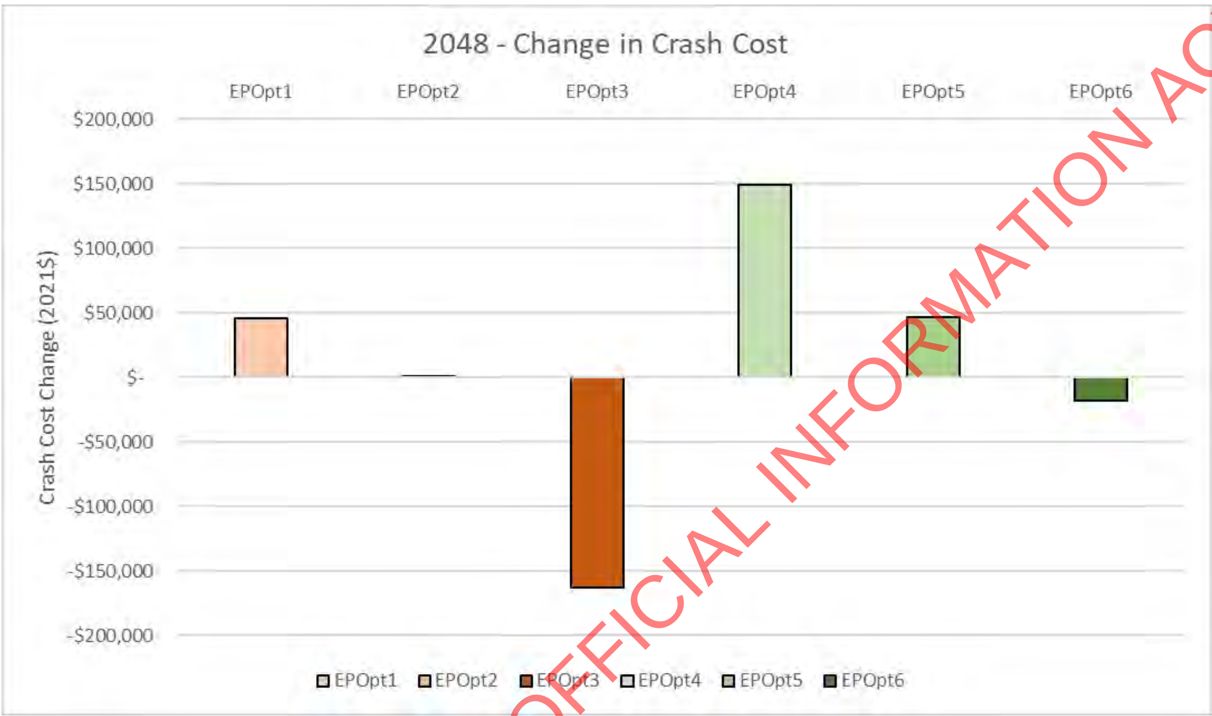

Figure 4-20: Change in Annual Crash Cost relative to an untolled TNL Stage 1 in 2048

4.3 Selection of Stage 1 Preferred Option

In consultation with Waka Kotahi, EPOpt2 / EPOpt5 was selected as the preferred TNL Stage 1 tolling strategy due to the balance in outcomes it was able to achieve. This balance being revenue generation, maintaining an acceptable level of diversion to the local roads, and improvement VKT and enabled emissions.

EPOpt2 / EPOpt5 consisted of a $2.10 toll for users on TNL Stage 1 (with no additional charge for using Takitimu Drive).

4.4 TNL Stage 2 Initial Testing

Following the selection of the Stage 1 preferred toll strategy, Stage 2 testing was undertaken. The Stage 2 strategy scenarios maintained the same Stage 1 strategy and then incrementally added a toll to Stage 2 (Opt1 – Opt8 in **Table 4-1**) at location D shown in the diagrammatic representation of TNL Stage 1 and 2 in **Figure 4-21**. Three further strategies were then added based on applying a discount or cap for users of both Stage 1 and Stage 2 (COpt5 – COpt7), as shown in **Table 4-4**.

At this stage of the project, advice was received from Waka Kotahi that it is estimated the toll on Takitimu Drive would expire by 2030 due to paying off the debt incurred from construction of the corridor. Modelling results from this point onwards assume that there is no toll for Takitimu Drive in the modelled years of 2031 and 2048. However, the risk analysis does account for the risk that the toll does not expire prior to the 2031 modelled year.

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The full set of strategies tested for the Stage 2 initial testing is shown in **Table 4-1**.

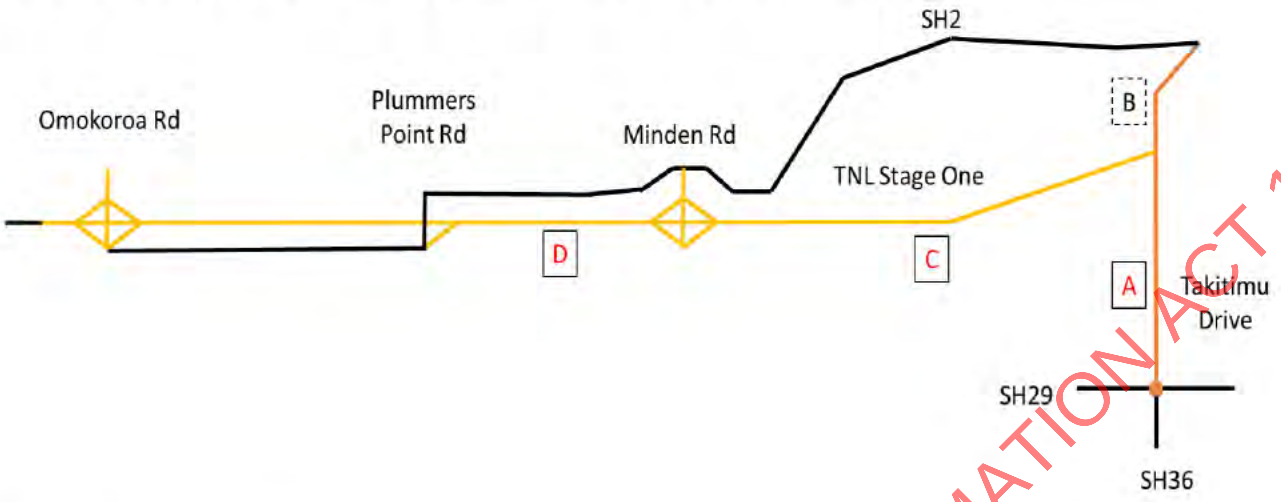

Figure 4-21: TNL Stage 2 Schematic

Table 4-4: TNL Stage 2 Initial Strategy Testing

Movement	Current Gantry											
	Existing	Opt1	Opt2	Opt3	Opt4	Opt5	Opt6	Opt7	Opt8	COpt5	COpt6	COpt7
A	$1.90	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
C	$0.00	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10	$2.10
D	$0.00	$0.00	$1.00	$1.50	$2.00	$2.50	$3.00	$3.50	$4.00	$2.50	$2.50	$2.50
C+D	$0.00	$2.10	$3.10	$3.60	$4.10	$4.60	$5.10	$5.60	$6.10	$2.50	$3.00	$3.50

4.4.1 Stage 2 Analysis

The following sections present the results of the TNL Stage 2 initial testing. Results are shown for forecast year 2048. All model results for Stage 2 testing assume that the toll on Takitimu Drive has expired.

Revenue

Figure 4-22 shows the potential annual net revenue from tolling TNL Stage 1 and Stage 2 for the strategies modelled.

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Figure 4-22: TNL Annual Net Revenue - 2048

The figure demonstrates that the revenue generally continues to increase as the toll on Stage 2 increases, with a maximum revenue of approximately $40 million per annum. The capped options (discounting the full through movement) sees a reasonably significant reduction in revenue; Option 5 generates revenue of just under $40 million, while Capped Option 5 (with 100% capping of the through movement) has revenue of just over $25 million, a 38% decrease.

There is potential to generate significant revenue from tolling TNL (both Stage 1 and Stage 2). Capping the toll price for users of Stage 1 and Stage 2 can significantly limit the revenue generated

Network Outcomes

The following **Figure 4-23** to **Figure 4-28** present average daily traffic (ADT) volumes for key locations in the study area.

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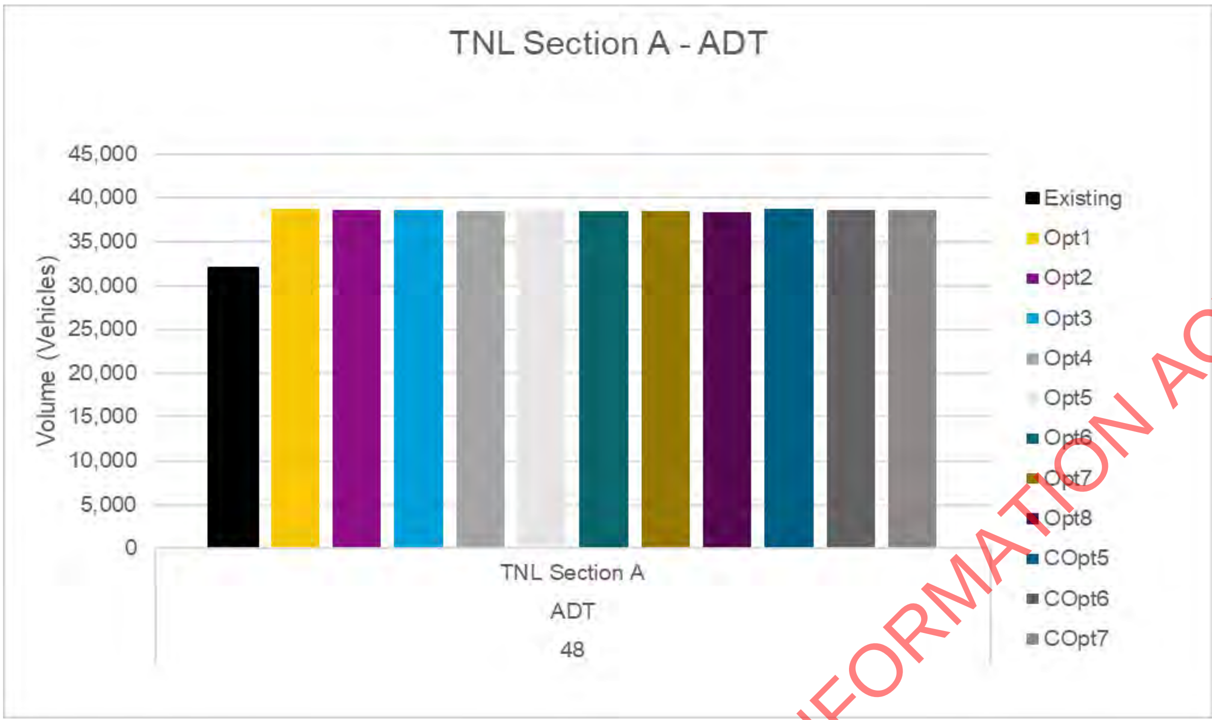

Figure 4-23: Average Daily Traffic for TNL Section A - 2048

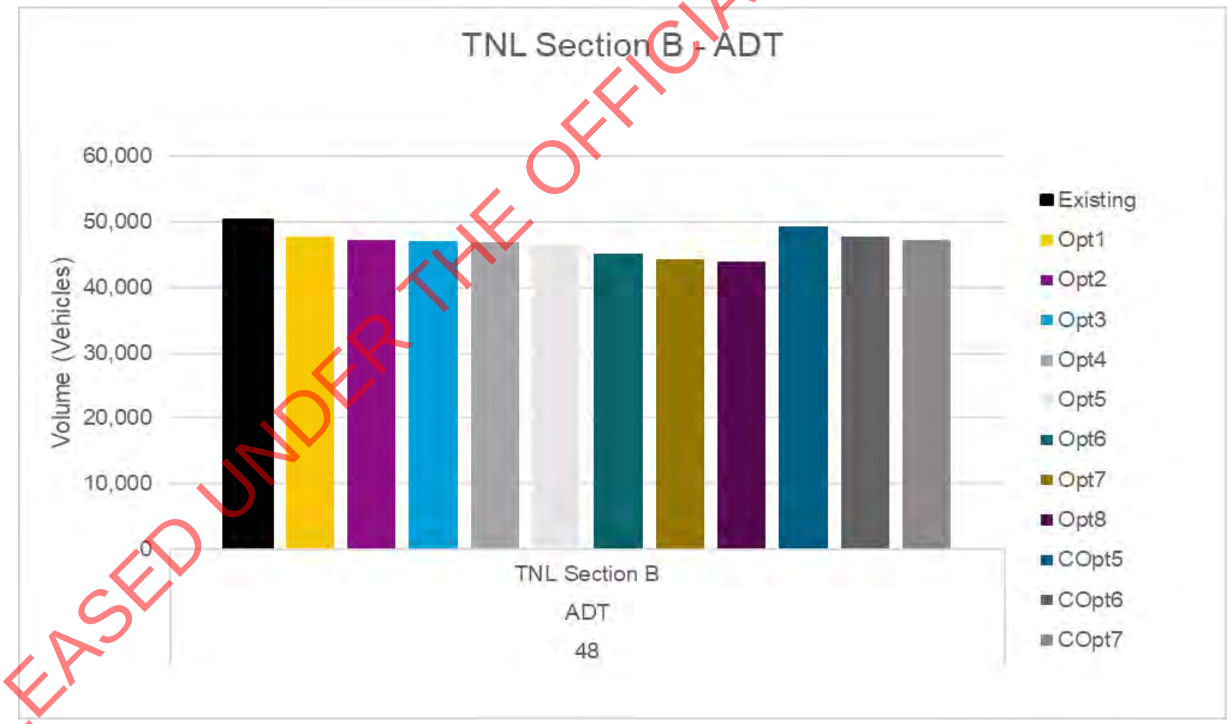

Figure 4-24: Average Daily Traffic for TNL Section B - 2048

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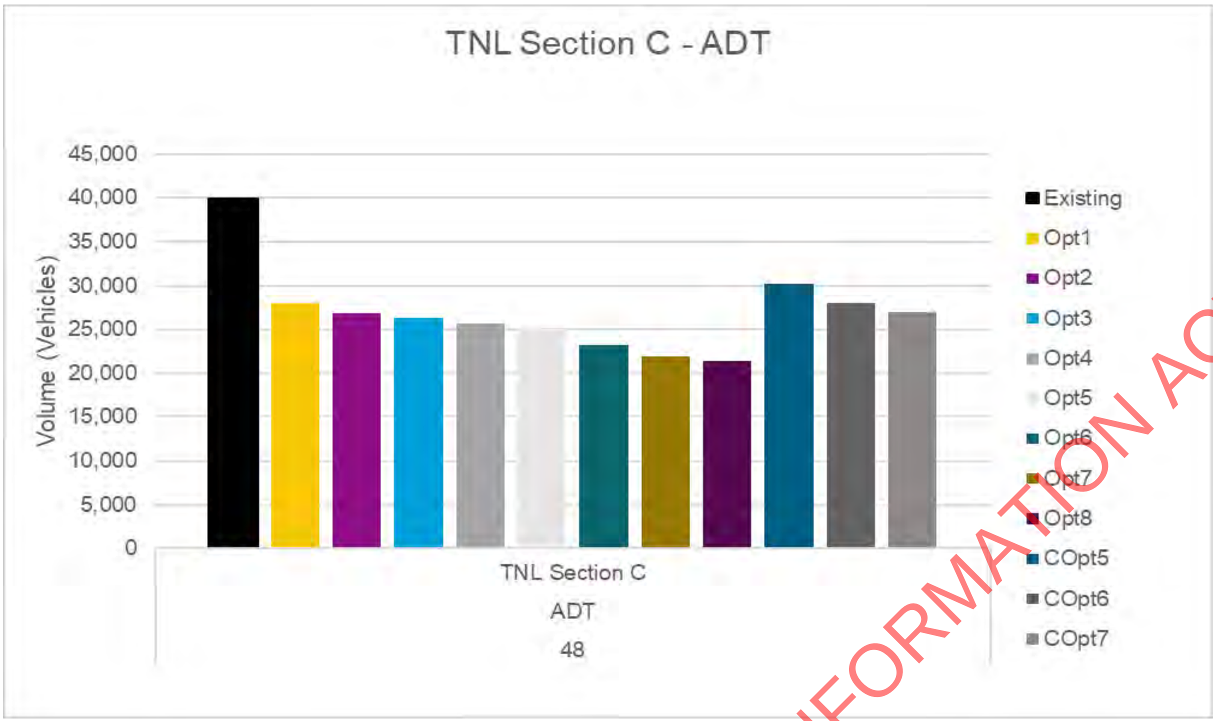

Figure 4-25: Average Daily Traffic for TNL Section C - 2048

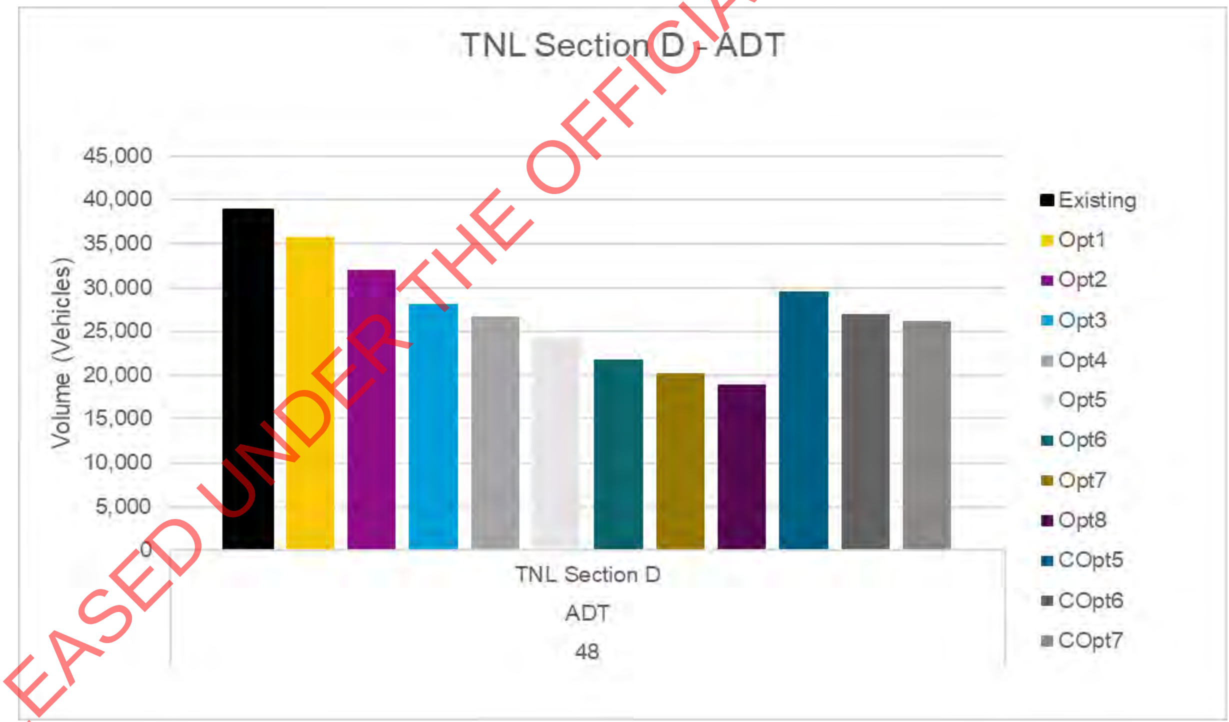

Figure 4-26: Average Daily Traffic for TNL Section D – 2048

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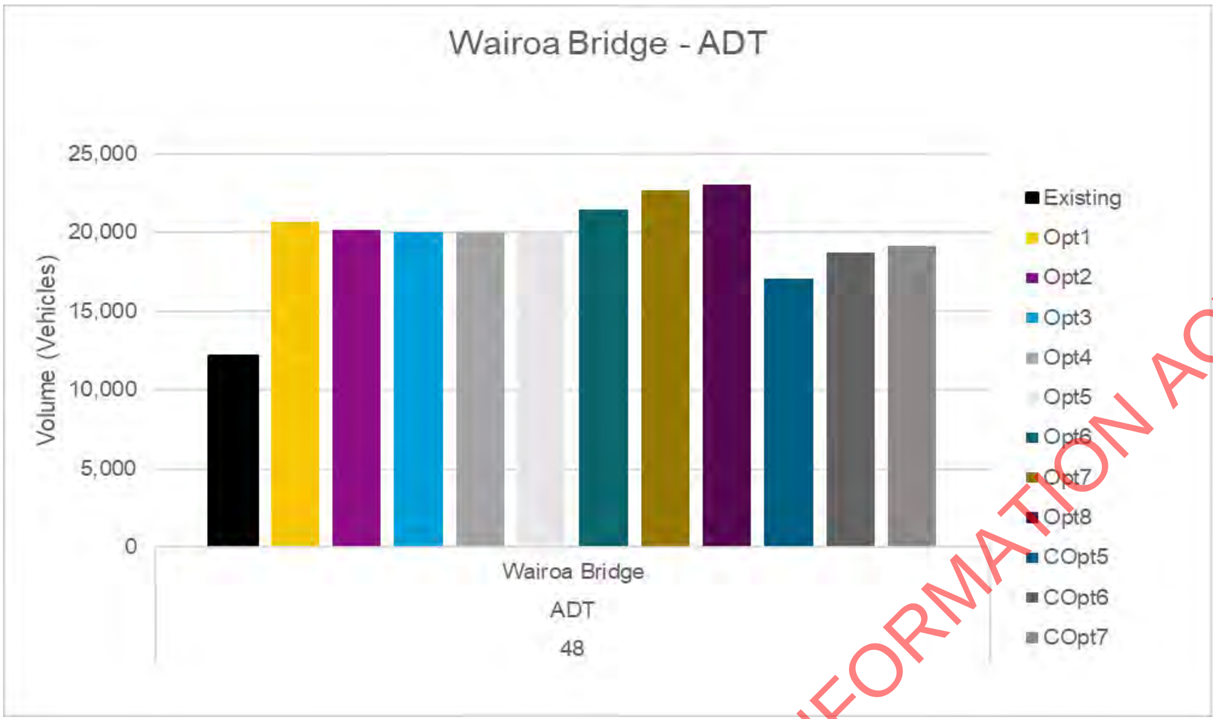

Figure 4-27: Average Daily Traffic for Wairoa Bridge - 2048

Figure 4-28: Average Daily Traffic for SH2 W Minden - 2048

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The following key observations have been made from the above figures:

- At the southern section of Takitimu Drive (TNL Section A) there is negligible difference between the toll strategies tested.

- At the northern section of Takitimu Drive (TNL Section B) there is negligible difference in traffic volume between the incremental toll strategies, however the capped options retain a higher volume on this section.
- At TNL Stage 1 (TNL Section C) there is limited difference in traffic volume between the incremental toll strategies, however the capped options retain a higher volume on this section.
- At TNL Stage 2 (TNL Section D) there is a consistent reduction in volume for increases in the incremental toll. Again, the capped strategies retain a higher volume of traffic on this section.
- On the existing SH2 at Wairoa Bridge, the traffic volume is fairly consistent for the incremental options until Option 5, after which there is a noticeable increase in volume. Option 5 has an ADT of 20,000 at this location. The capped toll strategies have a lower volume at this location due to the higher retention of traffic on TNL. The capped strategies have traffic volumes of 17,000 – 19,000. Daily traffic volumes of less than 20,000 would be desirable at this location.
- On the existing SH2 west of the Minden interchange (parallel with Stage 2) there is a noticeable increase in traffic volume with the increase in incremental toll. Option 5 has daily traffic volumes of just under 10,000 vehicles. The capped options have predicted volumes at this location of 6,800 vpd to 8,900 vpd. Daily traffic volumes of less than 10,000 would be desirable at this location.

Vehicle Kilometres Travelled

Figure 4-29 presents total network VKT for each of the Stage 2 strategies tested.

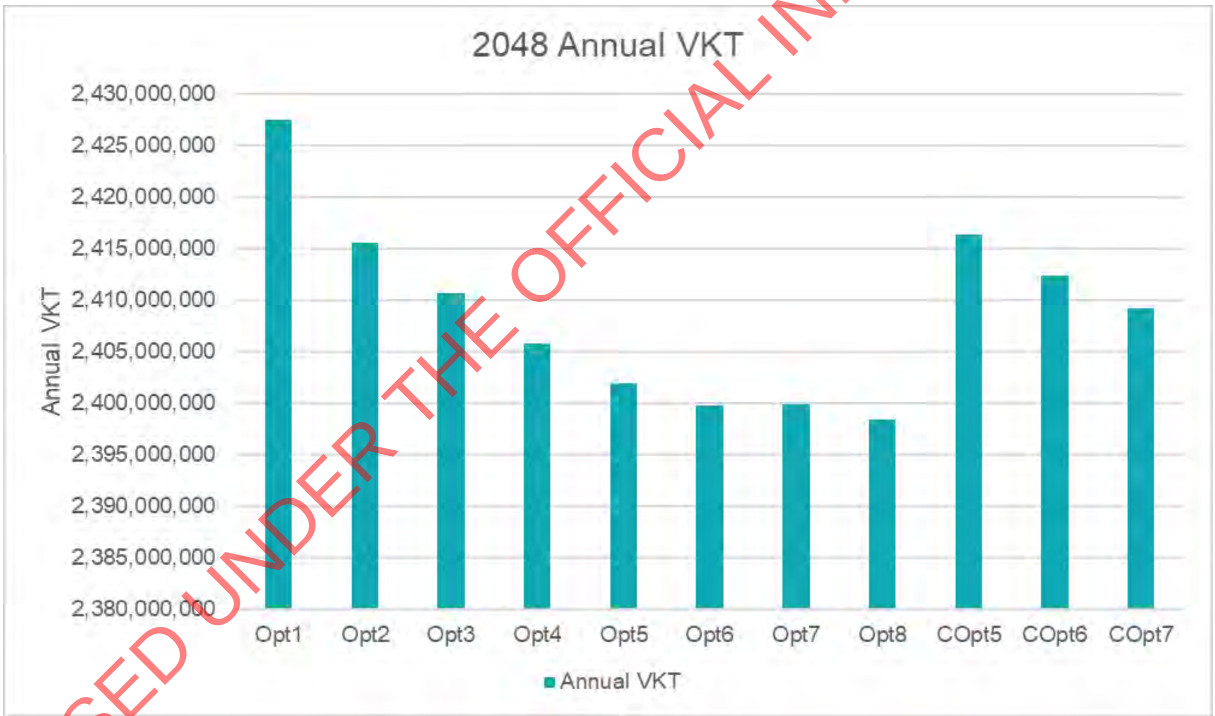

Figure 4-29: TNL Stage 2 Annual VKT - 2048

Increasing the toll reduces the annual VKT, however the difference between each strategy is not significant.

Enabled Emissions

Figure 4-30 presents the enabled emissions (CO_2e) for each of the Stage 2 strategies tested.

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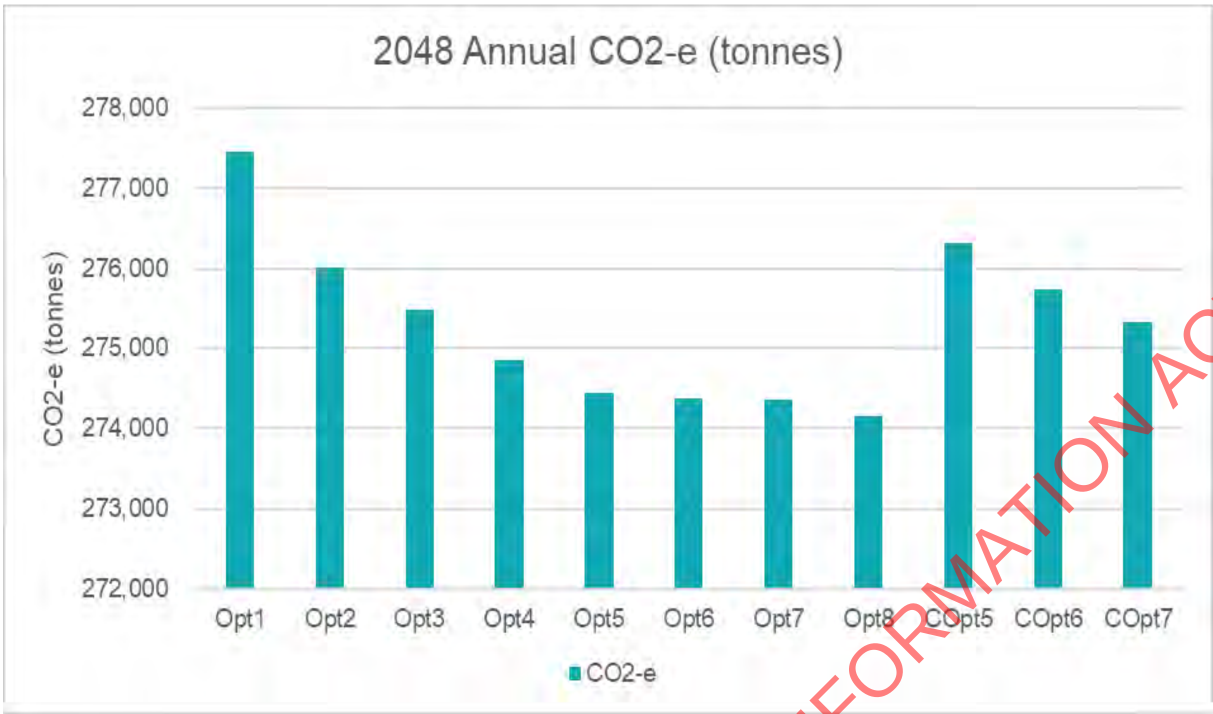

Figure 4-30: TNL Stage 2 Annual CO_2e - 2048

The annual emissions follow the same trend as the VKT, with higher tolls resulting in lower emissions. However, once again the difference between the strategies is not significant.

Safety Implications

Figure 4-31 presents the annual social crash cost for each of the Stage 2 strategies tested.

Figure 4-31: TNL Stage 2 Annual Crash Cost

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The figure demonstrates that the optimum strategy for social crash cost is Option 5, with a social crash cost approximately $2 million lower than the option with the highest crash cost (Option 1 / un-tolled Stage 2). Therefore, tolling of TNL Stage 2 is estimated to contribute towards lowering crash costs and DSIs.

4.5 TNL Stage 1 and Stage 2 Strategy Refinement

4.5.1 Consideration of Time Varying Tolls

There is potential to apply different toll tariffs by time of day. The following points are considered with respect to this option:

- Consistency of toll would be desirable for driver legibility, operating costs, enforcement etc.
- The model suggests there are clear commuter peaks along TNL, which means that the toll tariff could be switched at a discernible and logical point.
- The level of service on the network would benefit from higher suppression and diversion of trips in the commuter peaks. Particularly at the interchange of TNL and Takitimu Drive.

Figure 4-32 shows the model volumes on TNL Stage 1 (Section C) for the AM and PM peak by direction.

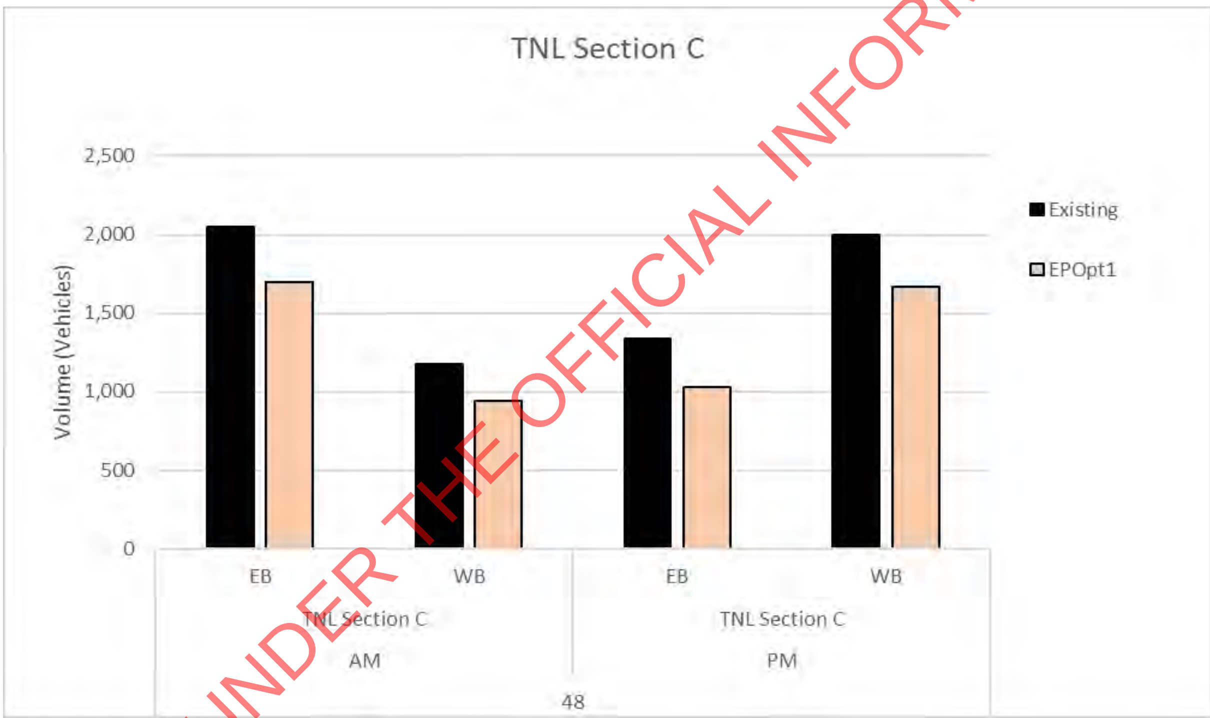

Figure 4-32: TNL Commuter Peak Illustration

The figure demonstrates evidence of commuter peaks, with the peak direction being just under 100% higher than the off-peak direction. For example, in the AM peak, the eastbound (peak direction) flow is just over 2,000 vehicles per hour, while the westbound direction (off-peak direction) is just over 1,000 vehicles per hour.

Four core time-varying toll strategies were modelled as shown in **Table 4-5**.

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Table 4-5: Time-varying toll strategies

Scenario	Stage 1 Peak Toll	Stage 1 Off-peak Toll	Stage 2 Peak Toll	Stage 2 Off-peak Toll
1	$2.40	$1.40	-	-
2	$2.50	$1.25	-	-
3	$2.40	$1.40	$2.40	$1.40
4	$2.50	$1.25	$2.50	$1.25

From these scenarios, the traffic volumes and revenue estimates could be easily combined across different peak and off-peak tolls, creating an additional four scenarios (two for Stage 1 and two for Stage 2).

Figure 4-33 presents ADT flows at key locations for the Stage 1 only scenario for the four time-varying toll strategies.

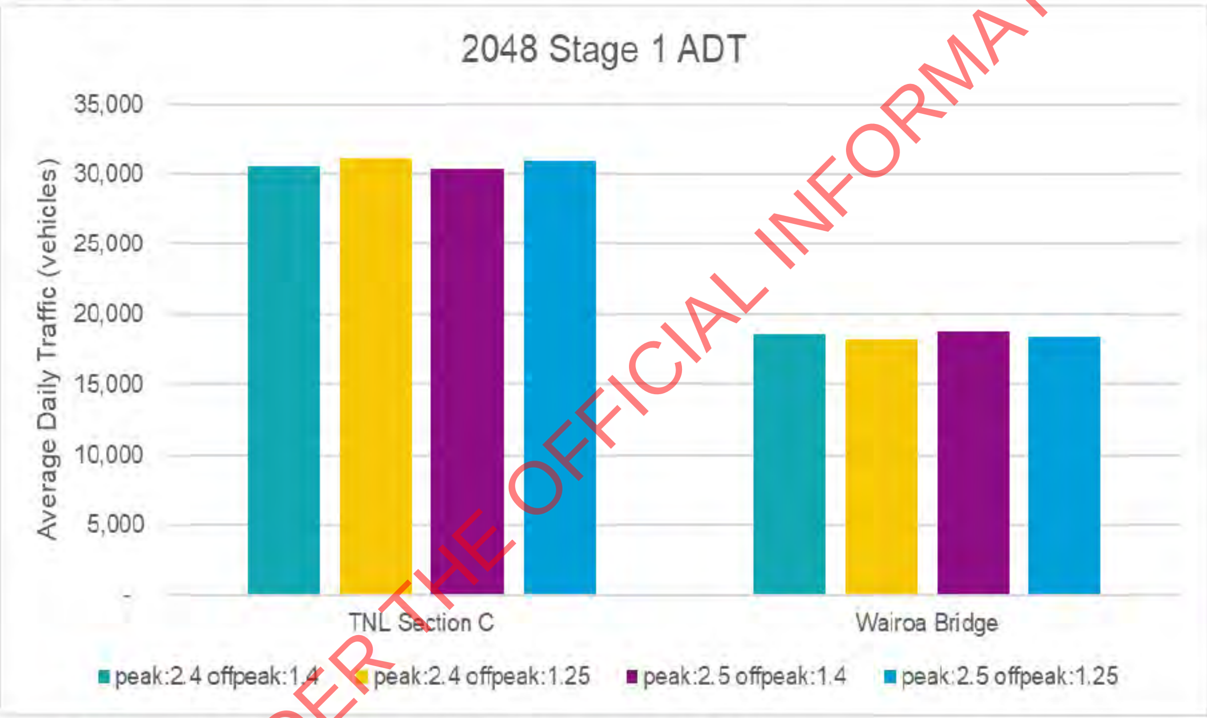

Figure 4-33: 2048 Stage 1 Only scenario ADTs for time-varying toll strategies

Figure 4-34 presents ADT flows at key locations for the Stage 1and 2 scenario for the four time-varying toll strategies.

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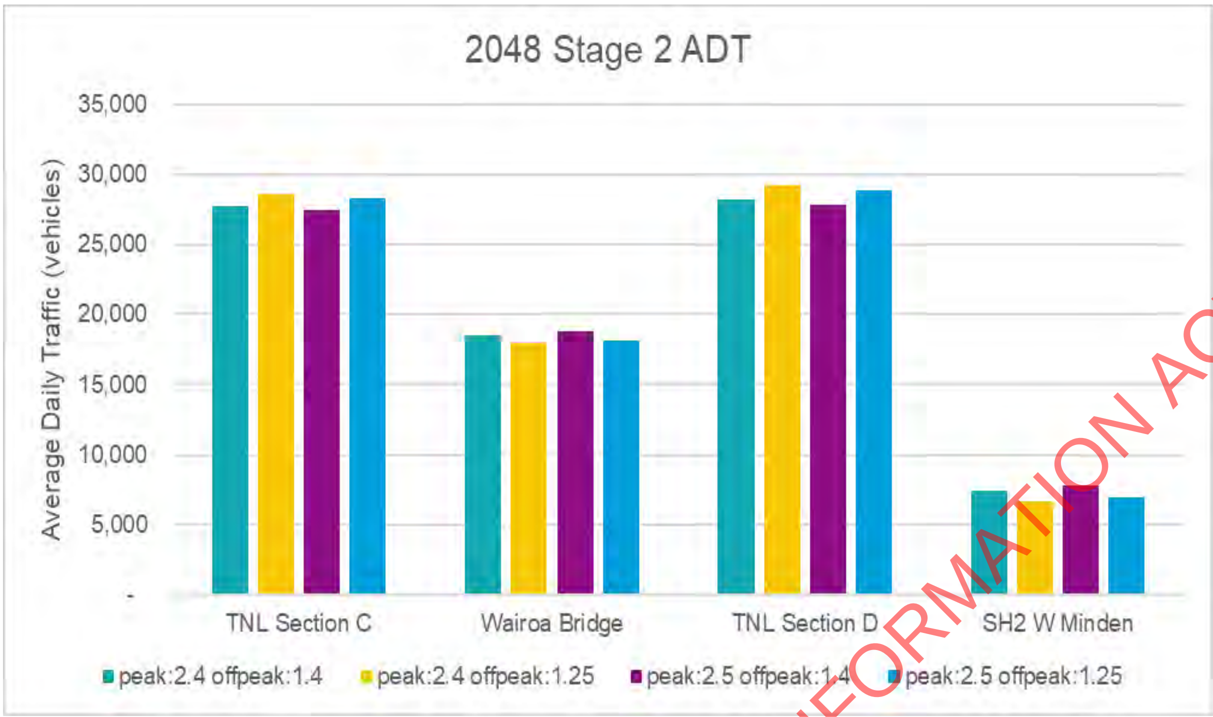

Figure 4-34: 2048 Stage 1 and 2 scenario ADTs for time-varying toll strategies

The following observations can be made from the figures above:

- For the 2048 Stage 1 Only scenario, the time-variable tolling results in just over 30,000 vpd on TNL Stage 1 (section C) and approximately 18,000-19,000 vpd on Wairoa Bridge.
- For the 2048 Stage 1 and 2 scenario, the time-variable tolling results in approximately 28,000 vpd on TNL Stage 1 (section C) and approximately 28,000 vpd TNL Stage 2 (section D). Wairoa Bridge has approximately 18,000-19,000 vpd, while SH2 west of the Minden interchange has traffic volumes of approximately 7,000-8,000 vpd.

The time-varying tolling strategies are able to achieve good diversion outcomes, with a reasonable amount of traffic retained on TNL, and traffic on Wairoa Bridge and SH2 west of Minden below desirable levels of 20,000 vpd and 10,000 vpd respectively.

The following **Figure 4-35** and **Figure 4-36** present the potential revenue estimates for the variable toll strategies tested on Stage 1 Only scenario and the Stage 1 and 2 scenario.

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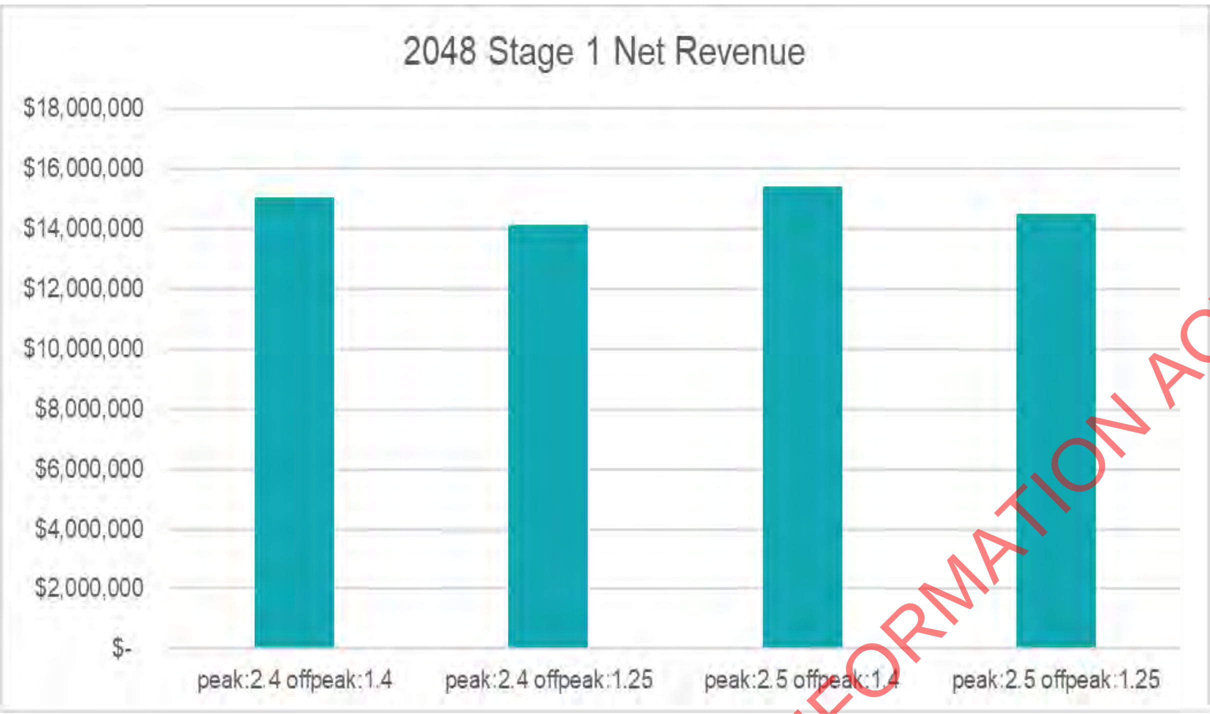

Figure 4-35: 2048 Stage 1 Only scenario Net Revenue

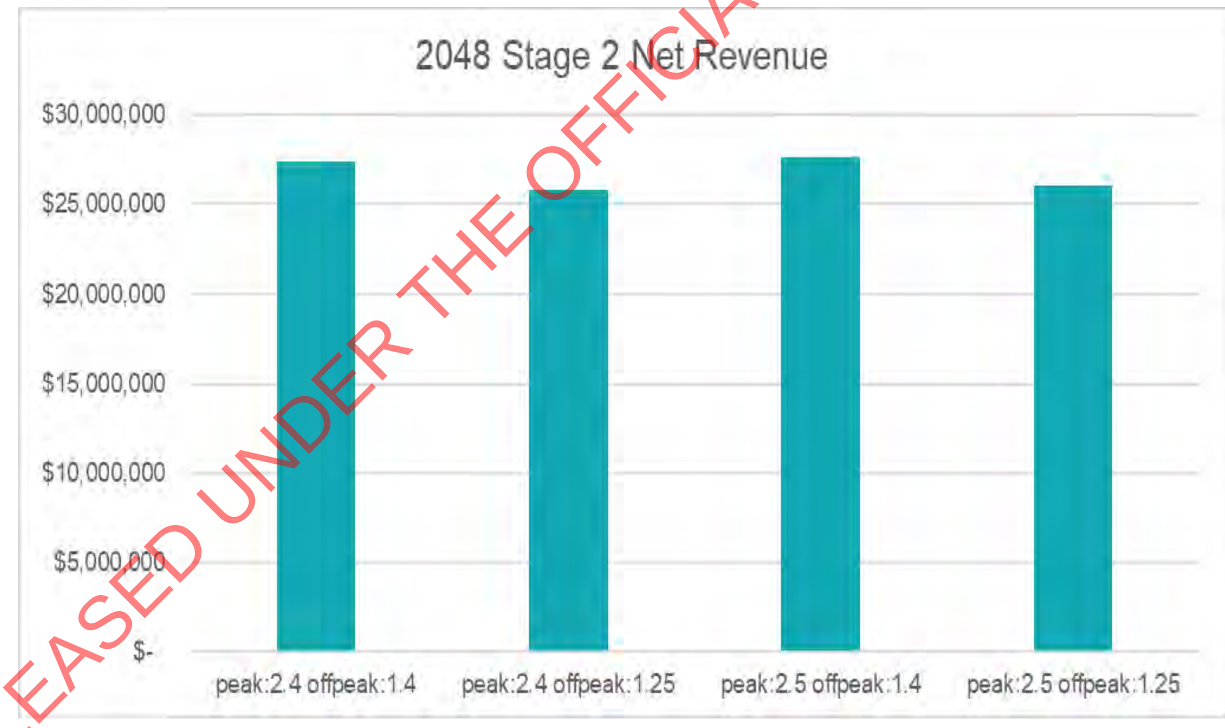

Figure 4-36: 2048 Stage 1 and 2 scenario Net Revenue

The key observation from the figures above is that the revenue estimates are similar to those of the capped scenarios undertaken in the initial Stage 1 and 2 scenario testing, i.e., the revenue is much lower than a consistent all-day toll at the toll levels modelled.

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4.5.2 VKT, Enabled Emissions, Safety Implications

All the time-varying options tested found very limited difference in VKT, enabled emissions and social crash cost i.e., the difference was less than 1% between the scenarios.

4.5.3 Consideration of Vehicle Differentials

Due to the existing toll on Takitimu Drive, and all strategies maintaining this same through movement toll (assuming it has not expired), it is recommended to maintain the same or similar ratio of heavy vehicle toll to light vehicle toll (2.63) for heavy vehicles.

4.6 Development of the Preferred TNL Strategy

The following points and observations have been made with respect to selection of a preferred TNL strategy:

- Option 5 (all-day toll of $2.10, with no capping) was deemed to have too much diversion and risk to the alternative routes
- Capping or time-varying tolls limit the diversion to within acceptable limits
- The capping and time-varying tolls tested lost a significant proportion of revenue compared to the all-day, no capping tolls
- Tolls for the full through movement (users of both Stage 1 and Stage 2) were deemed acceptable at approximately $3.50 or less for the off-peak periods
- Higher off-peak tolls are better for VKT / Emissions / Crash outcomes
- Higher peak tolls are better for achieving good level of service outcomes in the commuter peaks
- Higher peak tolls are better for travel demand outcomes (peak spreading, mode shift etc.)

In consideration of the points made above, the model scenarios undertaken, the desire to maintain a toll system with good user perception and to enable a staged approach for Stage 1 and Stage 2 if required, the preferred toll strategy has been developed, as outlined in **Table 4-6**.

Table 4-6: Preferred Toll Strategy

Peak	Stage 1 / Stage 2	Stage 1 and Stage 2 (Through)
Peak	$3.10	$4.10
Off-peak	$2.10	$3.10

Further details of the strategy and the outcomes of this strategy are described in the next section.

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5 Preferred tolling strategy

5.1 Introduction

The preferred tolling strategy for TNL combines both discounting / capping for the through movement (users of TNL Stage 1 and Stage 2) and time-varying tolling, with tolls increased in the commuter peaks. For the purpose of modelling, the commuter peaks have been defined as 7am – 9am and 4pm – 6pm.

The schedule of tolls for light vehicles is shown in **Table 5-1**.

Table 5-1: Schedule of tolls for light vehicles

Peak	Stage 1 / Stage 2	Stage 1 and Stage 2 (Through)
Peak	$3.10	$4.10
Off-peak	$2.10	$3.10

The incremental toll strategy uses the following logic:

- A starting off-peak toll of $2.10 – maintains good revenue and other network outcomes, whilst maintaining an acceptable level of diversion
- Consistent tolls between TNL Stage 1 and Stage 2
- A $1 increase in toll for using both Stage 1 and Stage 2
- A $1 increase in toll in the commuter peaks

Beca issued a draft report TNL tolling study in 2022 with outcomes for the preferred tolling strategy. In Spring 2023 Beca was asked by Waka Kotahi to update the preferred tolling strategy in the context of a number of future year scheme assumptions. The updated input assumptions were:

- Assume the PEI toll is implemented
- Include Cameron Road Stage 2 as part of 2031 transport network
- Assume the Spine Road connection enabling works implemented post-2031
- PT services updated based on the TTSM Do Something PT Services
- Assume latest future year CBD Parking charge assumptions
- Update of the transaction cost in revenue estimates from 70c per transaction to 80c per transaction
- Tauriko network assumptions
- TNL assumed to have no managed lanes
- Update of the TNL (Stage 2) design[5]

The comparison between outcomes from the 2022 modelling assumptions and outcomes from the 2023 modelling did not lead to any changes in the preferred tolling strategy.

In March 2024, some additional work was undertaken by Beca to test the sensitivity of the model's prediction of the crash costs to speed and road type assumptions on the existing SH2. The findings from this testing are described in section 5.8on Safety. However, as part of this work an error was found in the 2031 No Toll scenario toll assumption for TEL. This error was corrected and the 2031 No Toll scenario was re-run. The crash, VKT and emissions impacts of the toll described in the section reflect this correction. Other metrics described in this section were not impacted by this correction (because the error was sufficiently geographically distant from TNL as to not have a material impact).

[5] Takitimu North Link Stage 2 Preliminary Design dated 24 February 2023 (23.07.01_DRAFT Specimen Design Drawings_v15.pdf)

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5.2 Hourly Traffic flows

5.2.1 Stage 1 Only scenario

In the Stage 1 Only scenario, the preferred toll strategy diverts a relatively high proportion of traffic off TNL and back to the existing SH2. Table **5-2** presents the forecast 2031 average hour traffic flows at Wairoa River longitude - without and with tolling for each respective time period.

Table 5-2: 2031 Average hour traffic flows at Wairoa River longitude - without and with tolling by time period

		Existing SH2 at Wairoa River				TNL at Wairoa River			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	410	1057	647	158%	1600	852	-748	-47%
	Outbound	325	651	326	100%	872	455	-417	-48%
	Both directions	**735**	**1708**	**973**	**132%**	**2472**	**1307**	**-1165**	**-47%**
IP	Inbound	274	626	352	128%	1143	662	-481	-42%
	Outbound	332	640	308	93%	1074	632	-442	-41%
	Both directions	**606**	**1266**	**660**	**109%**	**2217**	**1294**	**-923**	**-42%**
PM	Inbound	293	704	411	140%	980	468	-512	-52%
	Outbound	517	1114	597	115%	1537	818	-719	-47%
	Both directions	**810**	**1818**	**1008**	**124%**	**2517**	**1286**	**-1231**	**-49%**

5.2.2 Stage 2 scenario

In the Stage 2 scenario, the traffic diversion as a result of the toll is less that in the Stage 1 scenario. The preferred toll strategy diverts a relatively high proportion of traffic off TNL and back to the existing roads. **Table 5-3** to **Table 5-5** present the average hour traffic flows at Wairoa River longitude - without and with tolling for each respective time period.

Table 5-3: 2031 traffic flows at Wairoa River longitude - without and with tolling by period

		Existing SH2 at Wairoa River				TNL at Wairoa River			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	456	984	528	116%	1765	1029	-736	-42%
	Outbound	385	687	302	78%	1027	524	-503	-49%
	Both directions	**841**	**1671**	**830**	**99%**	**2792**	**1553**	**-1239**	**-44%**
IP	Inbound	294	593	299	102%	1183	697	-486	-41%
	Outbound	359	623	264	74%	1109	649	-460	-41%
	Both directions	**653**	**1216**	**563**	**86%**	**2292**	**1346**	**-946**	**-41%**
PM	Inbound	338	710	372	110%	1177	575	-602	-51%
	Outbound	577	1047	470	81%	1734	1011	-723	-42%
	Both directions	**915**	**1757**	**842**	**92%**	**2911**	**1586**	**-1325**	**-46%**

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Table 5-4: 2031 traffic flows west of the Minden Interchange longitude - without and with tolling by period

		Existing SH2 West of the Minden Interchange				TNL West of the Minden Interchange			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	177	570	393	222%	1501	913	-588	-39%
	Outbound	142	404	262	185%	990	539	-451	-46%
	Both directions	**319**	**974**	**655**	**205%**	**2491**	**1452**	**-1039**	**-42%**
IP	Inbound	133	311	178	134%	1015	650	-365	-36%
	Outbound	122	305	183	150%	1012	633	-379	-37%
	Both directions	**255**	**616**	**361**	**142%**	**2027**	**1283**	**-744**	**-37%**
PM	Inbound	149	429	280	188%	1065	570	-495	-46%
	Outbound	156	547	391	251%	1650	1021	-629	-38%
	Both directions	**305**	**976**	**671**	**220%**	**2715**	**1591**	**-1124**	**-41%**

Table 5-5: 2048 traffic flows at Wairoa River longitude - without and with tolling by period

		Existing SH2 at Wairoa River				TNL at Wairoa River			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	539	962	423	78%	2051	1413	-638	-31%
	Outbound	483	728	245	51%	1180	730	-450	-38%
	Both directions	**1022**	**1690**	**668**	**65%**	**3231**	**2143**	**-1088**	**-34%**
IP	Inbound	336	617	281	84%	1391	923	-468	-34%
	Outbound	410	682	272	66%	1293	826	-467	-36%
	Both directions	**746**	**1299**	**553**	**74%**	**2684**	**1749**	**-935**	**-35%**
PM	Inbound	425	717	292	69%	1360	829	-531	-39%
	Outbound	674	1069	395	59%	1963	1305	-658	-34%
	Both directions	**1099**	**1786**	**687**	**63%**	**3323**	**2134**	**-1189**	**-36%**

Table 5-6: 2048 traffic flows west of the Minden Interchange longitude - without and with tolling by period

		Existing SH2 West of the Minden Interchange				TNL West of the Minden Interchange			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	200	508	308	154%	1841	1321	-520	-28%
	Outbound	163	367	204	125%	1197	790	-407	-34%
	Both directions	**363**	**875**	**512**	**141%**	**3038**	**2111**	**-927**	**-31%**
IP	Inbound	154	340	186	121%	1222	839	-383	-31%

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	Outbound	137	330	193	141%	1211	812	-399	-33%
	Both directions	**291**	**670**	**379**	**130%**	**2433**	**1651**	**-782**	**-32%**
PM	Inbound	205	369	164	80%	1259	862	-397	-32%
	Outbound	142	469	327	230%	1984	1400	-584	-29%
	Both directions	**347**	**838**	**491**	**141%**	**3243**	**2262**	**-981**	**-30%**

5.3 Average daily traffic flow

Figure 5-1 presents the effects of tolling on forecast average daily traffic volumes on TNL for the Stage 1 Only scenario and the Stage 1 and 2 scenario.

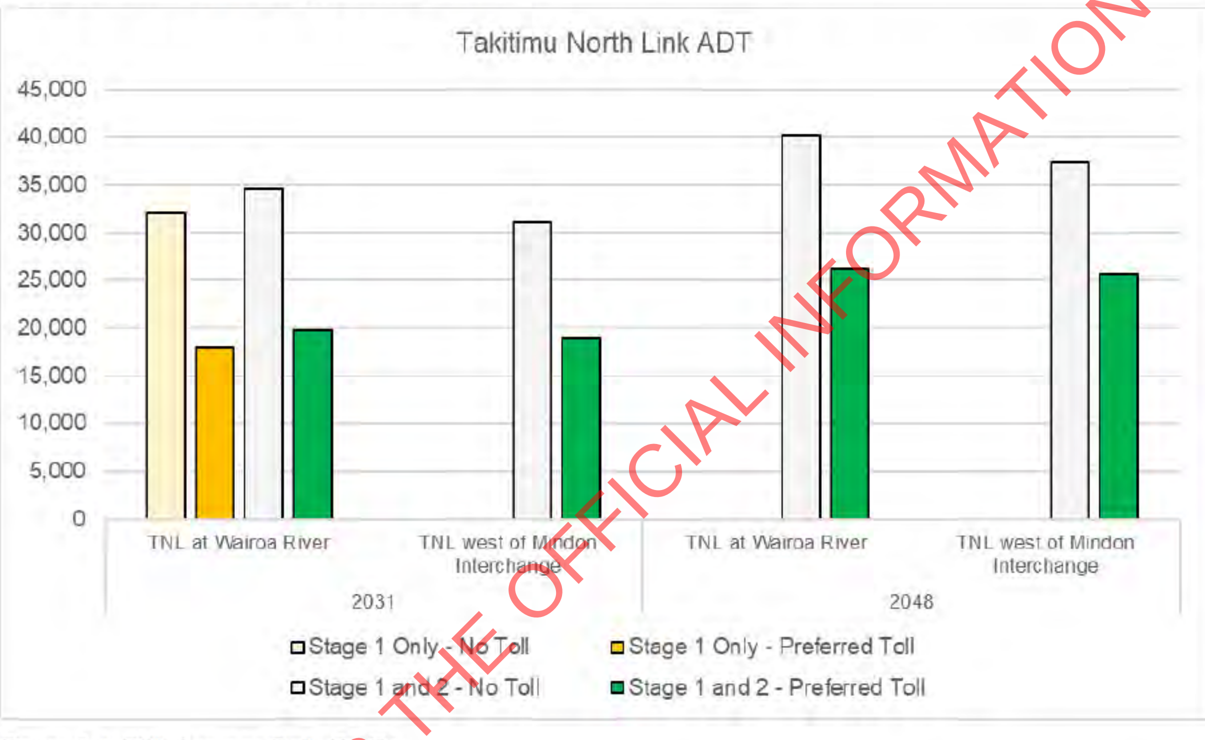

Figure 5-1: TNL Average Daily Traffic

Figure 5-2 presents the effects of tolling on forecast traffic volumes on the alternative route: Wairoa Bridge and SH2 West of the Minden Interchange.

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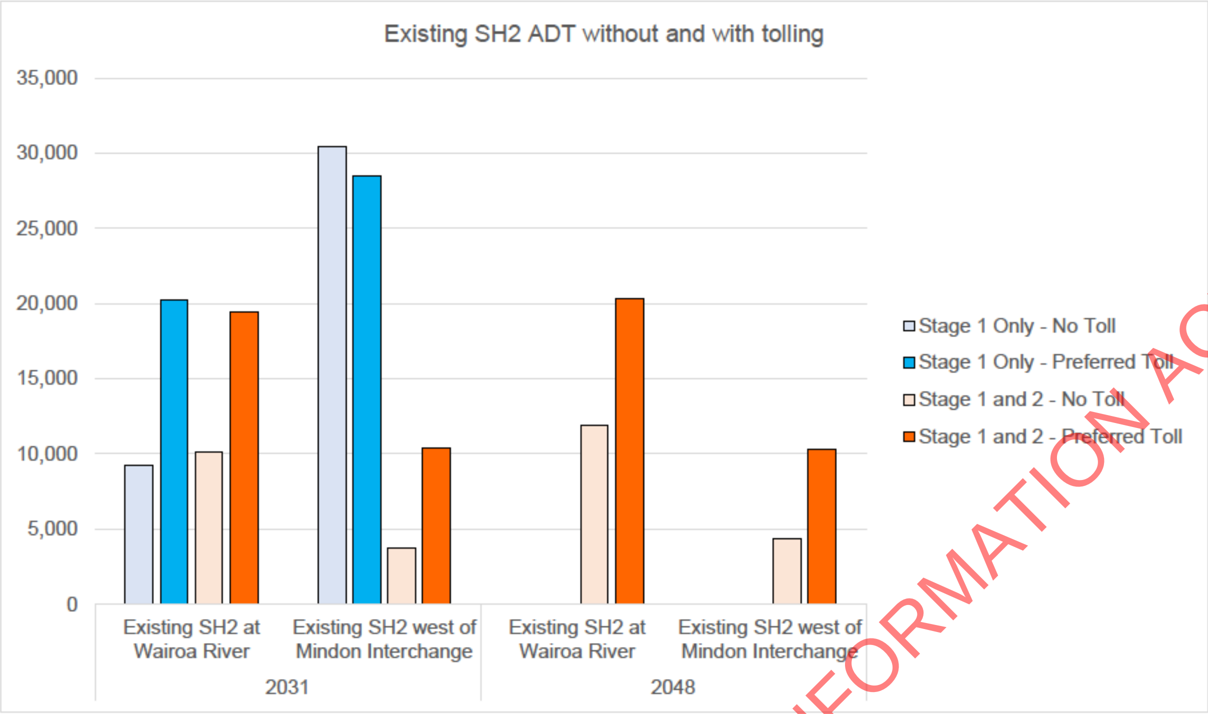

Figure 5-2: Alternative Route Average Daily Traffic

The plots demonstrate that the amount of traffic on the key location of Wairoa Bridge is very slightly above the desired threshold of 20,000 vehicles per day in 2031 in the Stage 1 Only scenario with the preferred toll, and the 2048 Stage 1 and 2 scenario with the preferred toll. The volume on State Highway 2 west of the Minden interchange remains near or below 10,000 vehicles per day in both 2031 and 2048 regardless of whether the toll is in place.

Flow difference plots for the Emerging Preferred Options are provided in **Appendix E.**

5.4 Journey times

The AM peak period journey times for the Omokoroa-CBD journey for 1) via the existing SH2 route and 2) via TNL route (as in the **Figure 5-3** and **Figure 5-4**) were extracted from the models and the results are summarised in **Table 5-7 to Table 5-9** below.

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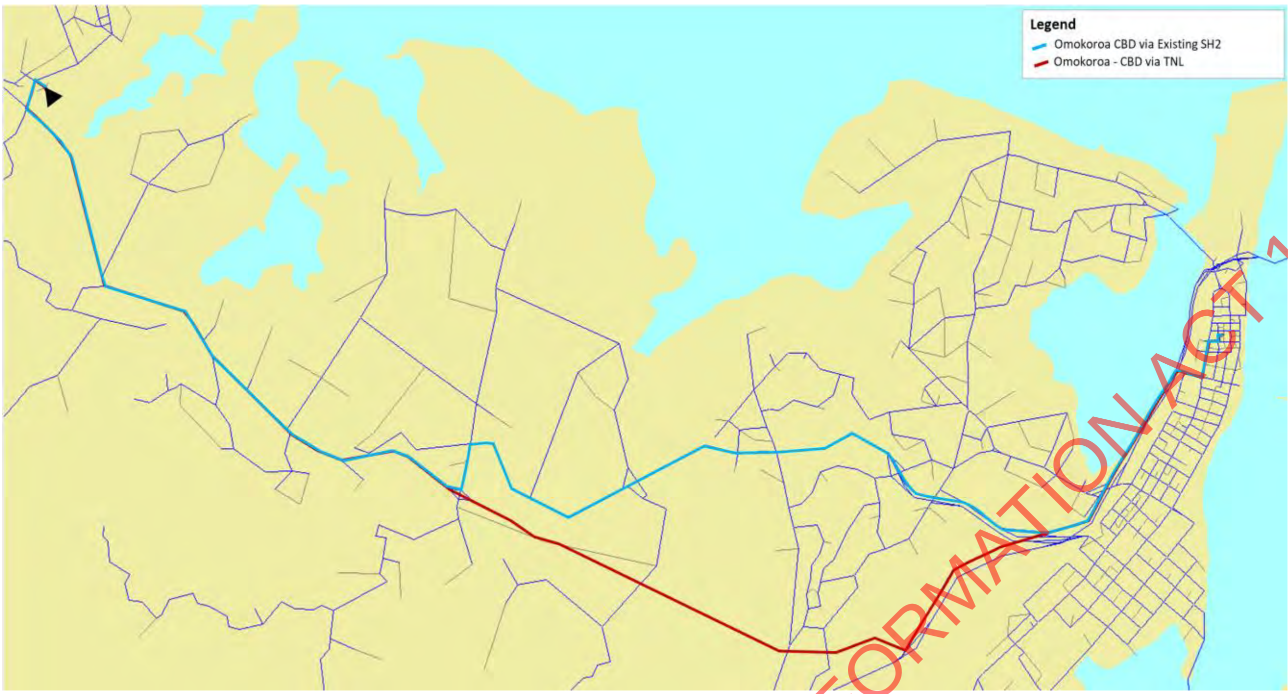

Figure 5-3: Travel Time Routes - Stage 1 Only scenarios

Figure 5-4: Travel Time Routes - Stage 1 and 2 scenarios

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Table 5-7: Travel Times (in min) - 2031 Stage 1 Only scenarios

		Omokoroa - Tauranga CBD via Existing SH2				Omokoroa - Tauranga CBD via TNL			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	24.5	23.8	-0.6	-2%	21.6	19.4	-2.2	-10%
	Outbound	19.3	19.4	0.1	+1%	16.1	16.0	-0.1	0%
IP	Inbound	19.2	19.1	0.0	0%	16.3	15.9	-0.3	-2%
	Outbound	20.1	20.0	-0.1	0%	17.0	16.7	-0.3	-2%
PM	Inbound	19.3	19.5	0.2	+1%	16.3	16.1	-0.2	-1%
	Outbound	30.6	28.3	-2.3	-8%	27.4	23.6	-3.8	-14%

Table 5-8: Travel Time Summary (in min) - 2031 Stage 1 and 2 Scenarios

		Omokoroa - Tauranga CBD via Existing SH2				Omokoroa - Tauranga CBD via TNL			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	19.1	20.3	1.2	+6%	14.8	14.6	-0.2	-1%
	Outbound	19.1	19.9	0.8	+4%	14.9	14.9	0.0	0%
IP	Inbound	18.8	19.1	0.3	+1%	14.5	14.4	-0.1	0%
	Outbound	19.7	19.7	0.0	0%	15.4	15.3	-0.1	-1%
PM	Inbound	19.4	19.7	0.4	+2%	14.9	14.7	-0.2	-1%
	Outbound	22.1	23.8	1.7	+8%	17.6	17.2	-0.3	-2%

Table 5-9: Travel Time Summary (in min) - 2048 Stage 1 and 2 Scenarios

		Omokoroa - Tauranga CBD via Existing SH2				Omokoroa - Tauranga CBD via TNL			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	19.6	20.5	0.9	+5%	15.5	15.0	-0.4	-3%
	Outbound	19.4	20.0	0.6	+3%	15.1	15.0	0.0	0%
IP	Inbound	19.1	19.5	0.4	+2%	14.8	14.7	0.0	0%
	Outbound	20.3	20.5	0.2	+1%	16.1	16.0	-0.1	-1%
PM	Inbound	19.6	19.8	0.2	+1%	15.1	14.9	-0.2	-1%
	Outbound	24.3	25.5	1.3	+5%	18.0	18.3	0.3	2%

Comparing journey times between the tolled and untolled scenarios provides insights into congestion levels along the existing SH2 corridor when the TNL route is subject to tolls. Furthermore, comparing the journey times on the TNL route under tolled and untolled conditions offers insights into the extent of traffic relief achieved in the tolled scenario.

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For the 2031 Stage 1 only scenario there isn't a significant change in travel times on the existing SH2 corridor, but there is some predicted savings in AM and PM travel times in the TNL route with tolling in place.

For the 2031 Stage 1 and Stage 2 scenario there is an increase in journey time for the tolled scenario by 1.2 min (+6%) inbound in AM Peak and 1.7 min (+8%) outbound in PM Peak. The changes to the travel times on TNL in these scenarios is minor. The 2048 scenario has similar outcomes for travel time as the 2031 scenario.

5.5 Level of Service

The level of service plots for the preferred option demonstrates the following:

For the 2031 scenario with only Stage 1:

- The existing State Highway 2 route through Wairoa Bridge sees a reduction in level of service
- There is a slight improvement in the level of service along TNL Stage 1

For the scenarios with Stage 1 and Stage 2:

- The plots indicate a significant improvement in level of service to the western corridor due to the construction of Stage 2
- There is slight improvement in the level of service along TNL

Level of service plots for the Preferred Option are provided in **Appendix F**.

5.6 Vehicle Kilometres Travelled

Figure 5-5 below presents the change in annual vehicle kilometres travelled for the following scenarios:

- 2031 preferred toll strategy (for Stage 1 Only) compared to a no toll scenario
- 2031 preferred toll strategy (for Stage 1 and 2) compared to a no toll scenario
- 2048 preferred toll strategy compared to a no toll scenario

The values are based on non-risk adjusted traffic volumes.

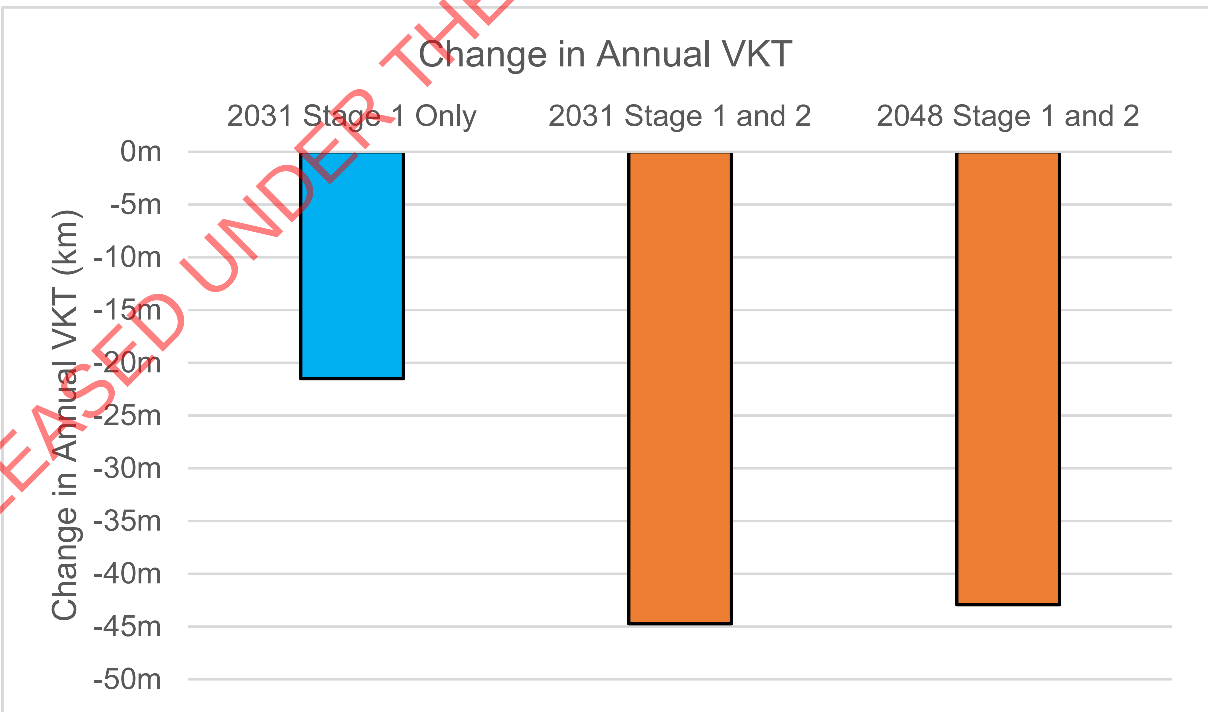

Figure 5-5: Preferred Toll Strategy Change in Annual Vehicle Kilometres Travelled

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As shown in the figure above, VKT reduces for each of the scenarios modelled. Two factors are contributing towards the reduction in VKT; trip redistribution – shorter trips being made as a result of the increase in travel cost, and trip length reduction – some trips that are being made on TNL under the no toll scenario would have a shorter route when priced off TNL due to the change in travel cost.

The model predicts that VKT reduces by approximately 21.4 million kilometres due to the toll strategy in 2031 if only Stage 1 is in place and further reduces by approximately 44.8 million kilometres if both Stage 1 combined with Stage 2 is in place. In 2048, the reduction in VKT is estimated to be 42.9 million kilometres.

5.7 Emissions

Figure 5-6 presents the change in annual CO_2e for the following scenarios:

- 2031 preferred toll strategy (for Stage 1 Only) compared to a no toll scenario
- 2031 preferred toll strategy (for Stage 1 and 2) compared to a no toll scenario
- 2048 preferred toll strategy compared to a no toll scenario

The values are based on the non-risk adjusted traffic volumes.

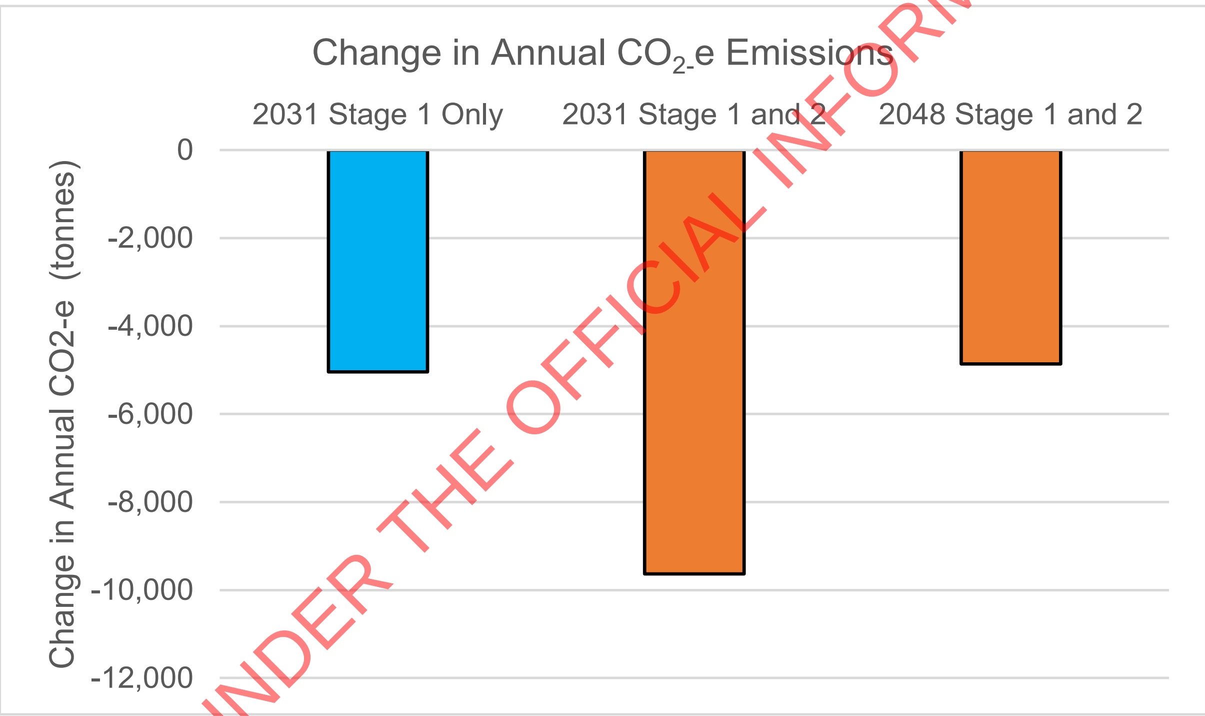

Figure 5-6: Preferred toll strategy change in annual CO_2e

As shown in the figure above, the emissions follow the same trend as the VKT changes. The reduction in emissions reduces in 2048 compared to 2031 largely due to the change in vehicle fleet mix i.e., higher proportions of low emission vehicles, resulting in reductions in emissions rates from road vehicles over time.

The toll strategy is expected to reduce CO_2e by approximately 5,000 tonnes per annum in 2031 if TNL Stage 2 has not been built, or 9,600 tonnes per annum with TNL Stage 2 built. The reduction in CO_2e is estimated at approximately 4,900 tonnes per annum in 2048.

5.8 Safety

Figure 5-7 below presents the change in annual crash costs and DSIs for the following scenarios:

- 2031 preferred toll strategy (for Stage 1 Only) compared to a no toll scenario
- 2031 preferred toll strategy (for Stage 1 and 2) compared to a no toll scenario

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- 2048 preferred toll strategy compared to a no toll scenario

The values are based on non-risk adjusted traffic volumes.

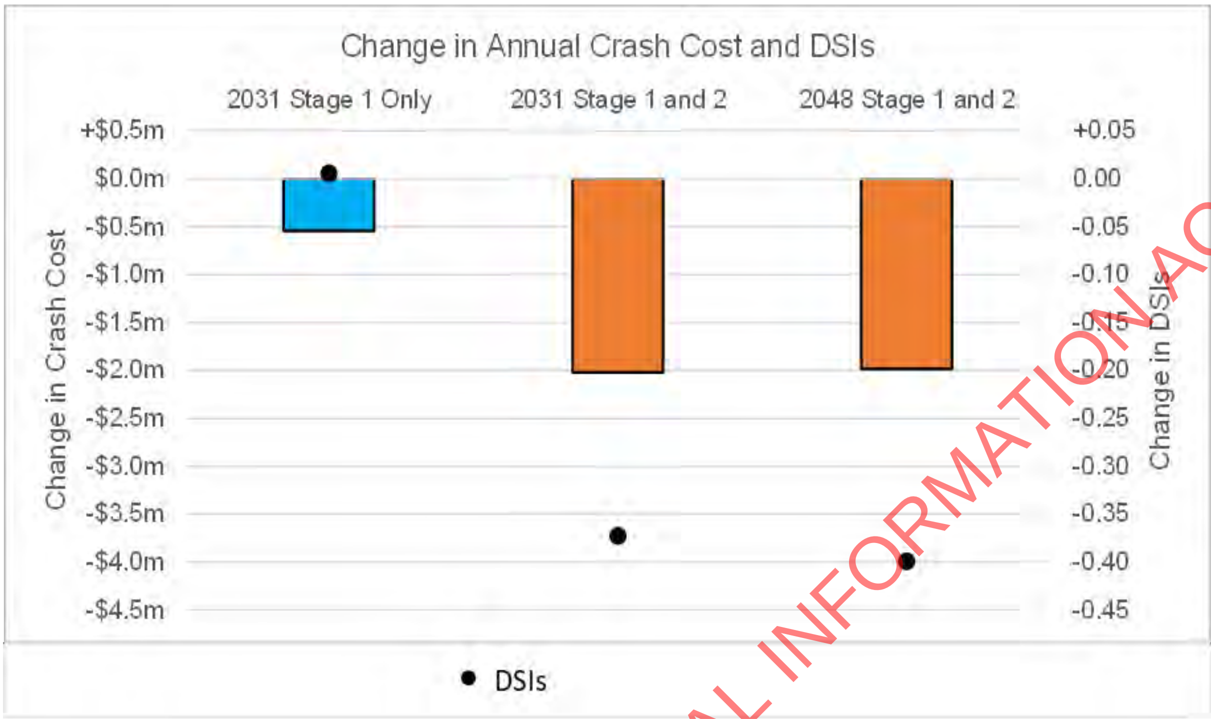

Figure 5-7: Preferred Toll Strategy Change in Annual Crash Costs and DSIs

As shown in the figure, changes in crash costs are predicted by the model to be relatively small and could be considered neutral. This is evident the 2031 Stage 1 Only scenario, where crash costs go down slightly with the toll and DSIs go up very slightly with the toll. In terms of the model predictions in the 2031 Stage 1 Only scenario, the crash cost is estimated to reduce by approximately $500,000 with a 0.1 increase in DSI. In 2031, with Stage 2 in place, the crash cost is estimated to reduce by approximately $2 million with a reduction in DSIs of 0.3. In 2048, the estimated reduction in crash cost is $2 million, with a reduction in DSIs of approximately 0.4.

In March 2024, some additional work was undertaken by Beca under the direction of Waka Kotahi to test the sensitivity of the model's prediction of crash costs to speed assumptions on the existing SH2. The above scenarios assume the speed between Wairoa and Mindon on the existing SH2 is reduced from 80 kph to 70kph in all TNL scenarios and the speed between Mindon and Omokoroa is reduced from 80 kph to 70kph in the TNL Stage 1 and 2 scenarios. In addition to the route choice impacts of speed, this assumption also has an impact on the crash cost rate and DSI rate assumptions: i.e. the crash cost rate and DSI rate assumed on these roads in the model are lower if the speed is assumed to be 70 kph instead of 80 kph. The toll shifts traffic from TNL to the existing SH2, so if the speed on the existing SH2 is assumed to be 70kph instead of 80kph then the diverted traffic is predicted by the model to less crash costs (per vehicle) than if the speed was 80kph. It is important to note that the amount of diverted traffic is also impacted by the speed assumptions on the existing SH2, and that volume is a variable in the calculation of crash costs.

The sensitivity tests modelled a speed of 80 kph on these sections instead of 70 kph in both the No Toll and Toll scenarios. The results re-enforced the assumption that effect of the toll on crash costs and DSI is relatively neutral. With these assumptions, the net-change in crash costs in response to the toll in the 2031 Stage 1 scenario changes to an increase rather than a decrease. The net-change in DSIs in response to the toll in the 2031 Stage 1 and 2 and the 2048 Stage 1 and 2 scenarios changes to an increase with these assumptions, rather than a decrease (while crash costs remain as a small decrease).

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5.9 Revenue

Risk adjusted revenue forecasts for the preferred toll strategy using the 2023 assessment assumptions are provided in Section 6.4 .

5.10 Revenue Maximisation

The purpose of the revenue maximisation test is to determine the toll which generates a maximum revenue for each model year for the project. Higher toll prices were tested in the Stage 1 and Stage 1 and 2 scenarios as shown in **Table 5-10** below.

Table 5-10: Toll Price tests for Revenue Maximisation testing

Scenario	Preferred Option Peak / Interpeak	Toll 2x Peak / Interpeak	Toll 3x Peak / Interpeak
Stage 1	$3.10 / $2.10	$6.20 / $4.20	$9.30 / $6.30
Stage 1 and Stage 2	$4.10 / $3.10	$8.20 / $6.20	$12.30 / $9.30

Additional price tests were then undertaken based on the revenue results. For example, in the Stage 1 scenario, the highest revenue is achieved at twice the preferred toll (Toll 2x) before it begins to decline at three times the preferred toll (Toll 3x). The 2.5x Toll was tested to check that revenue maximization occurs at Toll 2x. A similar trend was observed in Stage 1 combined with Stage 2 for 2031, details shown in **Figure 5-8**. On the other hand, in the year 2048, the highest revenue was attained at 3 times the preferred toll and a further test was done with 3.5x toll to confirm as shown in **Figure 5-10**.

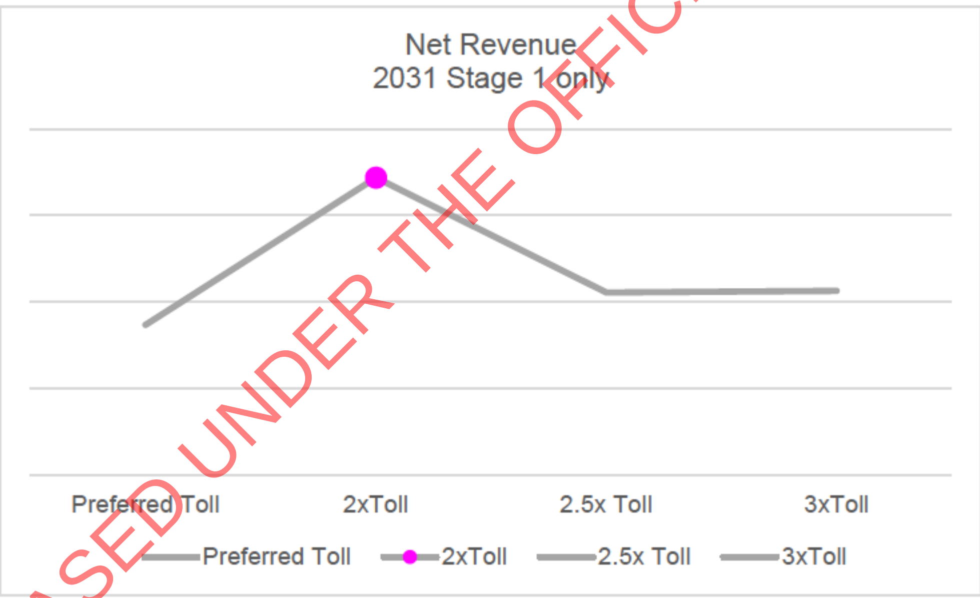

Figure 5-8: Total Toll revenue for Different Toll Options – Year 2031

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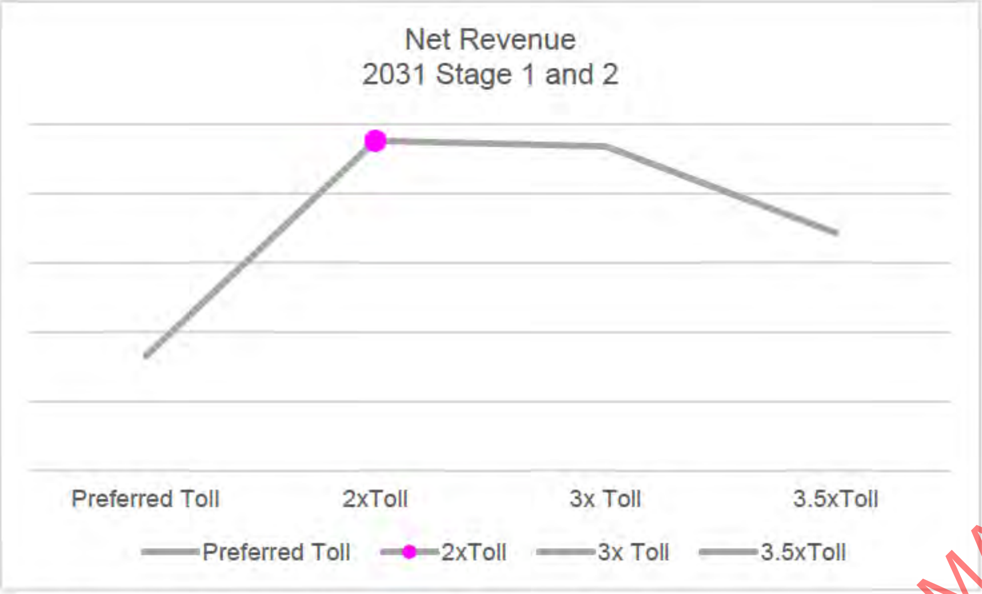

Figure 5-9: Total Toll revenue for Different Toll Options – Year 2048

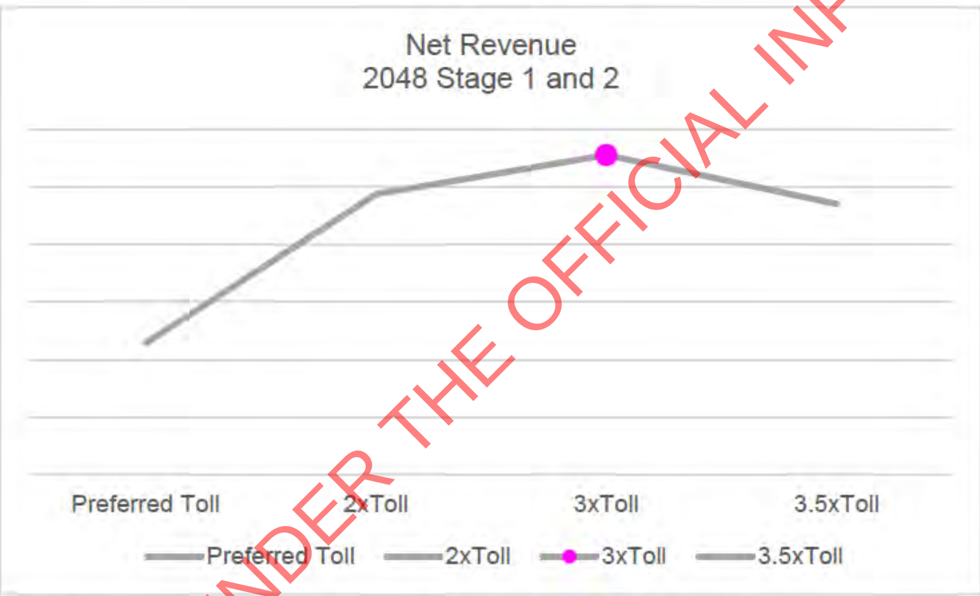

Figure 5-10: Total Toll revenue for Different Toll Options – Year 2048

The gross and net toll revenue obtained from the above tests are presented in **Table 5-11**.

Table 5-11: Gross and Net Toll Revenue in NZ $million

Scenarios	Toll	Annual Gross Toll Revenue ($m)	Annual Net Toll Revenue ($m)
2031 Stage 1	Preferred Toll	$16.6	$12.7
	Max Revenue toll (2x Preferred)	$17.8	$15.6
2031 Stage 1 and Stage 2	Preferred Toll	$26.8	$21.9
	Max Revenue toll (2x Preferred)	$30.2	$27.4
2048 Stage 1 and Stage 2	Preferred Toll	$35.7	$29.3
	Max Revenue toll (3x Preferred)	$46.8	$44.0

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The network impacts for Stage 1 and 2 scenario of the Revenue Maximised Scenario versus the Preferred Toll Strategy scenario are presented in **Table 5-12** below for 2031 and **Table 5-13** for 2048.

Table 5-12: Network impact of Revenue Maximised scenario vs Preferred Toll Strategy scenario - 2031

Measure		Preferred Toll Strategy	Revenue Maximised	Preferred vs Rev Max
ADT TNL	At Wairoa River	19,800	11,700	-8,100 (-41%)
	West of the Minden Interchange	19,000	11,300	-7,700 (-41%)
ADT Existing SH2	At Wairoa River	19,400	25,600	6,200 (+32%)
	West of the Minden Interchange	8,400	16,600	8,200 (+98%)
Annual VKT (km)		2,230,469,000	2,218,874,000	11,595,000 (+1%)
Annual CO_2e (tonnes)		460,000	458,000	2,000 (+0.4%)
Annual Crash Costs ($)		$158,953,000	$158,983,000	-30,000 (-0.02%)
DSI		21.5	21.6	-0.1 (-0.5%)
AM Travel Time - Inbound	Omokoroa - Tauranga CBD via TNL	14.6	14.6	0 (0%)
	Omokoroa - Tauranga CBD via Existing SH2	20.3	23.7	3.4 (+17%)
PM Travel Time - Outbound	Tauranga CBD - Omokoroa via TNL	17.2	17.1	-0.1 (-1%)
	Tauranga CBD – Omokoroa via Existing SH2	23.8	30.9	7.1 (+30%)

Table 5-13: Network impact of Revenue Maximised scenario vs Preferred Toll Strategy scenario - 2048

Measure		Preferred Toll Strategy (Preferred)	Revenue Maximised (Rev Max)	Preferred vs Rev Max
ADT TNL	At Wairoa River	26,200	11,900	-14,300 (-55%)
	West of the Minden Interchange	25,600	12,000	-13,600 (-53%)
ADT Existing SH2	At Wairoa River	20,300	29,100	8,800 (+43%)
	West of the Minden Interchange	10,200	19,900	9,700 (+95%)
Annual VKT (km)		2,683,077,000	2,653,643,000	+29,434,000 (+1%)
Annual CO_2e (tonnes)		275,000	273,000	-2,000 (-0.7%)
Annual Crash Costs ($)		187,967,000	187,522,000	445,000 (+0.2%)
DSI		24.9	25.0	-0.1 (-0.4%)
AM Travel Time - Inbound	Omokoroa - Tauranga CBD via TNL	15.0	14.8	-0.2 (-1%)

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	Omokoroa - Tauranga CBD via Existing SH2	20.5	27.4	6.9 (+34%)
PM Travel Time - Outbound	Tauranga CBD - Omokoroa via TNL	18.3	18.2	-0.1 (-1%)
	Tauranga CBD – Omokoroa via Existing SH2	25.5	35.0	9.5 (+37%)

6 Risk Analysis

6.1 Risks to traffic volume and revenue forecasts

The key risks and uncertainties that could influence the TNL traffic volume forecasts and revenue forecasts were identified in consultation with Waka Kotahi. The risks are catalogued and described in **Table 6-1** below. Items 1 to 10 have impacts on the traffic volumes on the toll road and in turn the revenue forecasts. Item 11 (revenue leakage) and item 12 (transaction costs) only impact the revenue forecasts.

Table 6-1 Risk elements to the traffic volume and revenue forecasts

Risk	Risk Category	Commentary and method of assessment
City wide population growth assumptions	Demand	Tauranga City Population and Dwelling Projection Review 2021 (Growth Allocations 2018-2118) April 2021 provides a plots of Stats NZ Low Medium and High growth assumptions. It is not stated whether Low and High represent 5th and 95th percentile estimates, but we have assumed they do. Based on these figures we have assumed the following adjustments to the traffic volumes forecasts: 2031: High scenario assume +8%, Low scenario assume -5% 2048 High scenario assume +13%, Low scenario assume -13% We note that this ignores suppressed traffic / latent demand effects.
Omokoroa growth assumptions	Demand	In the central forecast Omokoroa is forecast to grow at around 150-170 dwellings per year to 2033, and 135 dwellings per year from 2034 to 2038 and then slowing between 2039 and 2048. Various permutations on the future rates of growth could be tested, but a simplistic method has been adopted for the modelling tests. The Low test assumes growth occurring 30% slower and the High test assumes growth occurring 30% faster (with a 2048 upper limit).
Mode shift	Demand	In this test we assess the potential magnitude of this (cycling, walking, interregional travel, overall less travel, overall less car travel). To do this we changed a number of model assumptions for the test. These were: Public transport penalty (from 2018 calibration) Car ownership response to PT accessibility Central Tauranga parking costs Parking zone, test extension of parking zone to Tauranga Hospital.
WtP - VoT	Demand	A change in willingness to pay is generally defined as increasing or reducing the implied VTTS calculated from the cost parameters obtained from the SP surveys. This is implemented through adjusting the cost parameters used in the utility equation. The Low test assumes 25% lower WTP VoT values and the High test assumes 25% higher WTP VoT values.
WtP - Escalation	Demand	The assessment assumes that the tolls are escalated at the rate of inflation, but that WTP will escalate 1% faster. Low scenario assumes 0%, high scenario assumes 1.5%.
ASC values	Demand	Alternative Specific Constant (ASC) is a more intangible variable that represents motorists' perceptions of the toll road, such as the relative safety, reliability, convenience, and

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		general attractiveness, relative to the alternative. TEL ASC is -1 minutes and Takitimu Drive is -1.5 minutes The Low test assumes 0 minutes in 2031 and 2048. The High test assumes -0.5 minutes 2031 and in 2048.
Annualisation	Demand	The annualisation factors used in the central forecast are based on counts across the region. We have tested annualisation factors derived from counts on TEL.
VoC values in future year	Demand	We have tested alternative values of vehicle operating costs. One test assumes 25% lower VoCs in 2031 and 2048. The second test assumes 25% higher VoCs 2031 and in 2048.
Logit model	Demand	As part of the TTSM, there is a logit-based toll route response model. This utilises a logit function to estimate users' choice between a tolled route and un-tolled route. The logit model can only be applied to simple toll schemes. The strategies developed for TNL are too complex for the logit model, therefore a simple strategy was tested in both the logit model and the path-based model, with the differences being applied to the more complex strategies.
Toll expiry	Demand	The toll on Takitimu Drive is estimated to expire by 2030. The final results assume this toll is not in operation for either 2031 or 2048 modelled years. The sensitivity assumes that the toll is still in operation in the 2031 modelled year.
Revenue leakage	Revenue	The assessment assumed a 3% loss of revenue for lights and 2% for Heavies from non-payments. The risk analysis assumes 2% loss for lights and 1% loss for HCVs for high test and assume 5% for lights and 4% for HCVs for the low test.
Transaction costs	Transaction costs	The assessment assumes a transaction cost of 80 cents. For the low test we assume this might increase to 90 cents, for the high test we assume this may reduce to 75 cents.

6.2 Method

There are three components of demand on TNL that contribute to the revenue forecasts. These are:

1. Demand on TNL Stage 1, but not on TNL Stage 2 (named 'Stage 1 Only demand')
2. Demand on TNL Stage 2, but not on TNL Stage 1 (named 'Stage 2 Only demand')
3. Demand for both TNL Stage 1 and TNL Stage 2 (named 'Through' demand)

As each component of demand contributes to revenue, and with Through demand having a different toll amount to Stage 1 Only demand and Stage 2 Only demand, each component of demand has been treated individually in the risk analysis.

Some risk items impact each component of demand differently, but the impact would be similar across the two forecast years. For example, the Takitimu Drive toll continuation impacts Stage 1 demand to a greater degree than Stage 2 demand, but the impacts are expected to be reasonably similar across each forecast year.

Some risk items will have different impacts in different years. For example, the VoT escalation assumptions is of greater significance in the later years than in earlier years.

Some risks will have different effects on each demand component and for each forecast year. The land use assumptions are an example of this.

The 5th percentile, 50th percentile and 95th percentile forecasts were determined using a Monte Carlo simulation to combine results of a number of sensitivity tests concerning the key risks to the traffic volume and revenue forecasts. The sensitivity tests involve defining a range of potential values for an uncertain variable in the modelling or revenue forecasts calculations, and reviewing the variation in the forecast as the

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variable changes within the range. **Appendix G** provides the full set of risk adjustment parameters by movement and year.

Figure 6-1 below provides an example of the risk adjustment factors for demand on TNL through demand in 2031. As shown in the plot, the combined effect of the various willingness to pay tests (VoT, Escalation and ASC) has the greatest impact on the flows. When all risk factors are combined, the resulting 50th percentile factor is 0.96, the 5th percentile factor is 0.82 and the 95th percentile factor is 1.06.

	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.06	1.01	1.00	1.02	1.01	1.04	1.03	1.03	1.00	1.01	1.06
5th	0.97	0.98	0.99	0.97	0.94	0.90	0.97	1.00	0.85	1.00	0.82
50th	1.01	1.00	0.99	1.00	0.98	0.98	1.00	1.00	1.00	1.00	0.96

Figure 6-1 Example of the risk adjustment factors for TNL Stage 1 Only demand in 2031

6.3 Final Risk adjustment factors

Figure 6-2 presents the 5th, 50th and 95th percentile risk adjustment factors for traffic volumes for each demand component for each forecast year, 2031 and 2048.

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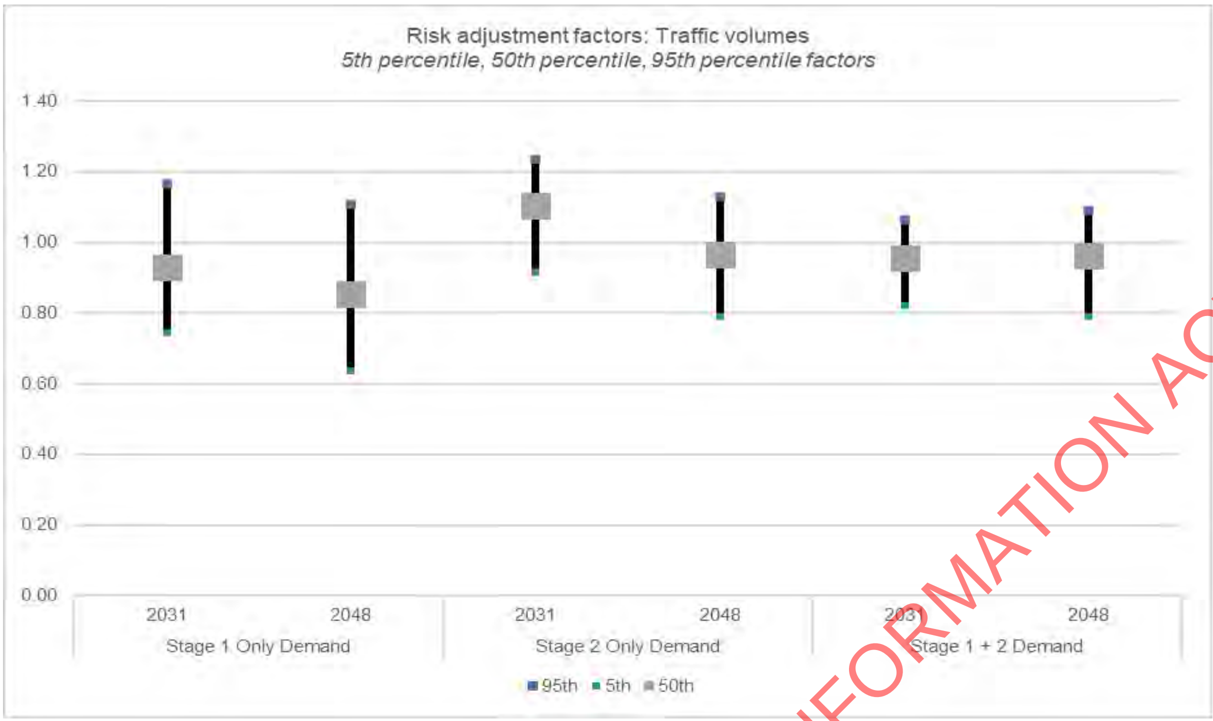

Figure 6-2 Risk adjustment factors: Traffic Volumes

Figure 6-3 presents the 5th, 50th and 95th percentile risk adjustment factors for revenue leakage for each demand component for each forecast year, 2031 and 2048. As shown, the revenue leakage risk adjustment factors are the same for all sections and all years.

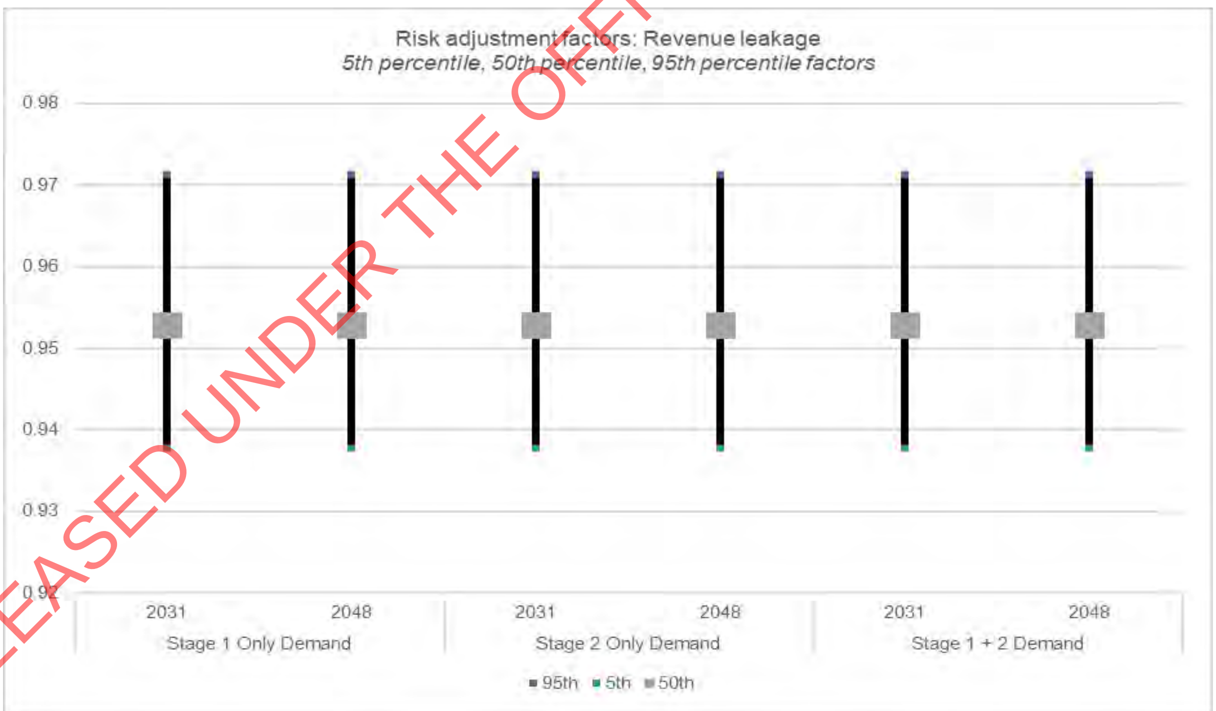

Figure 6-3 Risk adjustment factors: Revenue Leakage

Figure 6-4 presents the 5th, 50th and 95th percentile risk adjustment values for transaction costs for each demand component for each forecast year, 2031 and 2048.

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Figure 6-4 Risk adjustment: Transaction Costs

6.4 Results

The forecast 50th percentile average daily flows on TNL are presented in **Table 6-2** below.

Table 6-2 50th Percentile average daily flows

Year	Forecast average daily flows by movement		
	Users of Stage 1 Only	Users of Stage 2 Only	Users of Stage 1 and 2
2031 (Stage 1 toll only scenario)	15,400	-	-
2031 (Stage 1 and 2 scenario)	2,400	2,000	14,500
2048 (Stage 1 and 2 scenario)	3,000	2,900	19,300

The 5th percentile, 50th percentile and 95th percentile forecast average daily flows are presented in **Figure 6-5** below.

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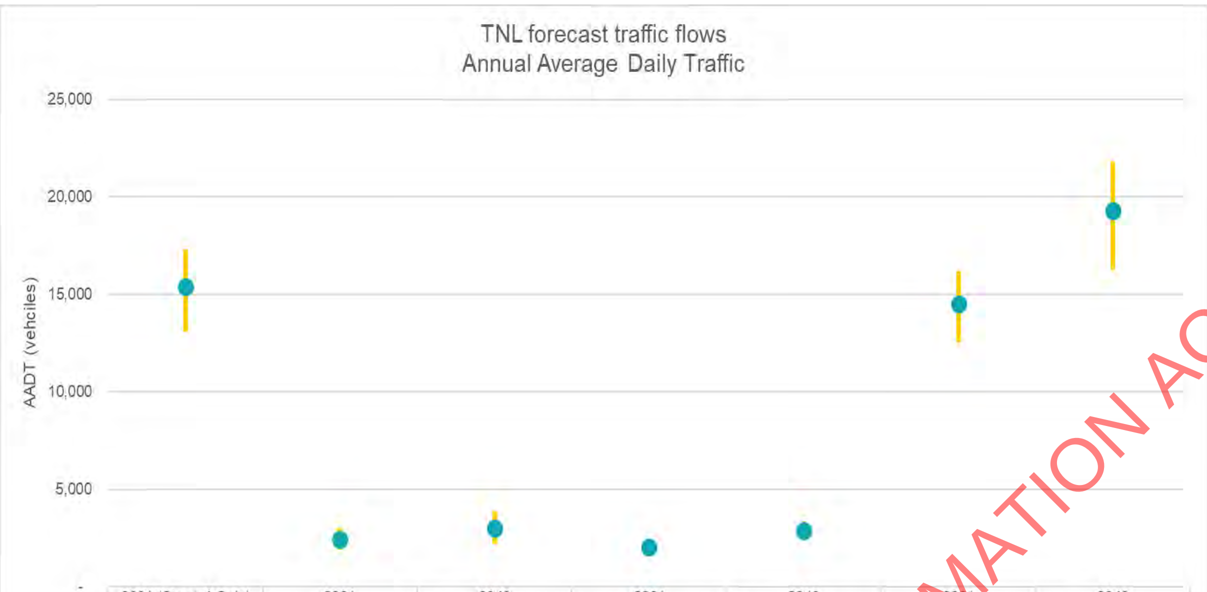

	2031 (Stage 1 Only)	2031	2048	2031	2048	2031	2048
		Stage 1 Only		Stage 2 Only		Stage 1 + 2 (Through)	
5th %ile	13,100	1,900	2,200	1,680	2,360	12,500	16,300
50th %ile	15,400	2,400	3,000	2,030	2,870	14,500	19,300
95th %ile	17,300	3,000	3,900	2,270	3,360	16,200	21,800

Figure 6-5 Forecast average daily flows on TNL

These traffic flows are estimated to generate annual gross revenue[6] of

- $16.6m in 2031 (Stage 1 Only Scenario)
- $26.8m in 2031 (Stage 1 and 2 Scenario)
- $35.7m in 2048 (Stage 1 and 2 Scenario)

With a 50th percentile toll transaction cost of 80c per journey[7] (as advised by Waka Kotahi), the 50th percentile net revenue of the preferred toll strategy is estimated to be:

- *$12.1m in 2031 (Stage 1 Only Scenario)*
- *$21.2m in 2031 (Stage 1 and 2 Scenario)*
- *$28.1m in 2048 (Stage 1 and 2 Scenario)*

This report does not address the level of tolling that is appropriate in order to recover the costs of operating and maintaining TNL, revocation and construction costs as this will be the subject of separate consideration by Waka Kotahi.

The 5th percentile, 50th percentile and 95th percentile forecast net revenue from tolling with the preferred strategy is presented in **Figure 6-6** below.

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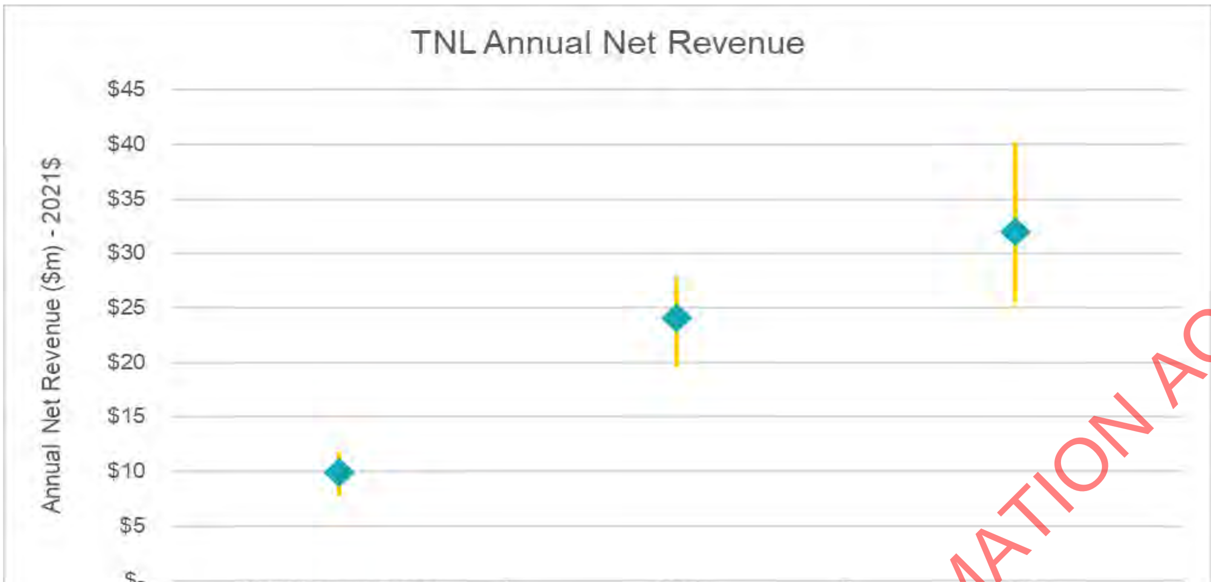
[6] The 50th percentile estimate of gross revenue includes a reduction to account for 'revenue leakage' of 3% for light vehicles and 2% for heavy vehicles.

[7] All revenue forecasts presented in this report exclude the impact of taxes (such as GST) on net revenue.



	2031 (Stage 1 Only)	2031	2048
5th %ile	$7.80	$19.51	$25.49
50th %ile	$9.93	$24.08	$31.98
95th %ile	$11.80	$28.03	$40.24

Figure 6-6 Forecast annual net revenue from tolling

7 Alternate Tolling Scenarios and updated SH2 Revocation assumptions

7.1 Introduction

Alternate tolling scenario tests were undertaken to investigate if revenue from tolling could be increased whilst maintaining traffic on the existing SH2 at Wairoa Bridge below 20,000 vpd. The alternate toll scenarios also assume lower tolls for heavy vehicles (2 times the light vehicles toll rather than 2.5 times the light vehicle toll). The alternate toll scenarios were also tested with updated revocation assumptions on the existing SH2 as provided by Waka Kotahi.

The scenarios are as follows:

- **No Toll Scenario:** The standard No Toll Scenarios for Stage 1 and Stage 1 and 2 scenarios but with updated SH2 revocation network assumptions as presented in Error! Reference source not found..
- **Scenario 1 (S1)**: Lower tolls for heavy vehicles (2 times the light vehicles toll rather than 2.5 times the light vehicle toll). The toll charges for light vehicles are the same as preferred scenario.
- **Scenario 2 (S2)**: All day tolls rather than time varying tolls. Lower peak period tolls, and slightly lower interpeak tolls for traffic using Stage 1 or Stage 2 only, and slightly higher interpeak tolls for traffic using both Stage 1 and 2.

The tolls for the two scenarios are shown in Error! Reference source not found. below.

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Table 7-1: Updated SH2 revocation assumptions used in the Alternate Toll Scenarios

No	Network Intervention Project	No Toll		Tolled	
		Stage 1 2031	Stage 1 and 2 2031/2048	Stage 1 2031	Stage 1 and 2 2031/2048
Road Network					
1	Managed Lane (T2) on existing SH2 through Bethlehem town centre between Te Paeroa Road roundabout and Bethlehem Road roundabout	✓	✓	✓	✓
2	Managed Lane (T2) on existing SH2 between Waihi Road to Cameron Road			✓	✓
3	30km/h through Bethlehem town Centre between Te Paeroa Road roundabout and Bethlehem Road roundabout	✓	✓	✓	✓
4	60km/h through Te Puna town centre	✓	✓	✓	✓
5	50km/h between Wairoa River and Te Paeroa Road roundabout	✓	✓	✓	✓
6	For TNL Stage 1 Only, 80km/h on Loop Road	✓		✓	
7	For TNL Stage 1, 80km/h from Te Puna Road to Wairoa River	✓	✓	✓	✓
8	For TNL Stage 2, 80km/h from Omokoroa Interchange to Loop Road		✓		✓

Table 7-2: Toll assumptions for Scenario 1 and Scenario 1 (the Alternate Toll Scenarios)

Movement	Scenario 1 (S1)				Scenario 2 (S2)	
	Peak		Interpeak		Peak / Interpeak	
	Light	Heavy	Light	Heavy	Light	Heavy
Stage 1 / Stage 2	[redacted] s 9(2)(j)					
Stage 1 and Stage 2 (Through)						

The tests have been undertaken in the future year 2031 for the Stage 1 Only scenario and in the future years 2031 and 2048 for Stage 1 and 2 Scenarios. The Scenario 1 and Scenario 2 are compared against the Preferred Scenario for the following model output statistics:

- Traffic flows
- Vehicle kilometres travelled
- Carbon dioxide emissions
- Toll revenue

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7.2 Traffic Flows

In the Stage 1 Only scenario both the new toll scenarios (S1 and S2) have less diversion on the existing SH2 compared to the Preferred Toll scenario and similar trend follows for the Stage 1 and 2 scenario as presented in **Table 7-3**.

Table 7-4 presents the resulting flows on TNL and the percent change compared to the Preferred Toll scenario. This is due to the combination of speed reduction on the lower existing SH2 and lower tolls for trucks.

In Stage 2 both the scenarios have minor changes in daily flow on both the existing SH2 and TNL compared to the Preferred Toll scenario, shown in

Table 7-5 and **Table 7-6**, respectively. This implies that the impact of reduced tolls on flow is minimal compared to the influence of an increased speed on the existing SH2 from Omokoroa to Loop Road.

Table 7-3: Stage 1 and 2 Traffic Flows for existing SH2 at Wairoa River – Year 2048

Time Period	Direction	TNL at Wairoa River					
		No Toll	Preferred Toll	S1	S2	% change S1 vs Preferred Toll	% change S1 vs Preferred Toll
AM	Inbound	515	962	894	779	-7%	-19%
	Outbound	449	728	681	608	-6%	-16%
	Both directions	**964**	**1,690**	**1,575**	**1,387**	**-7%**	**-18%**
IP	Inbound	319	617	550	563	-11%	-9%
	Outbound	384	682	602	607	-12%	-11%
	Both directions	**703**	**1,299**	**1,152**	**1,170**	**-11%**	**-10%**
PM	Inbound	409	717	666	586	-7%	-18%
	Outbound	653	1,069	989	882	-7%	-17%
	Both directions	**1,062**	**1,786**	**1,655**	**1,469**	**-7%**	**-18%**
Daily	Inbound	5,200	9,700	8,800	8,400	-9%	-13%
	Outbound	6,200	10,600	9,600	9,100	-9%	-14%
	Both directions	**11,400**	**20,300**	**18,400**	**17,500**	**-9%**	**-14%**

Table 7-4: Stage 1 and 2 Traffic Flows for TNL at Wairoa River – Year 2048

Time Period	Direction	TNL at Wairoa River					
		No Toll	Preferred Toll	S1	S2	% change S1 vs Preferred Toll	% change S1 vs Preferred Toll
AM	Inbound	2,053	1,413	1,473	1,604	+7%	+23%
	Outbound	1,194	730	775	863	+11%	+32%
	Both directions	**3,247**	**2,143**	**2,248**	**2,466**	+8%	+26%
IP	Inbound	1,396	923	965	934	+6%	+5%
	Outbound	1,308	826	881	856	+5%	+1%
	Both directions	**2,704**	**1,749**	**1,845**	**1,790**	+5%	+3%
PM	Inbound	1,359	829	874	969	+10%	+33%
	Outbound	1,965	1,305	1,378	1,497	+5%	+19%
	Both directions	**3,324**	**2,134**	**2,251**	**2,466**	+7%	+24%
Daily	Inbound	20,900	13,800	14,400	14,700	+7%	+14%

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	Outbound	19,500	12,400	13,200	13,500	*+5%*	*+10%*
	Both directions	**40,400**	**26,200**	**27,600**	**28,200**	***+6%***	***+12%***

Table 7-5: Stage 1 and 2 Traffic Flows for existing SH2 west of the Minden Interchange – Year 2048

Time Period	Direction	TNL at Wairoa River					
		No Toll	Preferred Toll	S1	S2	% change S1 vs Preferred Toll	% change S1 vs Preferred Toll
AM	Inbound	215	508	564	480	+11%	-6%
	Outbound	168	367	400	329	+9%	-10%
	Both directions	**383**	**875**	**964**	**809**	**+10%**	**-8%**
IP	Inbound	167	340	345	359	+1%	+6%
	Outbound	147	330	329	344	-0%	+4%
	Both directions	**314**	**670**	**674**	**703**	**+1%**	**+5%**
PM	Inbound	218	369	417	322	+13%	-13%
	Outbound	155	469	475	409	+1%	-13%
	Both directions	**373**	**837**	**891**	**731**	**+6%**	**-13%**
Daily	Inbound	2,600	5,200	5,500	5,200	+6%	+0%
	Outbound	2,100	5,000	5,100	4,900	+2%	-2%
	Both directions	**4,700**	**10,200**	**10,600**	**10,100**	**+4%**	**-1%**

Table 7-6: Stage 1 and 2 Traffic Flows for TNL West of the Minden Interchange – Year 2048

Time Period	Direction	TNL at Wairoa River					
		No Toll	Preferred Toll	S1	S2	% change S1 vs Preferred Toll	% change S1 vs Preferred Toll
AM	Inbound	1,822	1,321	1,287	1,374	-3%	+4%
	Outbound	1,189	790	783	856	-1%	+8%
	Both directions	**3,012**	**2,112**	**2,070**	**2,230**	**-2%**	**+6%**
IP	Inbound	1,211	839	847	813	+1%	-3%
	Outbound	1,202	812	826	790	+2%	-3%
	Both directions	**2,412**	**1,651**	**1,673**	**1,603**	**+1%**	**-3%**
PM	Inbound	1,248	862	837	933	-3%	+8%
	Outbound	1,970	1,400	1,417	1,481	+1%	+6%
	Both directions	**3,218**	**2,261**	**2,255**	**2,415**	**-0%**	**+7%**
Daily	Inbound	18,400	12,900	12,800	13,000	-1%	+1%
	Outbound	18,600	12,700	12,800	12,900	+1%	+2%
	Both directions	**37,000**	**25,600**	**25,600**	**25,900**	**+0%**	**+1%**

7.3 Network Impacts

The network impacts for Stage 1 and 2 scenario of the two new toll scenarios versus the Preferred Toll scenario is presented in **Table 7-7** along with the toll revenue estimates. The VKT of the new toll scenarios are similar to the Preferred Toll scenario. However, there is a small increase in crash costs and a reduction in the toll revenue observed for Scenario 1 and Scenario 2 compared to the Preferred Scenario.

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Table 7-7: Network Impact of the Additional Toll Scenarios vs Preferred Scenarios

Year	Scenario	Average Daily VKT[1a]	Average Daily Delays Vehicle Hours Travel	Carbon dioxide equivalent (CO_2e) Kg/day	Crash Costs ($/day)	Annual Gross Toll Revenue[a] (Risk Adjusted 50th %tile, $m)	Annual Net Toll Revenue[a] (Risk Adjusted 50th %tile, $m)
2031	No Toll	6,293,085	24,158	1,300,765	$162,587,773	0	0
	Preferred Toll	6,110,875	23,501	1,261,024	$158,953,279	26.76	21.92
	Scenario 1	6,116,667	23,500	1,263,372	$161,099,511	26.42	20.61
	Change on Scenario 1 vs Preferred Toll	*+0.1%*	*-0.0%*	*+0.2%*	*+1.4%*	*-1.3%*	*-6.0%*
	Scenario 2	6,111,745	23,482	1,262,362	$160,670,256	25.97	19.69
	Change on Scenario 2 vs Preferred Toll	*+0.0%*	*-0.1%*	*+0.1%*	*+1.1%*	*-3.0%*	*-10.2%*
2048	No Toll	7,470,085	34,967	767,499	$191,496,322	0	0
	Preferred Toll	7,350,897	34,065	753,653	$187,966,714	35.74	29.32
	Scenario 1	7,350,157	33,959	754,867	$189,955,159	34.60	27.01
	Change on Scenario 1 vs Preferred Toll	*-0.0%*	*-0.3%*	*+0.2%*	*+1.1%*	*-3.2%*	*-7.9%*
	Scenario 2	7,344,970	33,935	754,548	$189,643,763	32.88	25.00
	Change on Scenario 2 vs Preferred Toll	*-0.1%*	*-0.4%*	*+0.1%*	*+0.9%*	*-8.0%*	*-14.7%*

7.4 Summary

The comparison of the Scenario 1 and Scenario 2 against the Preferred Scenario indicates that there is negligeable change in the vehicle kilometres travelled, delay and the crash cost. Both the scenarios have higher crash cost and lower toll revenue (-8% and -15% net toll revenue change for Scenario 1 and Scenario 2 respectively) making them less favourable than the Preferred Scenario.

8 Tolling New SH29 Four Lane Highway

8.1 Introduction

A tolling test was undertaken in relation to the long-term emerging preferred Tauriko network plan (previously called Option B – Offline[8]). The test evaluated the impact of a toll on the proposed 4-lane corridor which is proposed alongside the existing SH29 from Redwood Lane to Takitimu Drive (referred to in this report as "New SH29"). **Figure 8-1** shows the proposed SH29 four-lane highway and the Long-term transport improvements.

[8] https://www.nzta.govt.nz/projects/tauriko-network-plan

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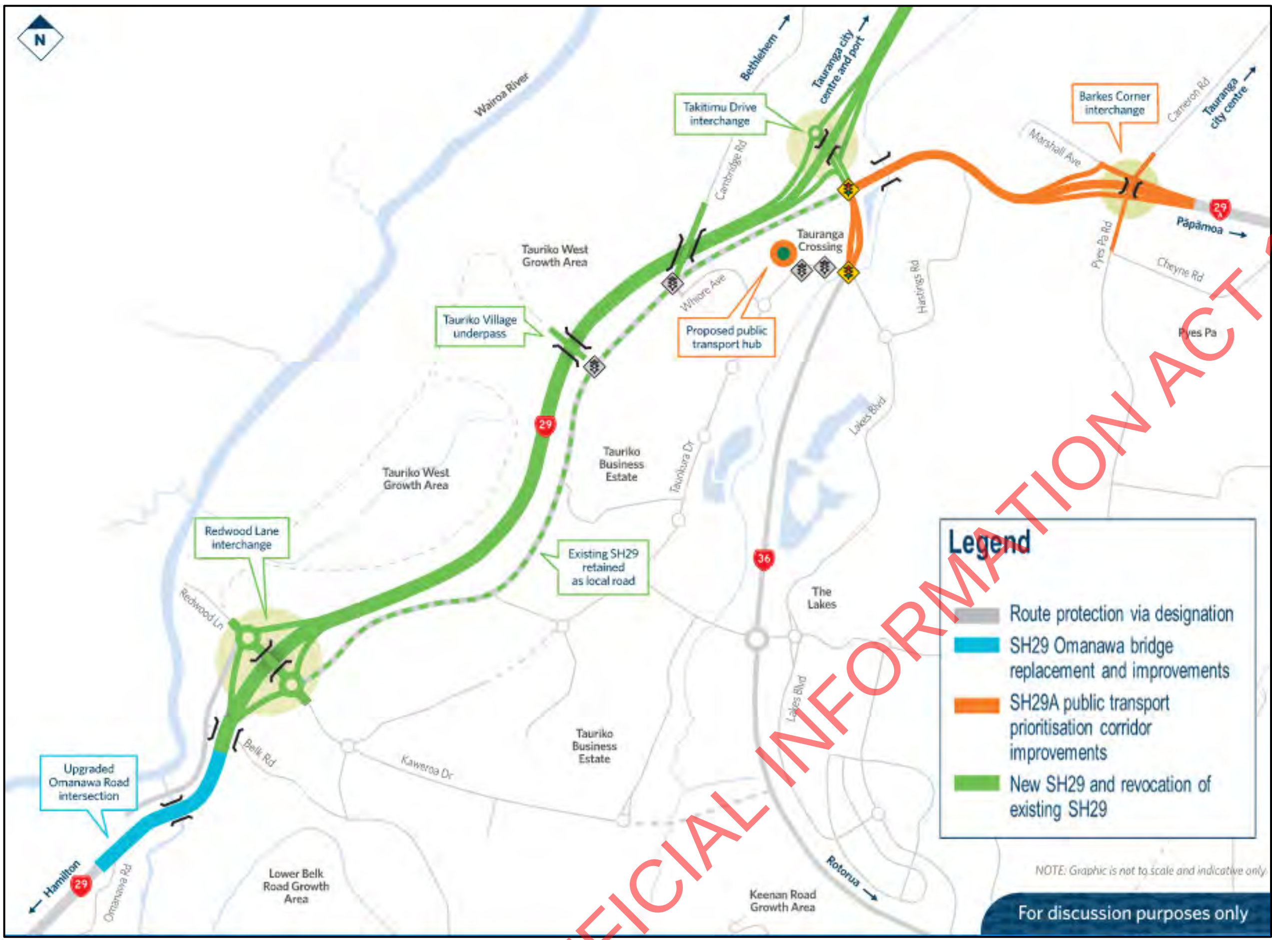

Figure 8-1: New SH29 Four-Lane Highway

The toll gantry location on the New SH29 would be between the Redwood interchange and the Takitimu Drive interchange. This is illustrated in the schematic in **Figure 8-2** but it is noted the precise gantry location is inconsequential to the tolling test, the key point being that it is assumed to be somewhere between the two interchanges.

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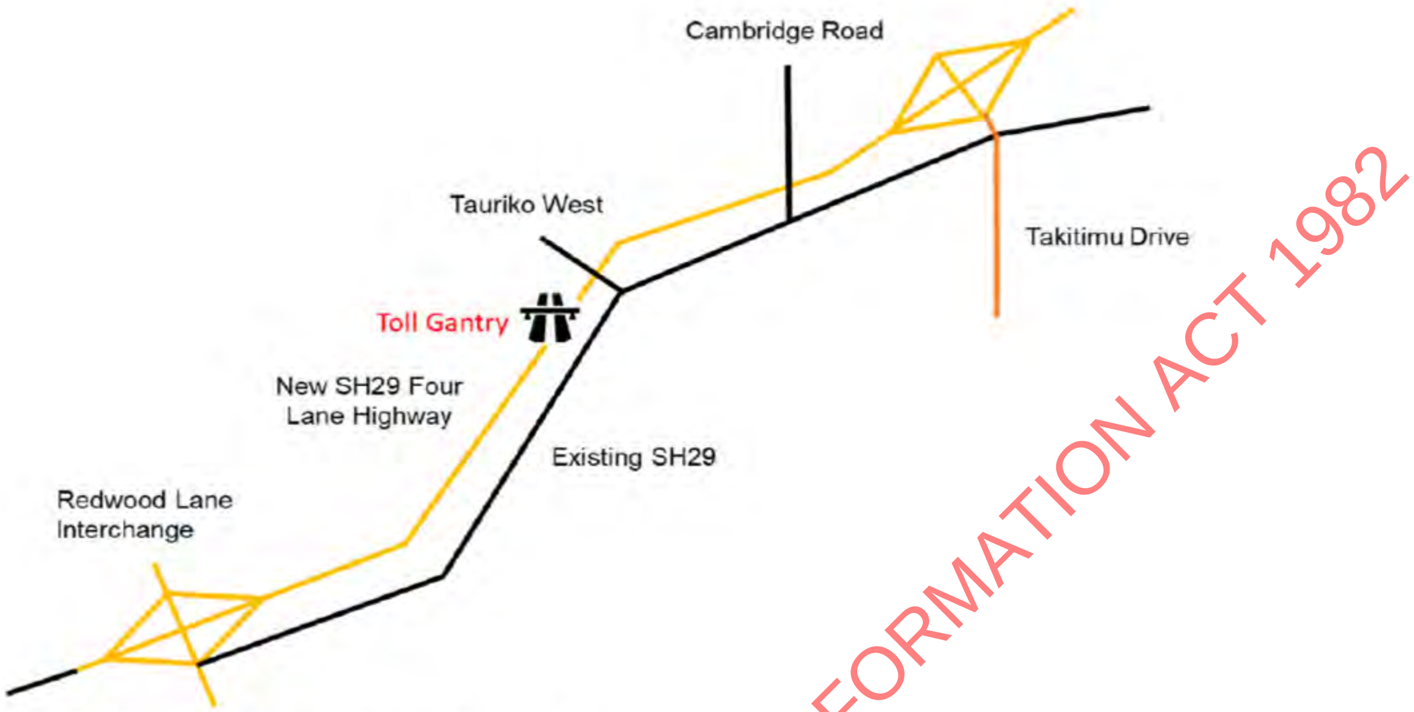

Figure 8-2: New SH29 Four-Lane Highway Schematic

The tolls on the New SH29 Four-Lane Highway were $2.10 for light vehicles and $5.40 for heavy vehicles. These prices a presented in **Table 8-1** below.

Table 8-1: New SH29 Four-Lane Highway Toll Strategy

Scenario	Peak	Interpeak
Light vehicles	$2.10	$2.10
Heavy vehicles	$5.40	$5.40

The tolling tests were undertaken for the 2048 forecast year and used the same wider network assumptions as the TNL tolling scenarios. For TNL itself, the New SH29 assumed the TNL Stage 1 and 2 are in place and it also assumes no toll on TNL on either section.

8.2 Traffic Flows

The toll diverts approximately 40% of traffic off the New SH29. **Figure 8-3** shows that the effect of toll on traffic flow is a localised shift from the New SH29 to the Existing SH29 and parallel corridor of SH36; there is little to no impact in other areas. The daily flow difference plot for the wider area is provided in **Appendix H**.

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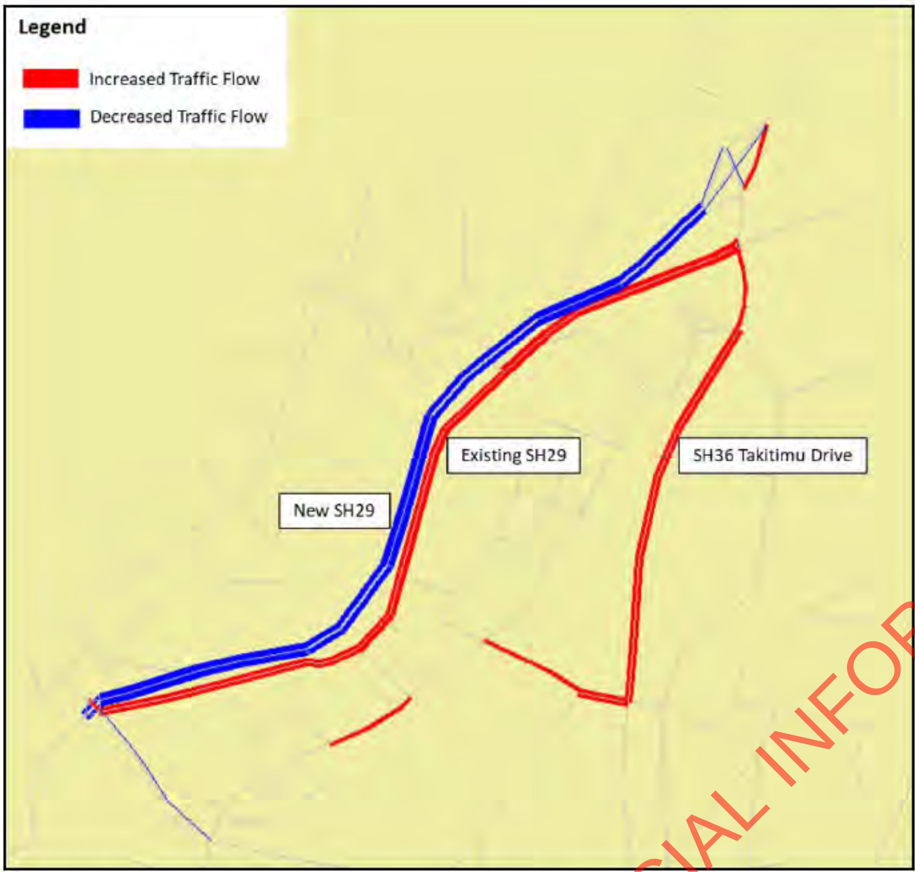

Figure 8-3: Illustration of the flow diversion with toll the New SH29

Table 8-2 presents the 2048 average hour traffic flows at Tauriko West of New and Existing SH29 corridor - with and without tolling for each respective time period and also as AADT values.

Table 8-2: 2048 traffic flows at SH29 longitude - without and with tolling by period

		Existing SH29 at Tauriko West				New State Highway at Tauriko West			
Time Period	Direction	No Toll	Tolled	Change	Percent change	No Toll	Tolled	Change	Percent change
AM	Inbound	183	550	+367	+201%	1308	548	-736	-56%
	Outbound	732	1173	+441	+60%	1507	628	-503	-33%
	Both directions	**915**	**1723**	**+808**	**+88%**	**2815**	**1176**	**-1239**	**-44%**
IP	Inbound	198	610	+412	+208%	1263	442	-486	-38%
	Outbound	405	915	+510	+126%	1174	372	-460	-39%
	Both directions	**603**	**1525**	**+922**	**+153%**	**2437**	**814**	**-946**	**-39%**
PM	Inbound	359	837	+478	+133%	1737	742	-602	-35%
	Outbound	421	836	+415	+99%	1284	553	-723	-56%
	Both directions	**780**	**1673**	**+893**	**+114%**	**3021**	**1295**	**-1325**	**-44%**
AADT	Inbound	2,800	8,000	5,200	+186%	16,900	6,400	-10,500	-62%
	Outbound	5,800	11,800	6,000	+103%	15,600	5,600	-10,000	-64%
	Both directions	**8,600**	**19,800**	**11,200**	**+130%**	**32,500**	**12,000**	**-20,500**	**-63%**

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The daily flow difference plot with and without toll on the new SH29 shows the traffic diversion effect. The flow difference plot (blue representing decrease and red increase in traffic flow) below in Level of Service.

8.3 Level of Service

The level of service plot is provided in **Appendix I**. The toll on the New SH29 results in the following outcomes for LOS:

- The new four-lane State Highway 29 operates at LOS A or B depending on the location and direction along the new road
- The parallel existing State Highway 29 between Gargan Road and Tauriko West operates at LOS E in at least one time period
- The existing State Highway 29 sees more delays from Cambridge Road to Takitimu Drive Signalised intersection, operating at LOS E
- The State Highway 36 corridor also operates LOS E in at least one time period due to the traffic diversion resulting from the toll

8.4 Network Impacts

The network impacts all tolling the New SH29 are presented in **Table 8-3** below. The measures presented are VKT, CO_2e emissions, Crash Costs and DSIs. Tolling the New SH29 results in a slight decrease in network VKT and CO_2e emissions mostly likely due to distributional effects where people choose destinations closer to their trip origins as a result of higher travel costs with the toll. However, there is an increase in crash cost and DSI due to diversion of traffic from the motorway (which has lower cents/km of crash cost compared to other road categories) to alternative route on the existing SH29.

Table 8-3: Network impact of SH29 Tolled vs Un-Tolled Scenario (2048 scenario)

Measure	New SH29 without Toll	New SH29 With Toll	Change	Percent change
Annual VKT (km)	2,763,953,000	2,749,368,000	-14,585,000	-0.5%
Annual CO_2e (tonnes)	283,000	281,000	-2,000	-0.6%
Annual Crash Costs ($)	$185,493,000	$186,566,000	$1,073,000	+0.6%
DSI	24.6	24.8	+0.2	+0.7%

9 Conclusions

This analysis has identified the transport system effects of implementing a toll strategy for the Takitimu North Link, including assessment of potential changes in total crash costs, enabled vehicle emissions and level of service.

Preferred Tolling Strategy

A preferred tolling strategy and tolling level was selected that balanced the need to generate additional revenue over the existing strategy for the implementation of toll infrastructure and meet or contribute to maintenance and operational costs, revocation, and construction costs, while minimising the impact on the forecast crash costs and deaths and serious injuries (DSI). The preferred strategy also had the benefit of reducing emissions compared to the existing toll strategy.

The preferred tolling strategy comprises:

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- A toll gantry on the Stage 1 section of TNL (between Takitimu Drive and the Minden Interchange)
- A toll gantry on the Stage 2 section of TNL (south of the Plummers Point ramp)
- For light vehicles, a $2.10 toll for TNL Stage 1 or TNL Stage 2 users outside of the commuter peaks and a $3.10 toll during the commuter peaks
- For heavy vehicles, a $5.50 toll for TNL Stage 1 or TNL Stage 2 users outside of the commuter peaks and a $8.15 toll during the commuter peaks
- For light vehicles, a $3.10 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) outside of the commuter peaks and a $4.10 toll during the commuter peaks
- For heavy vehicles, a $8.15 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) outside of the commuter peaks and a $10.80 toll during the commuter peaks

The modelling indicated that, relative to the existing toll strategy, tolling was found to:

- Divert approximately 10,000 trips from the TNL back to the existing SH2 in 2031, and 6,500 trips in 2048
- Reduce social crash cost and DSIs through the reduction of vehicle kilometres travelled and suppression of trips
- Reduce enabled emissions compared to the existing toll scenario by reducing induced traffic and re-routing users who choose to avoid the toll to the shorter route on the existing SH2
- Have limited detriment to the level of service on the local network

Alternate Tolling Strategy

The alternate tolling strategy scenarios comprises:

- Scenario 1 (S1): Lower tolls for heavy vehicles. The toll charges for light vehicles are the same as preferred scenario.
- Scenario 2 (S2): All day tolls rather than time varying tolls. Lower tolls for all traffic.

The strategies were therefore as follows:

For S1 scenarios, The Stage 1 alternate tolling strategy comprises:

- Same gantry location
- For light vehicles, a $2.10 toll for TNL Stage 1 or TNL Stage 2 users outside of the commuter peaks and a $3.10 toll during the commuter peaks
- For heavy vehicles, a $4.20 toll for TNL Stage 1 or TNL Stage 2 users outside of the commuter peaks and a $6.20 toll during the commuter peaks
- For light vehicles, a $3.10 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) outside of the commuter peaks and a $4.10 toll during the commuter peaks
- For heavy vehicles, a $6.20 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) outside of the commuter peaks and a $8.20 toll during the commuter peaks

For S1 scenarios, The Stage 1 alternate tolling strategy comprises:

- Same gantry location
- For light vehicles, a $2.00 toll for TNL Stage 1 or TNL Stage 2 users for both commuter peak and off-peak periods
- For heavy vehicles, a $4.00 toll for TNL Stage 1 or TNL Stage 2 users for both commuter peak and off-peak periods
- For light vehicles, a $3.40 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) for both commuter peak and off-peak periods
- For heavy vehicles, a $6.80 toll for users of both TNL Stage 1 and TNL Stage 2 (through movement) for both commuter peak and off-peak periods

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The comparison of the S1 and S2 scenarios against the Preferred Scenario indicates that there is negligeable change in the vehicle kilometres travel, delay and the crash cost. Both the scenarios have higher crash cost and lower toll revenue (-8% and -15% net toll revenue change for the S1 and S2 scenarios respectively) making them less favourable than the Preferred Scenario.

Sensitivity Tests

The tolling strategy for the sensitivity test was detailed as follows:

- A gantry on the New SH29 would be between the Redwood interchange and the Takitimu Drive interchange.
- A light vehicle commuter toll of $2.10 for both peak and off-peak
- A heavy vehicle commuter toll of $5.40 for both peak and off-peak

The toll proposed for the sensitivity test diverts approximately 40% of traffic off the new SH29. It also results in a slight decrease in network VKT and CO_2e emissions. However, there is an increase in crash cost and DSI due to diversion of traffic from the motorway to alternative route on the existing SH29.

For the purpose of modelling, the commuter peaks have been defined as 7:00am to 9:00am and 4:00pm to 6:00pm.

Forecasting traffic flows for a new toll road contains inherent uncertainty. While this report has attempted to quantify the potential scale of the key uncertainties, the risks associated with traffic forecasts should be considered in design and policy decisions for this project.

10 Limitations

This analysis is based on the existing TTSM traffic model and the driver willingness to pay (WtP) parameters calibrated to local conditions. Detailed market research into WtP has not been undertaken specifically for this work, however the effects of uncertainties in WtP and other key inputs and assumptions have been estimated via sensitivity tests and risk-profiling. While this work provides estimates of traffic volumes and revenue suitable for network planning, the revenue estimates are not considered 'investment grade' such as might be required for private-sector investment.

This report aimed to assess the transport network impacts and revenue of the preferred tolling strategy in accordance with the parameters of our agreed scope as set out in our proposal. Further analysis may be required in order to support more detailed financial analysis.

Although Beca offers professional advice and may express opinions on likely or possible outcomes, we cannot guarantee any particular outcome and any decision to proceed with the next phase of investigation is a commercial decision for Waka Kotahi.

It should be noted that the toll revenue estimates provided as part of the Services are not a statement of absolute revenue suitable for detailed investment decisions, rather they will have an accuracy range corresponding with various factors including the extent of relevant information provided, data certainty and assumptions, and the level of detail available at the time of preparation.

The assessment of the transport network impacts is limited to the following outcome measures:

- Traffic flows
- Travel times
- Safety –measured by the social crash cost difference between a tolled and un-tolled scenario
- Emissions –measured by the change in vehicle CO_2e emissions between a tolled and un-tolled scenario
- Revenue

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This assessment has included the transport system effects noted above and has not included a wider assessment against Waka Kotahi or other Government policies or frameworks. Forecasting traffic flows contains inherent uncertainty. While this report has attempted to quantify the potential scale of the key uncertainties, the risks associated with traffic forecasts should be considered in design and policy decisions for this project.

In preparing this assessment we have relied on the inputs and assumptions provided by or agreed with Waka Kotahi as outlined in this report, including:

- TTSM model
- Design of TNL project
- Land use inputs
- Wider network project assumptions
- Toll system transaction costs
- Waka Kotahi's Vehicle Emission Prediction Model

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Appendix A – Short List Toll Strategy Flow Difference Plots

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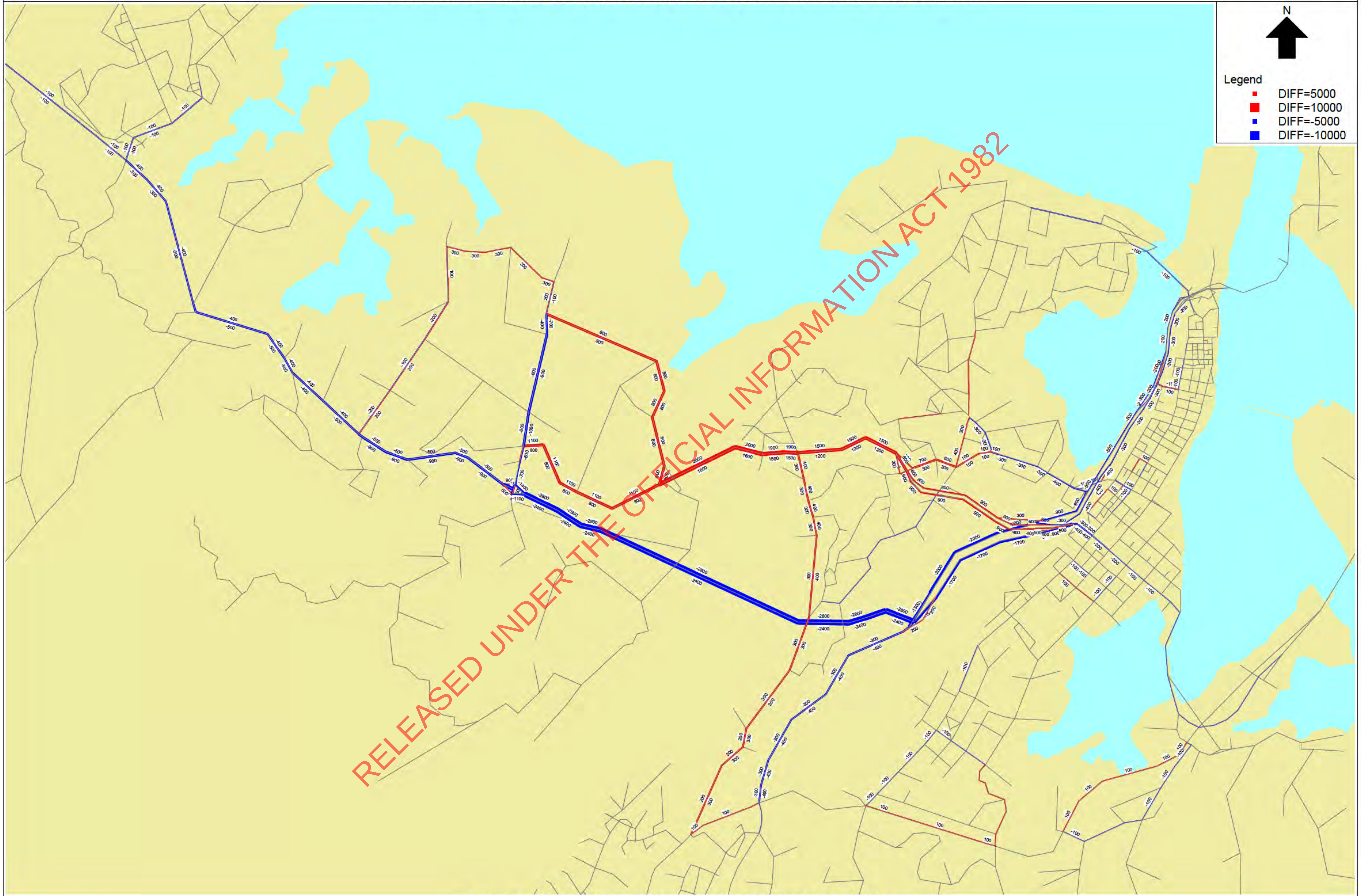
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 1 vs Existing Scenarios_Y2031



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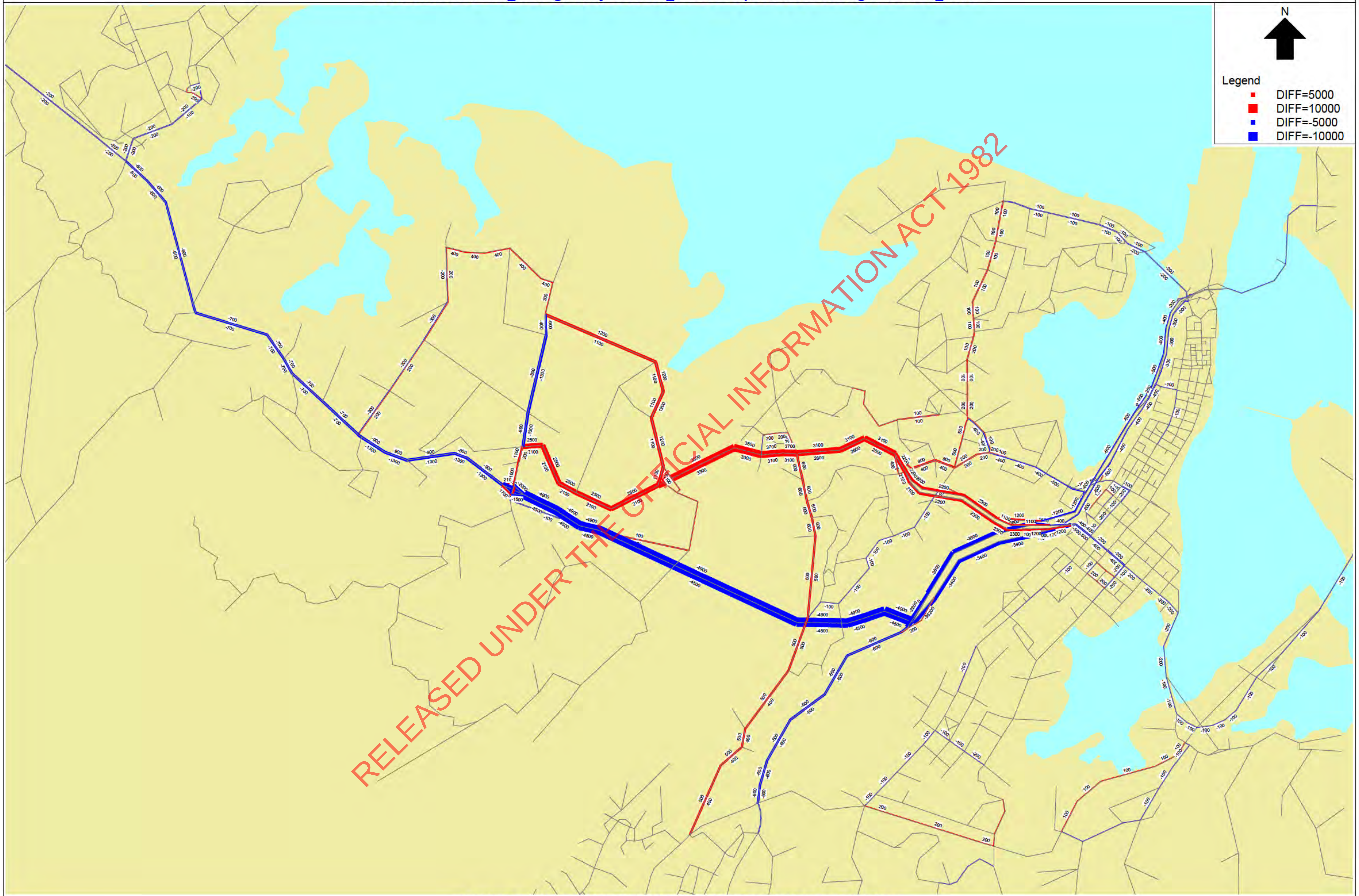
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 2 vs Existing Scenarios_Y2031



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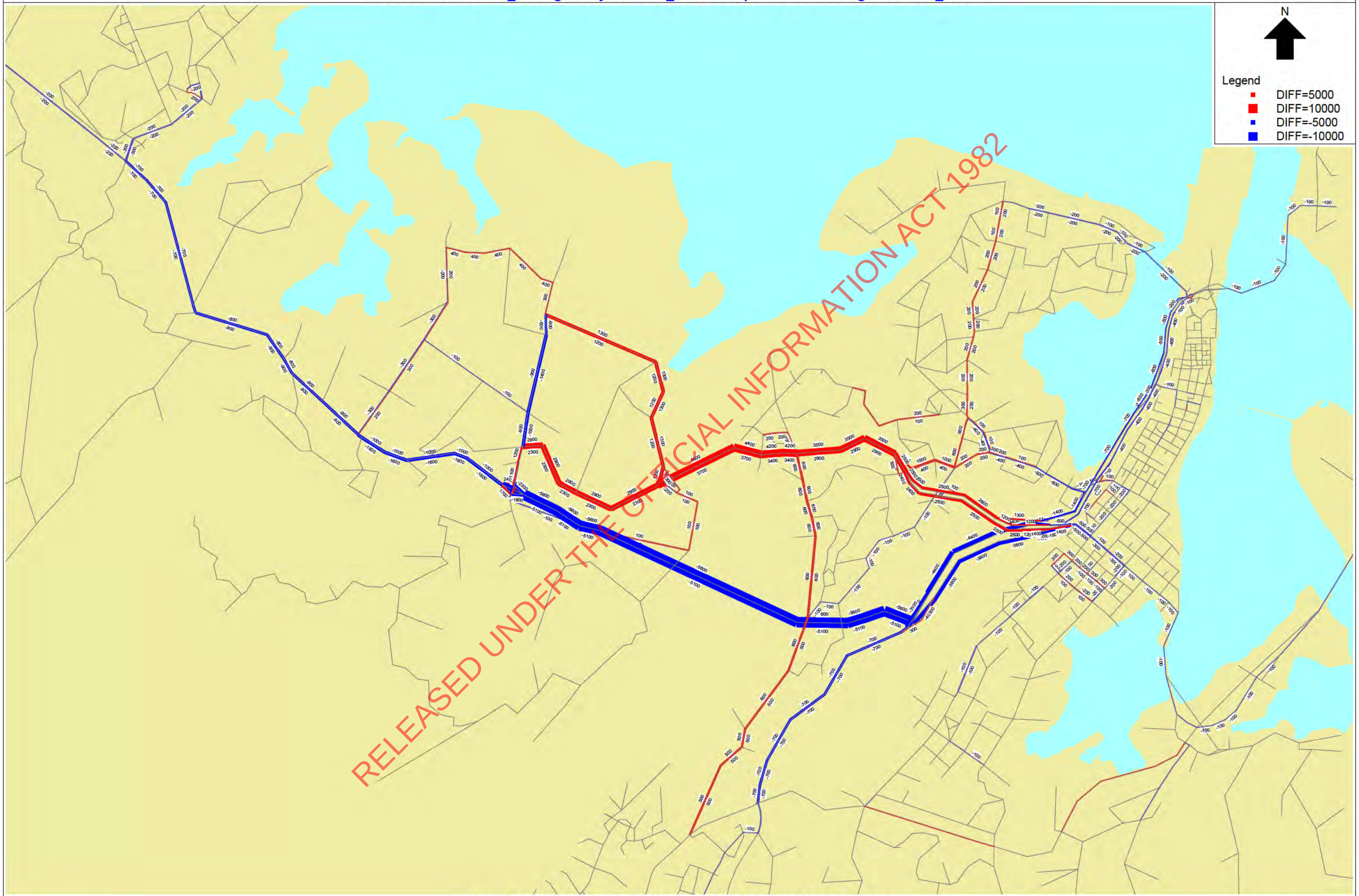
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 3 vs Existing Scenarios_Y2031



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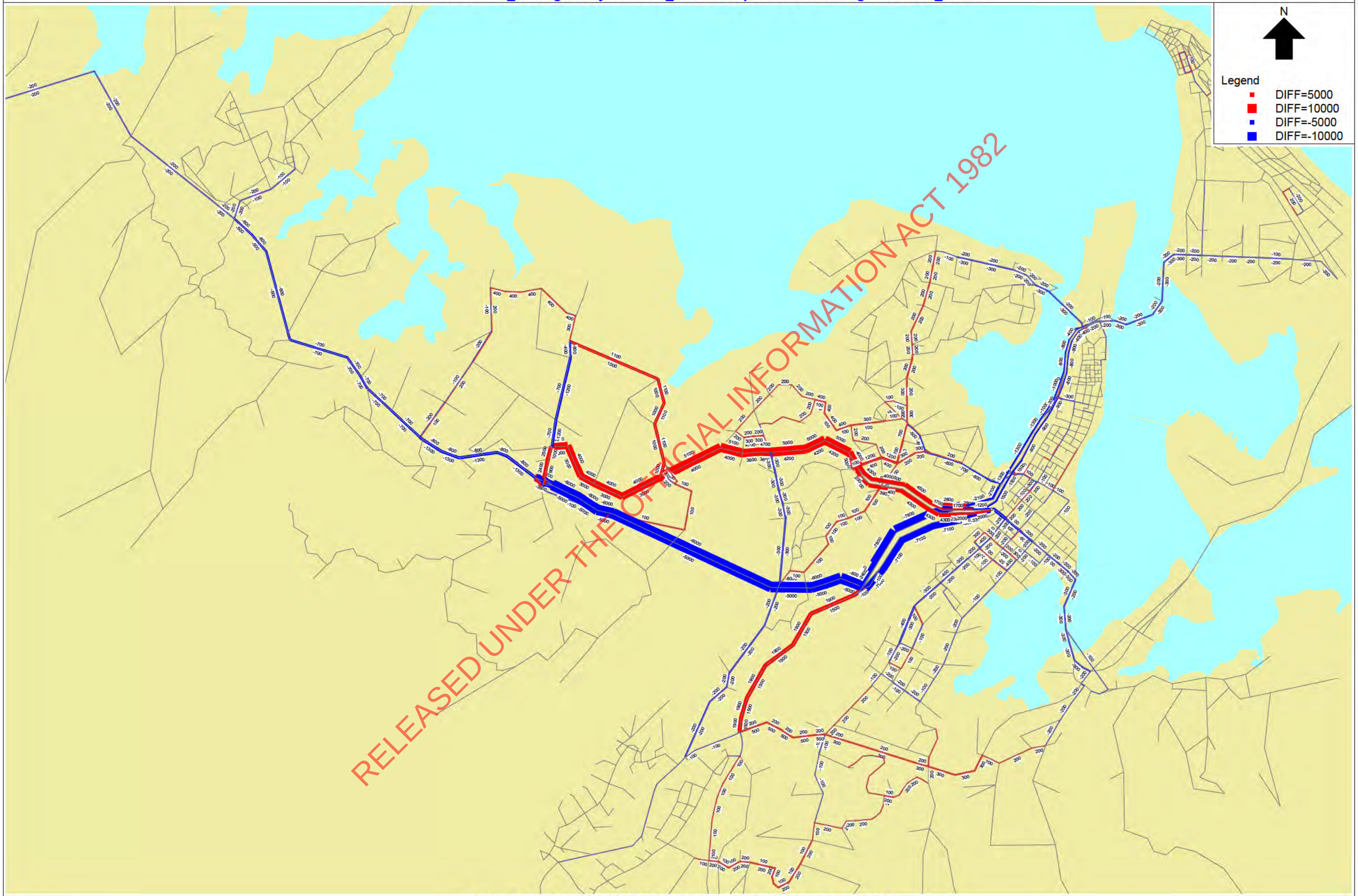
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 4 vs Existing Scenarios_Y2031



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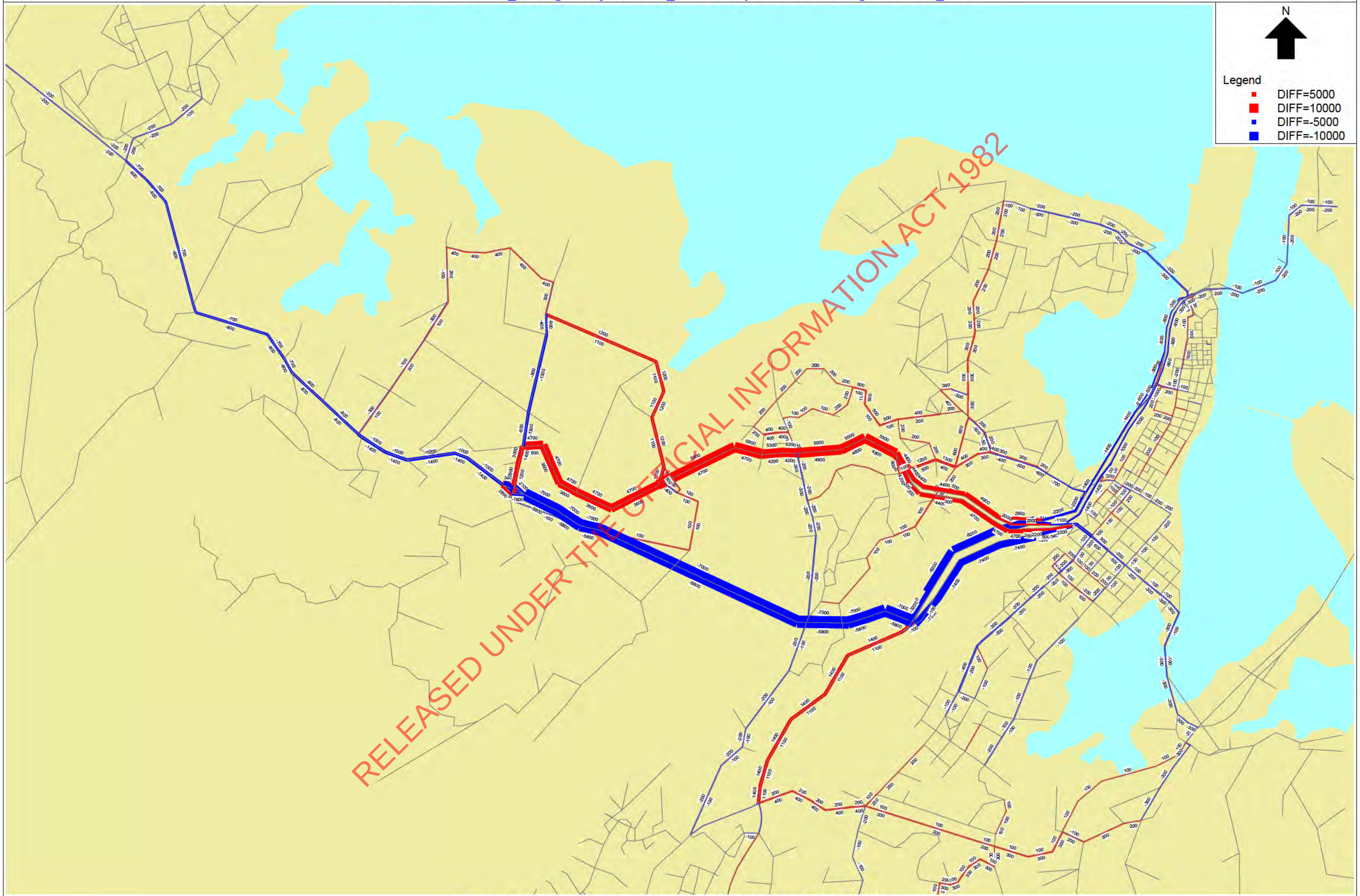
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 5 vs Existing Scenarios_Y2031



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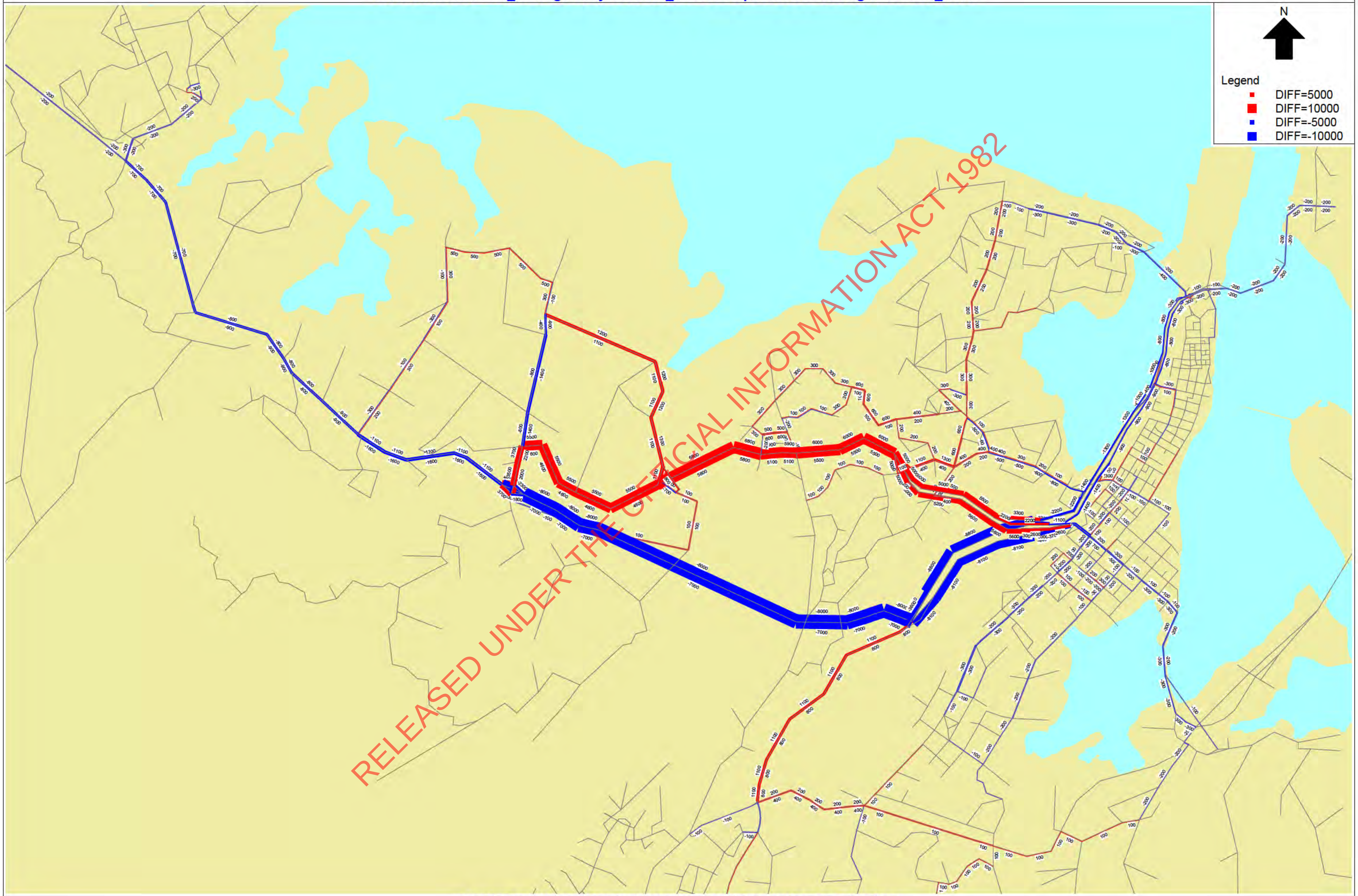
Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 6 vs Existing Scenarios_Y2031



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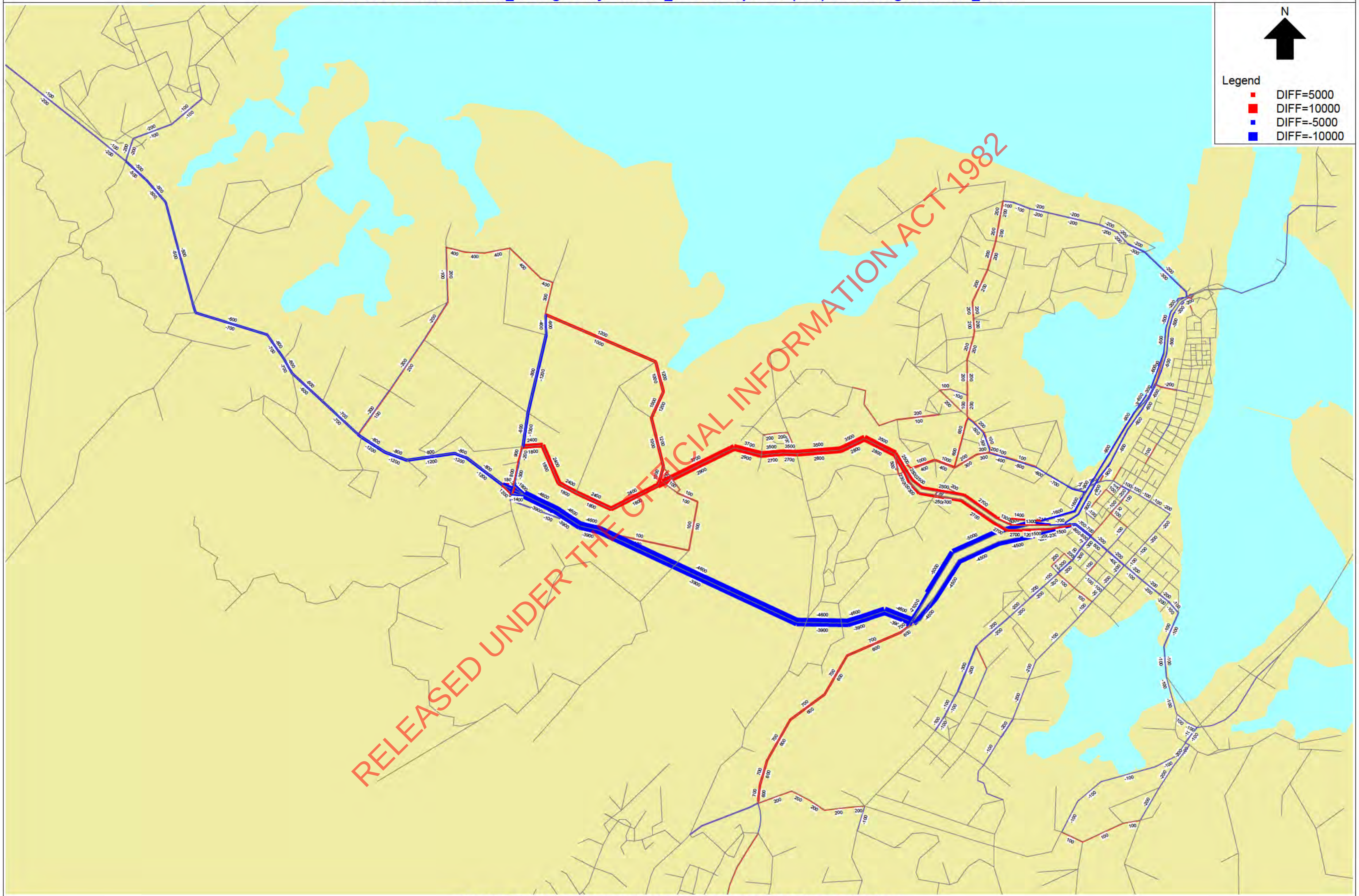
Flow Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 7 (or 9) vs Existing Scenarios_Y2031



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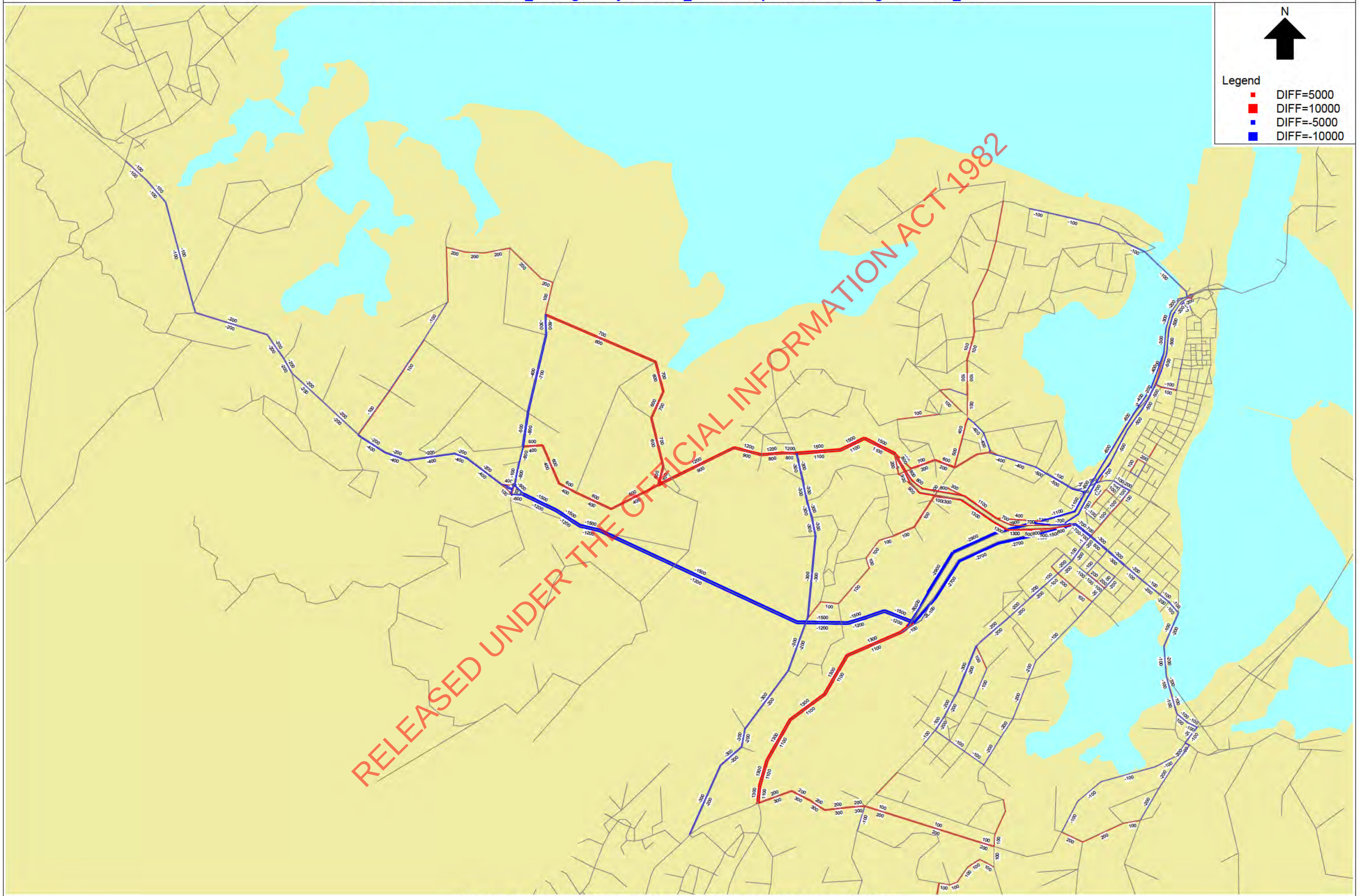
Flow Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 8 vs Existing Scenarios_Y2031



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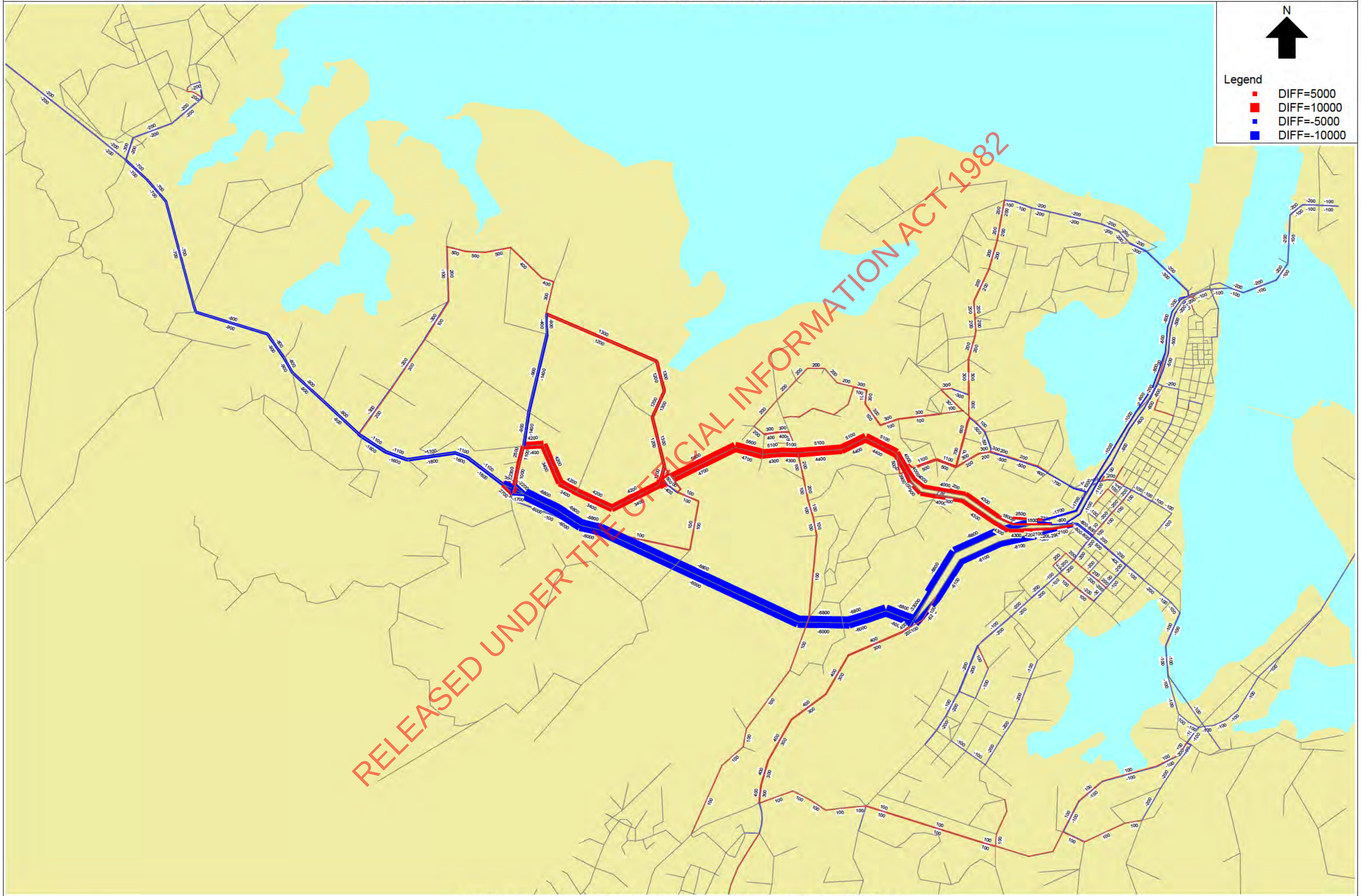
Flow Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 10 vs Existing Scenarios_Y2031



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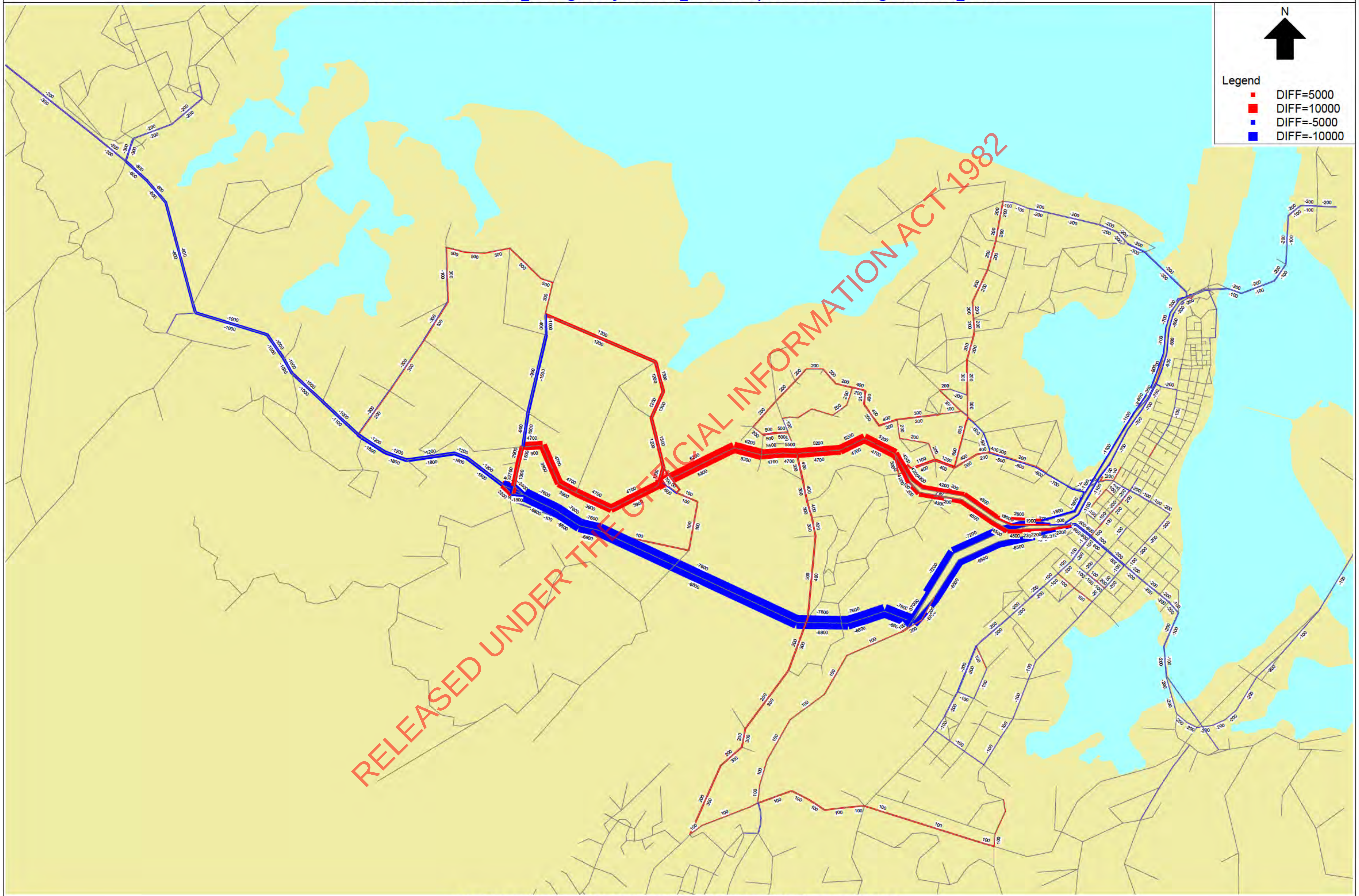
Flow Flow Difference Plot_Average Daily Vehicles_TNL Toll Option 11 vs Existing Scenarios_Y2031



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Appendix B – Short List Toll Strategy Level of Service Plots

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Appendix B – Short List Toll Strategy Level of Service Plots

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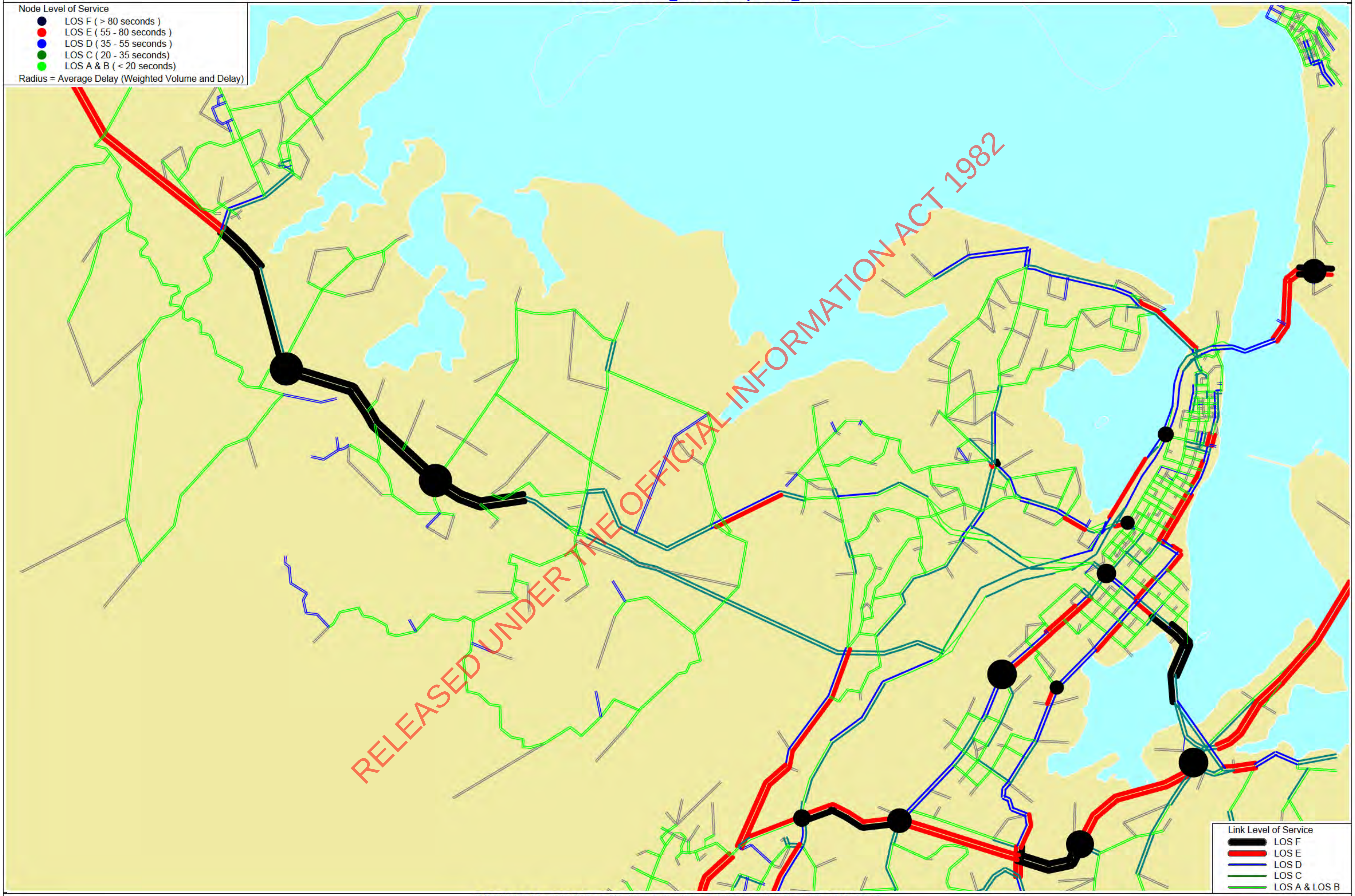
Level of Service_TNL Toll Option 1_Y2031



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Level of Service_TNL Toll Option 2_Y2031

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Level of Service_TNL Toll Option 3_Y2031

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Level of Service_TNL Toll Option 4_Y2031

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Level of Service_TNL Toll Option 5_Y2031

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Level of Service_TNL Toll Option 6_Y2031

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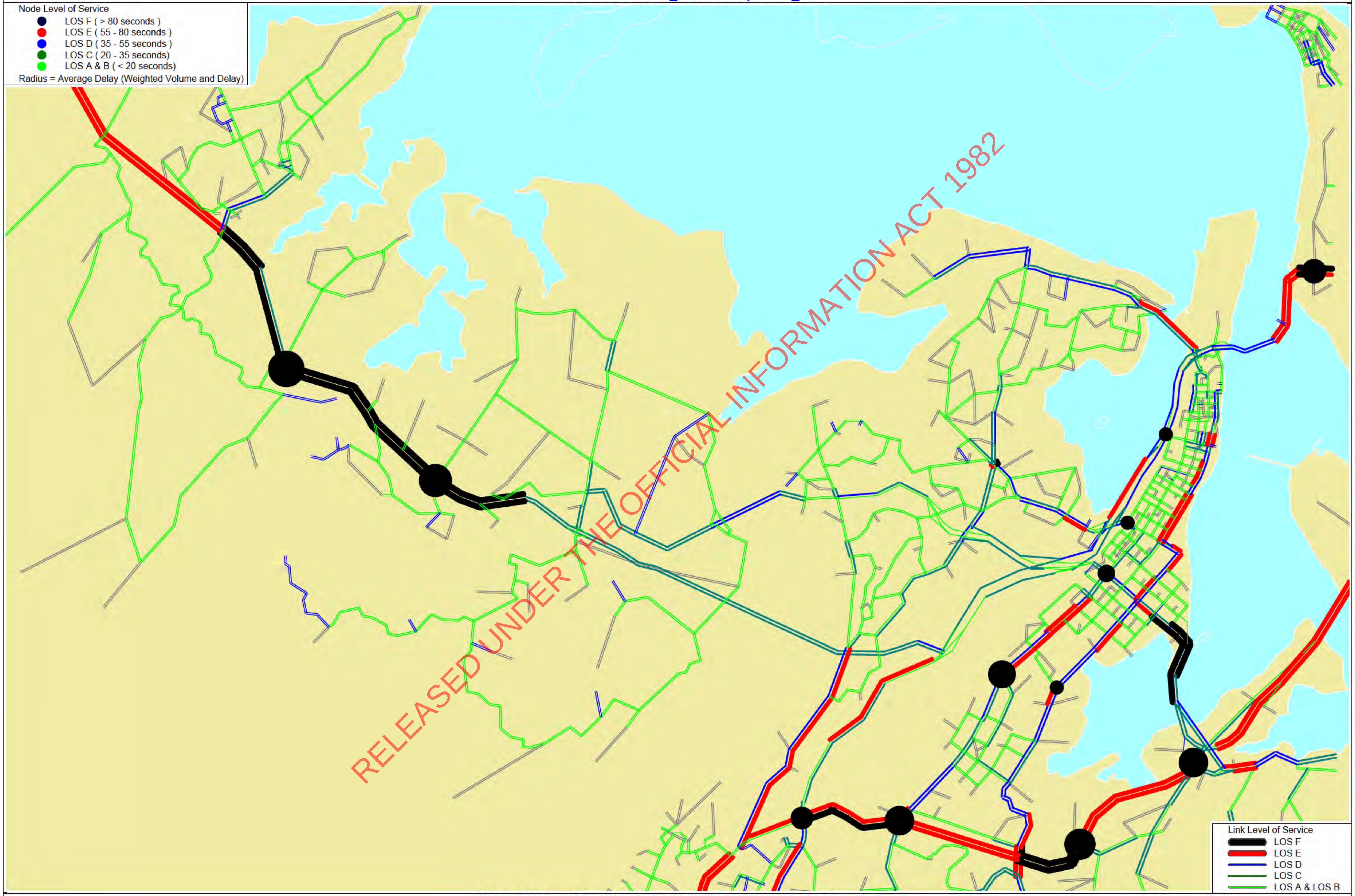
Level of Service_TNL Toll Option 8_Y2031



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Level of Service_TNL Toll Option 10_Y2031

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Level of Service_TNL Toll Option 11_Y2031

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Appendix C – Emerging Preferred Toll Strategy Flow Difference Plots

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Appendix C – Emerging Preferred Toll Strategy Flow Difference Plots

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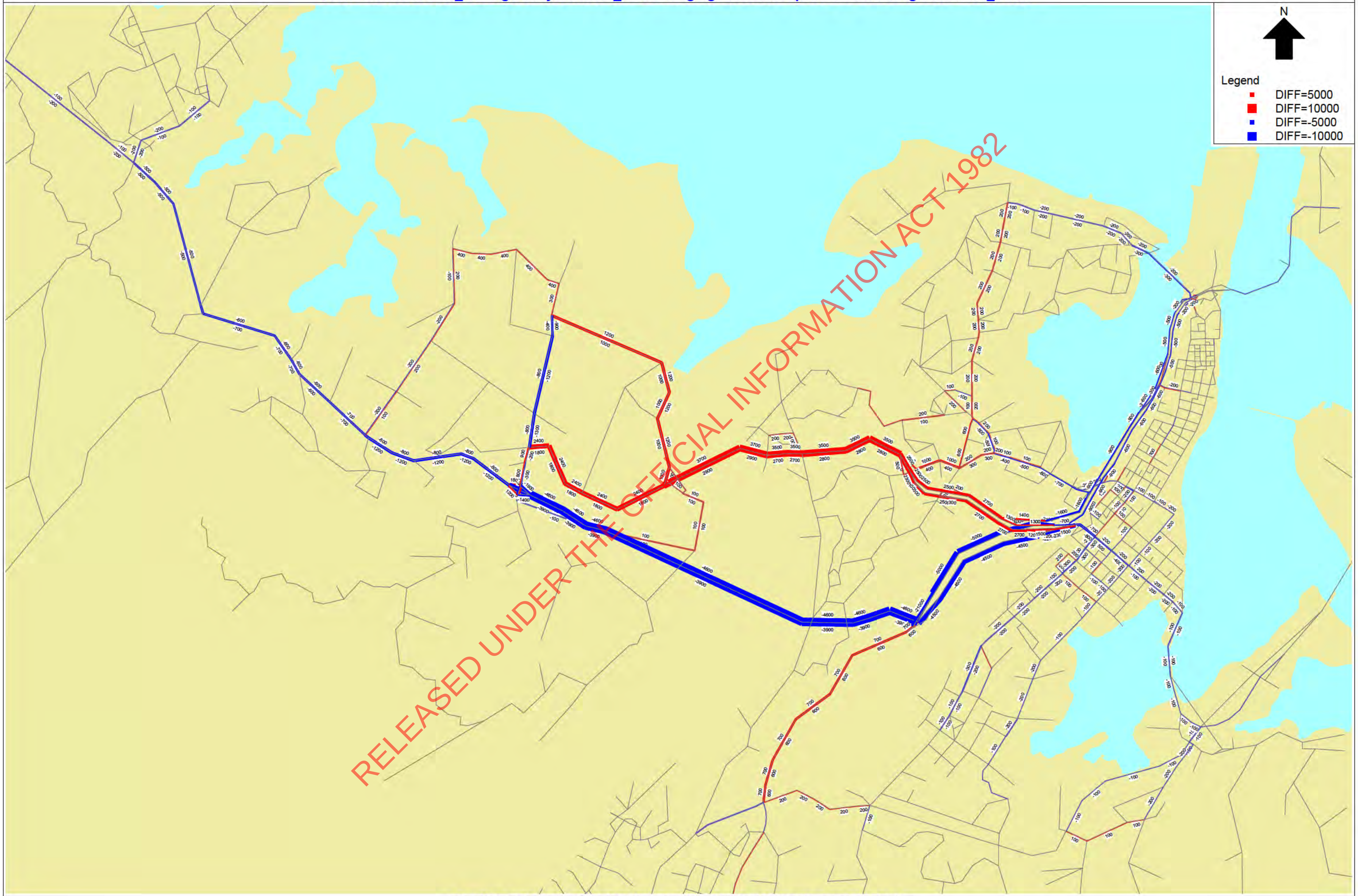
Flow Difference Plot_Average Daily Vehicles_TNL Emerging Preferred Option 1 vs Existing Scenarios_Y2031



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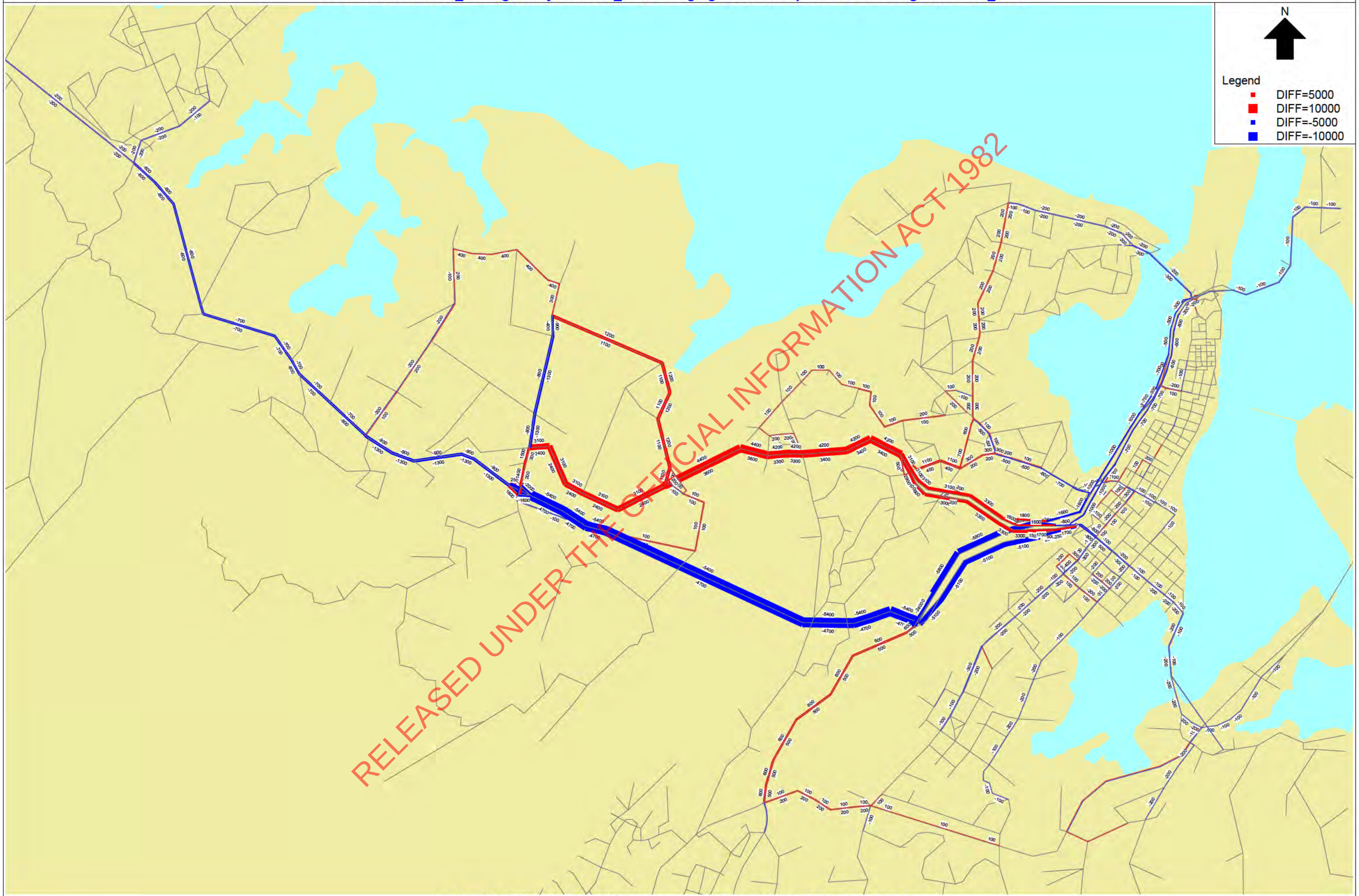
Flow Difference Plot_Average Daily Vehicles_TNL Emerging Preferred Option 2 vs Existing Scenarios_Y2031



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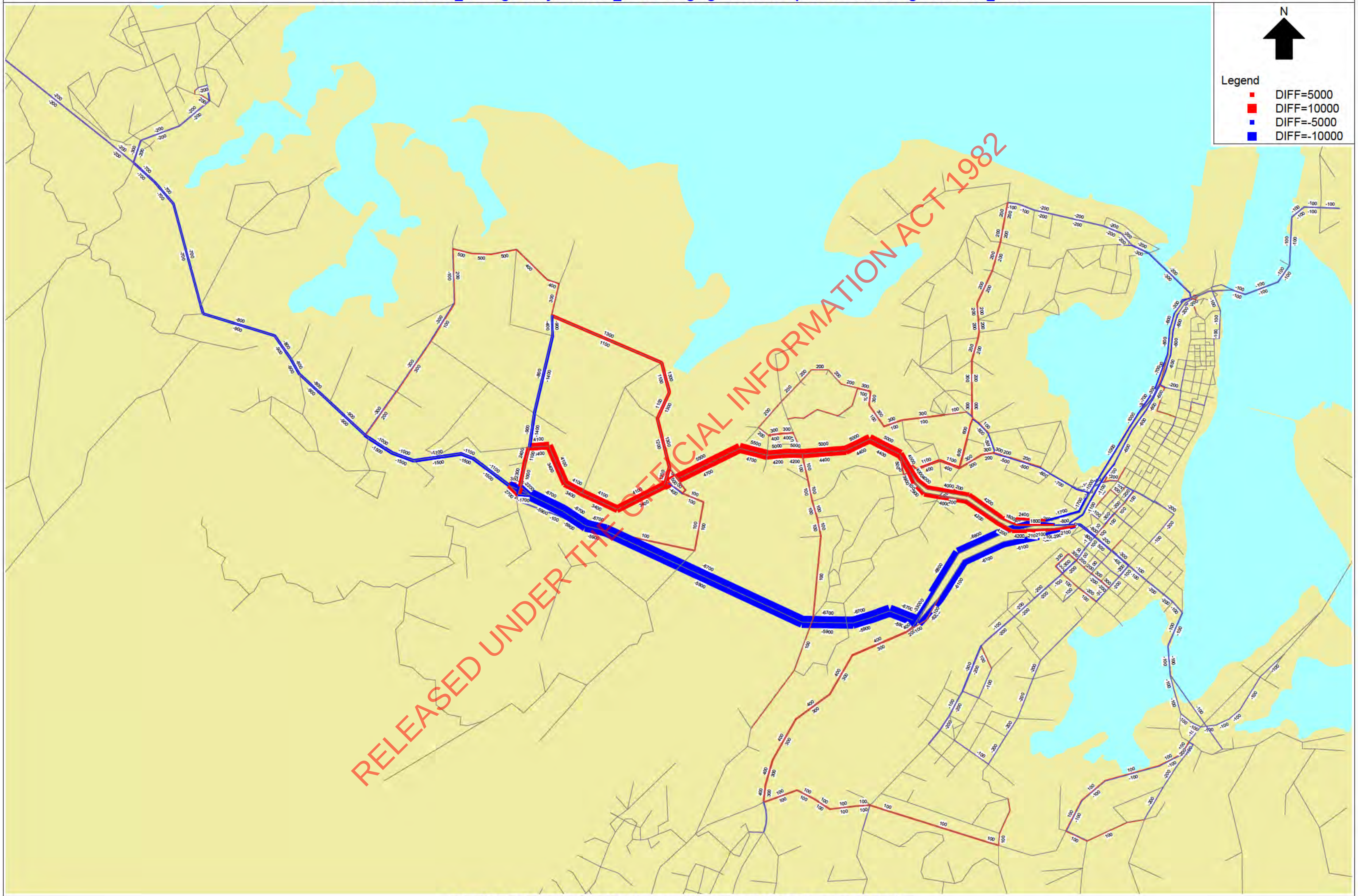
Flow Difference Plot_Average Daily Vehicles_TNL Emerging Preferred Option 3 vs Existing Scenarios_Y2031



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Flow Difference Plot_Average Daily Vehicles_TNL Existing withToll vs noToll Scenarios_Y2048

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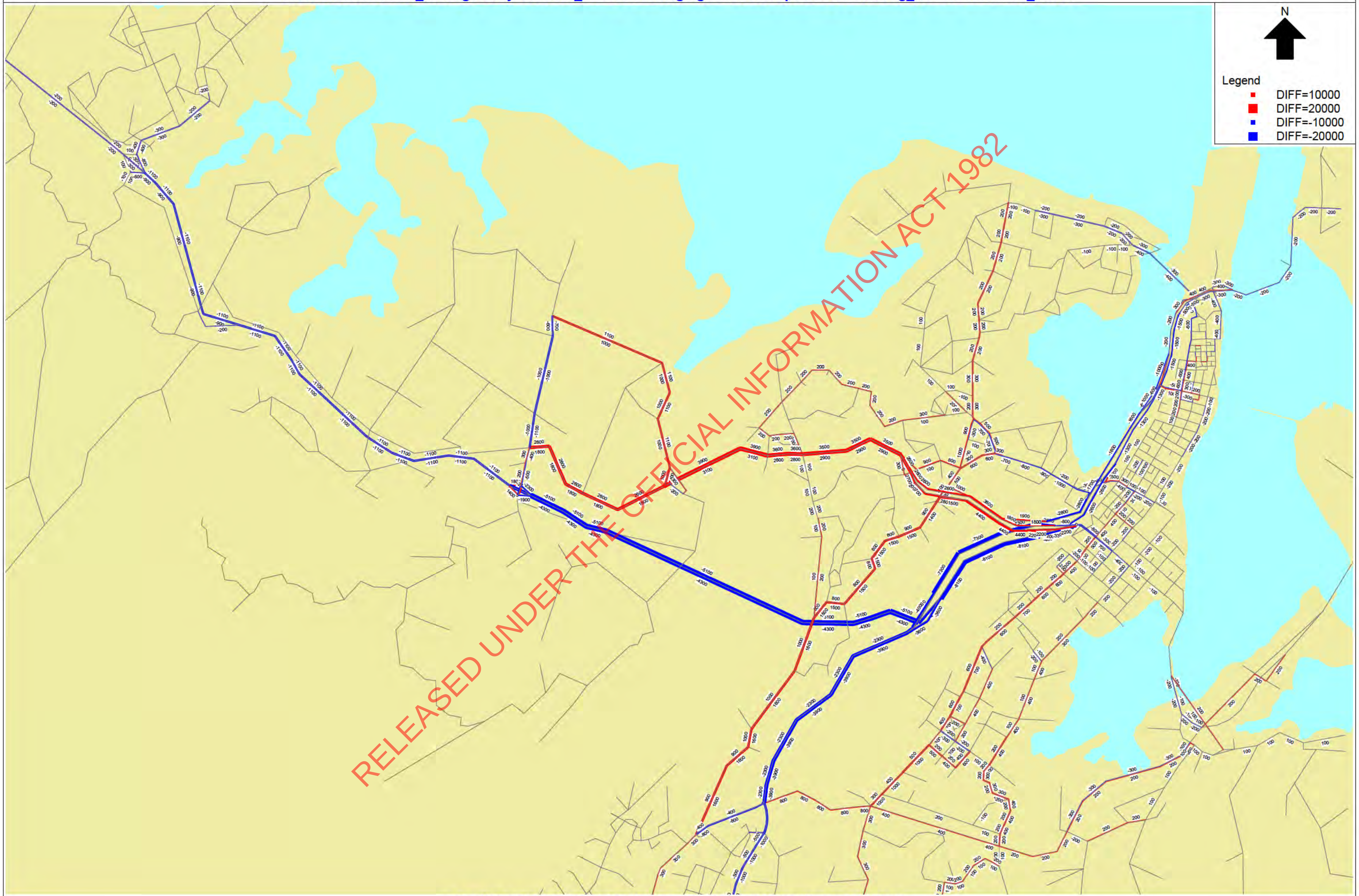
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 1 vs Existing_NoToll Scenarios_Y2048



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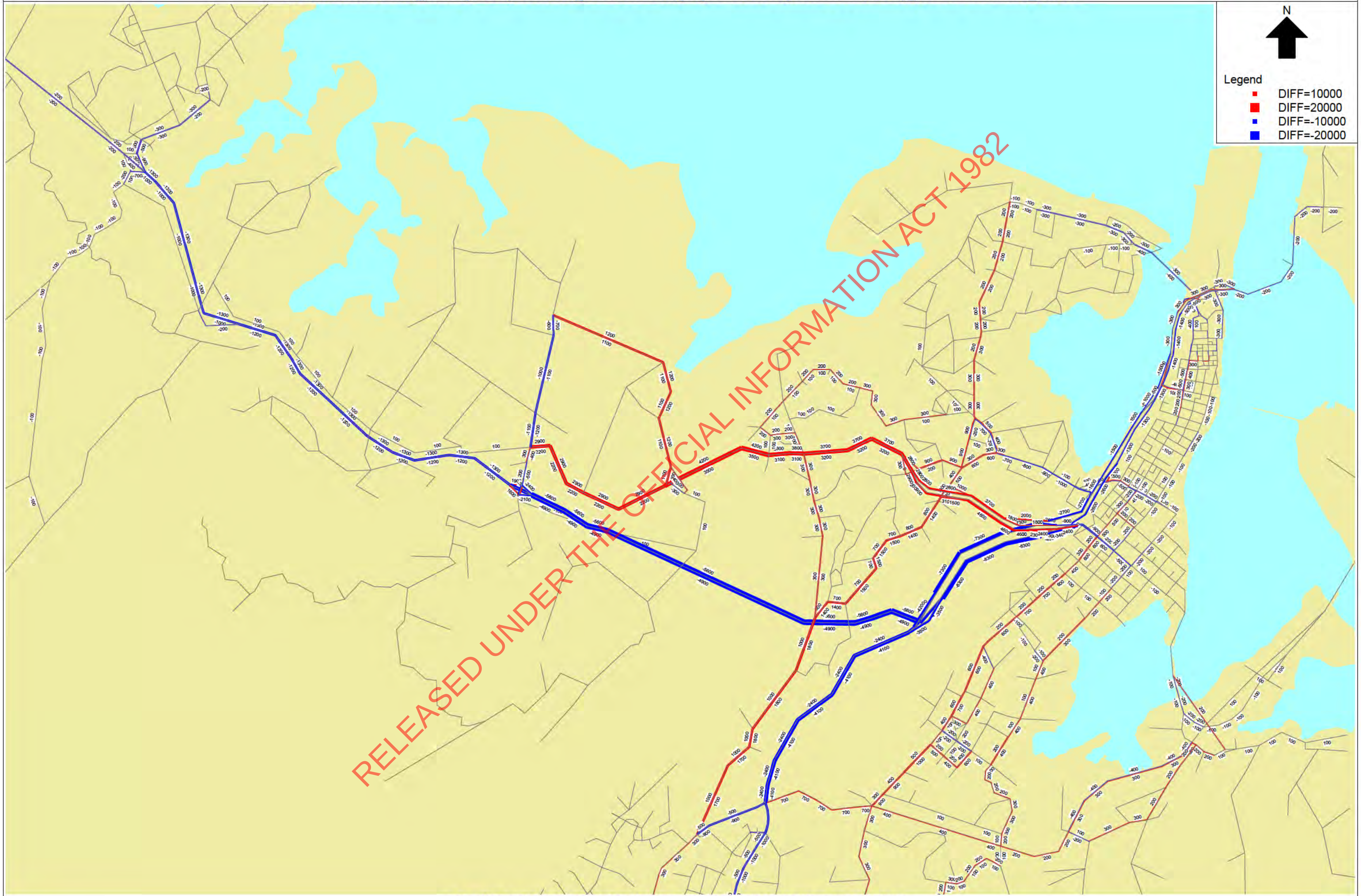
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 2 vs Existing_NoToll Scenarios_Y2048



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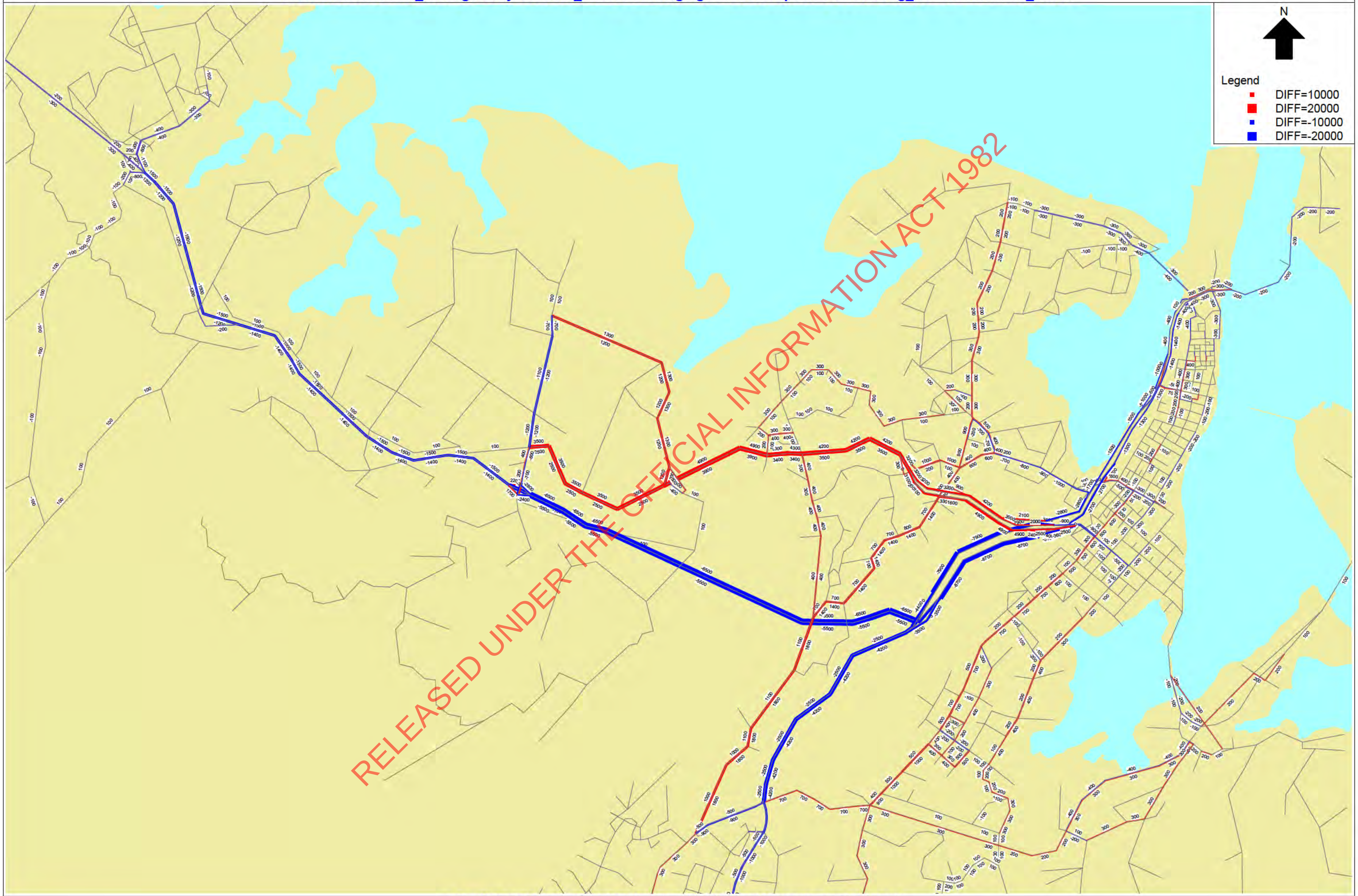
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 3 vs Existing_NoToll Scenarios_Y2048



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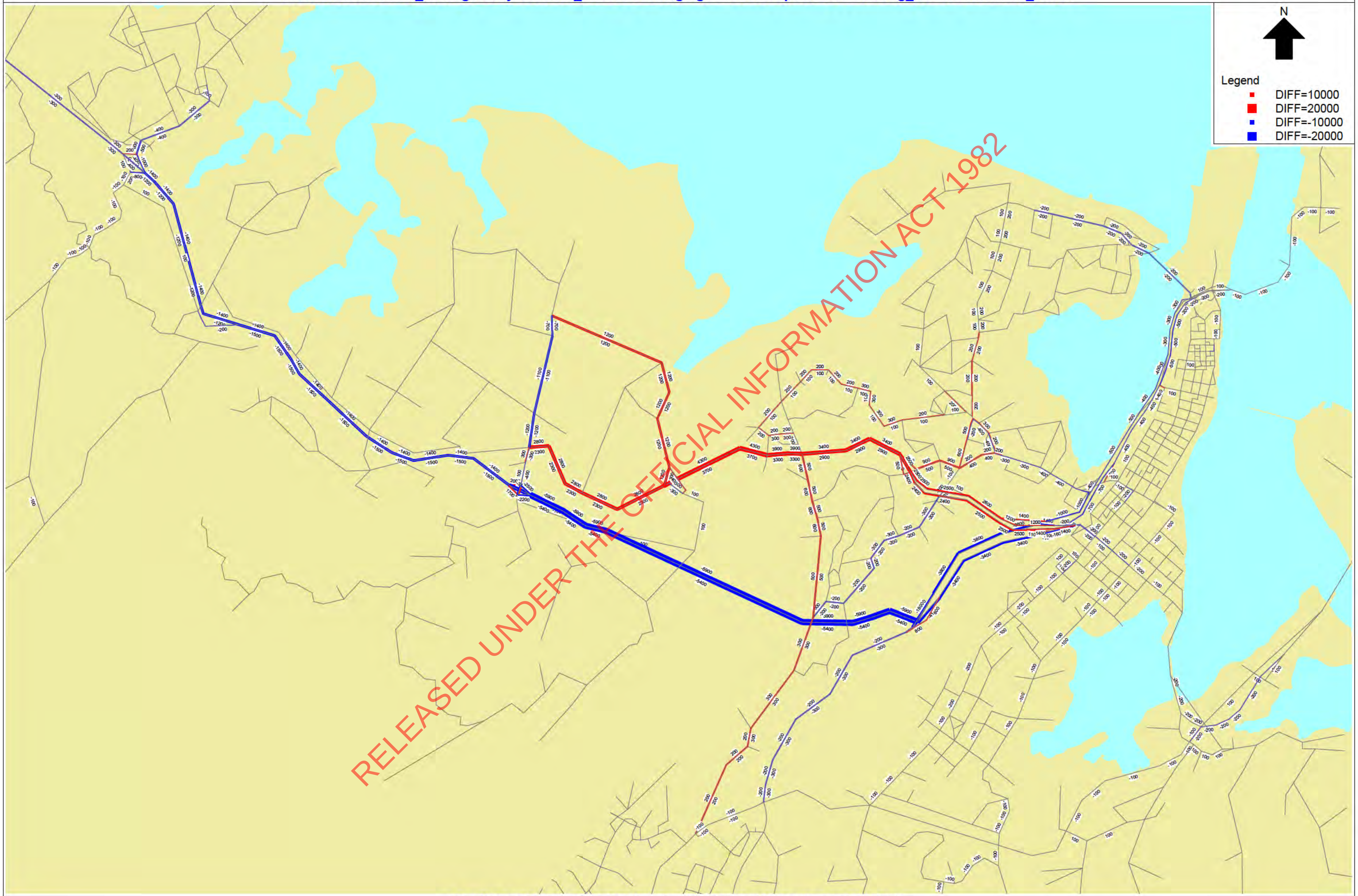
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 4 vs Existing_NoToll Scenarios_Y2048



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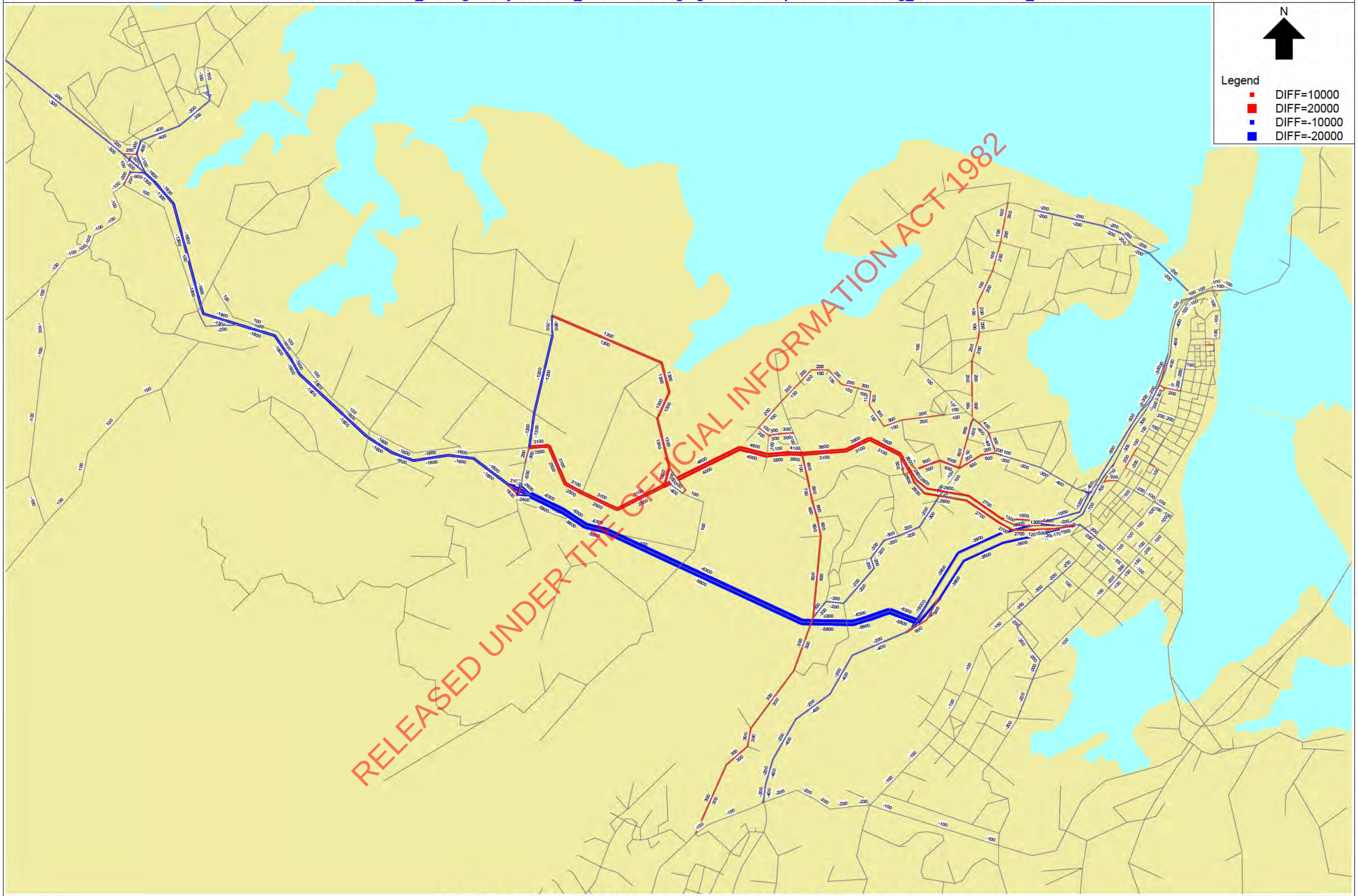
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 5 vs Existing_NoToll Scenarios_Y2048



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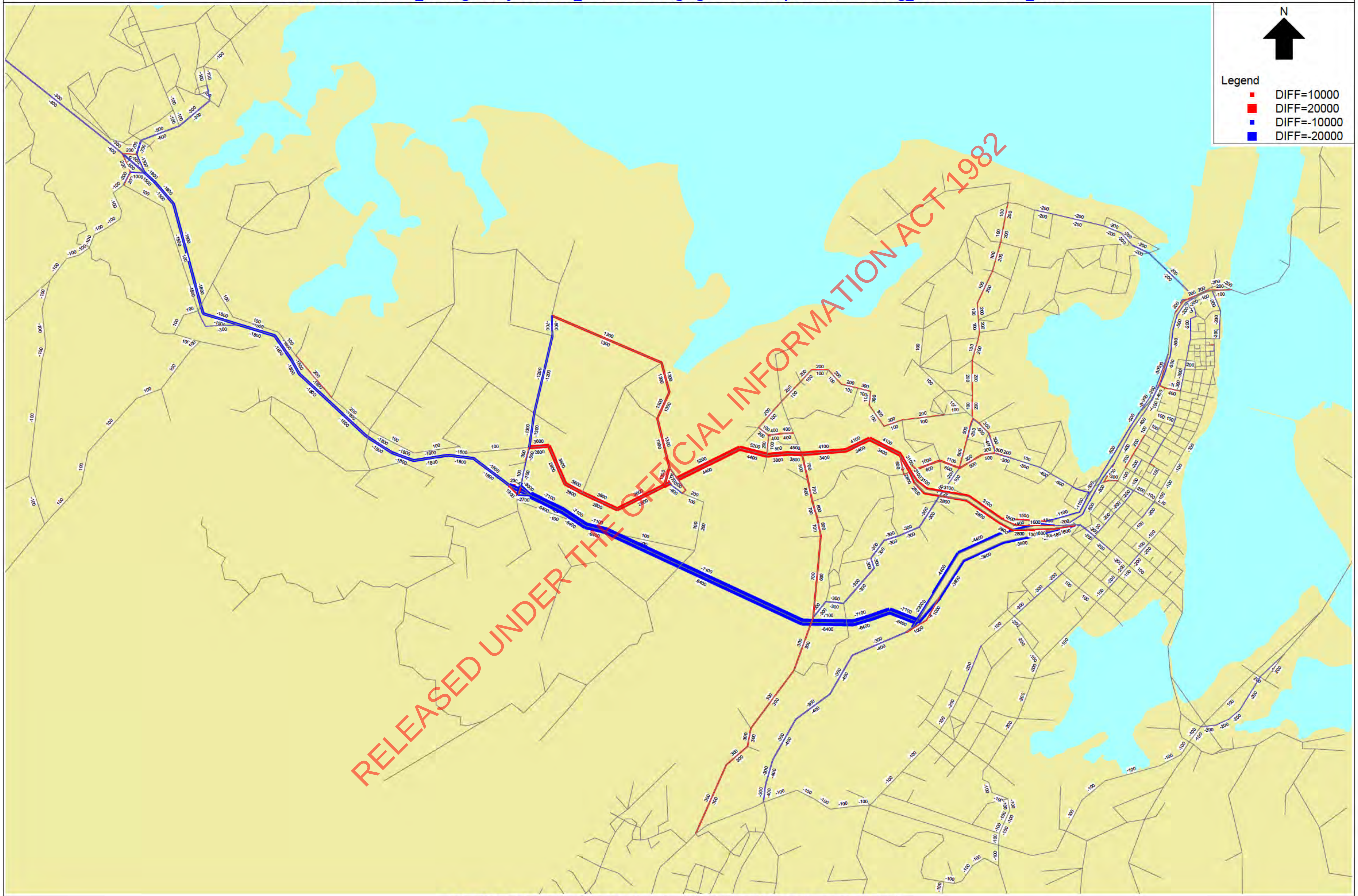
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 6 vs Existing_NoToll Scenarios_Y2048



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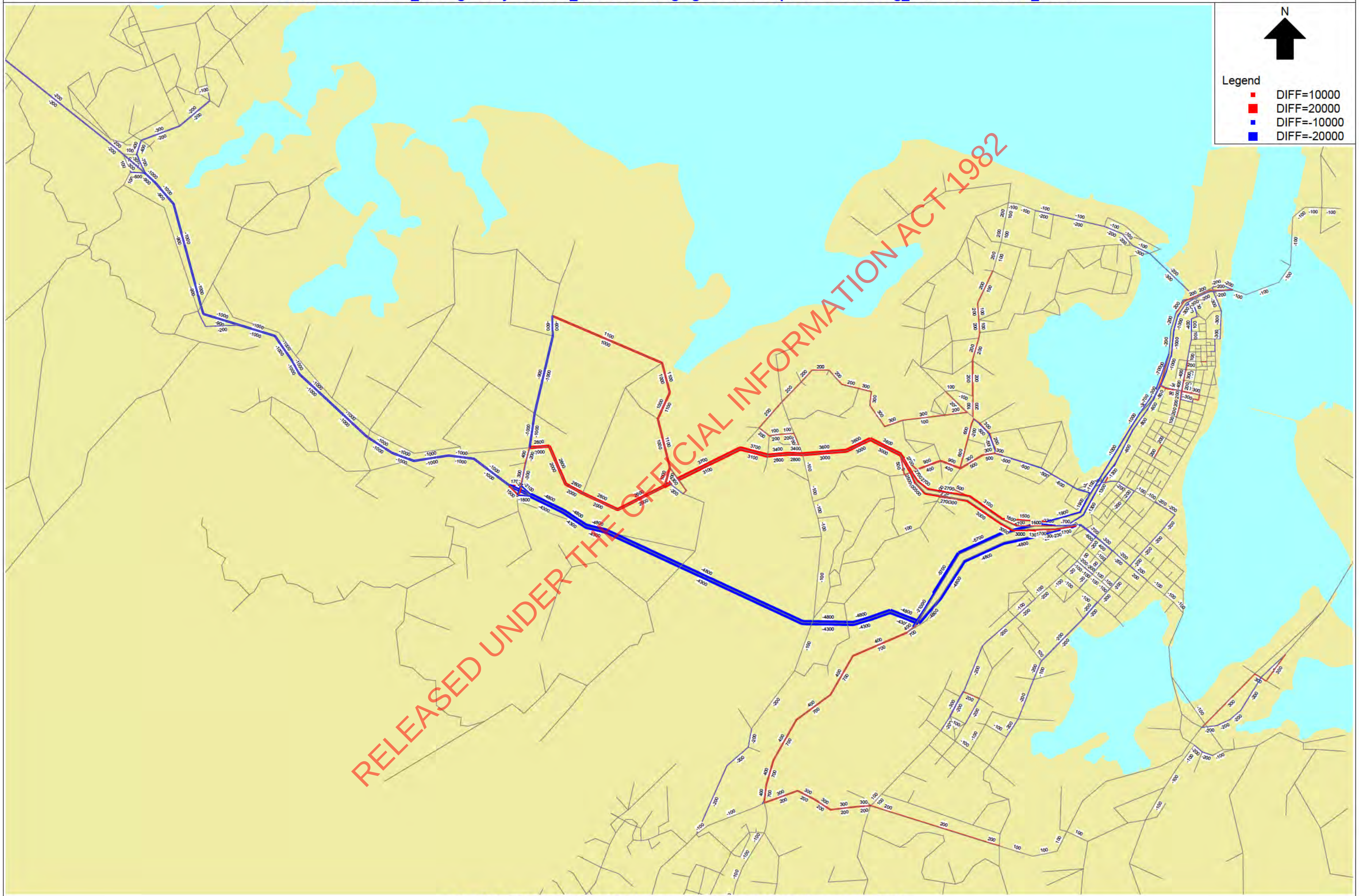
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 1 vs Existing_withToll Scenarios_Y2048



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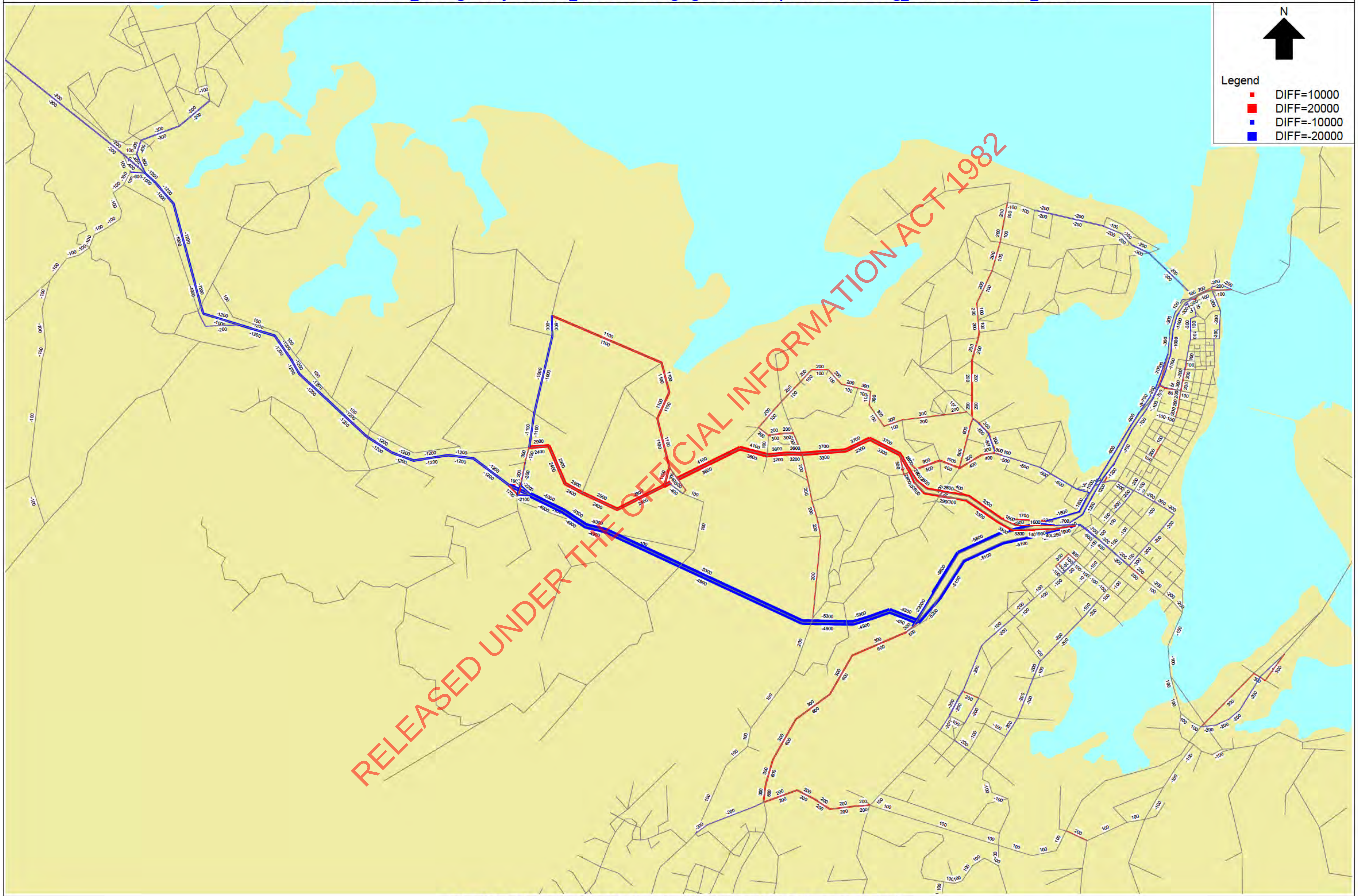
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 2 vs Existing_withToll Scenarios_Y2048



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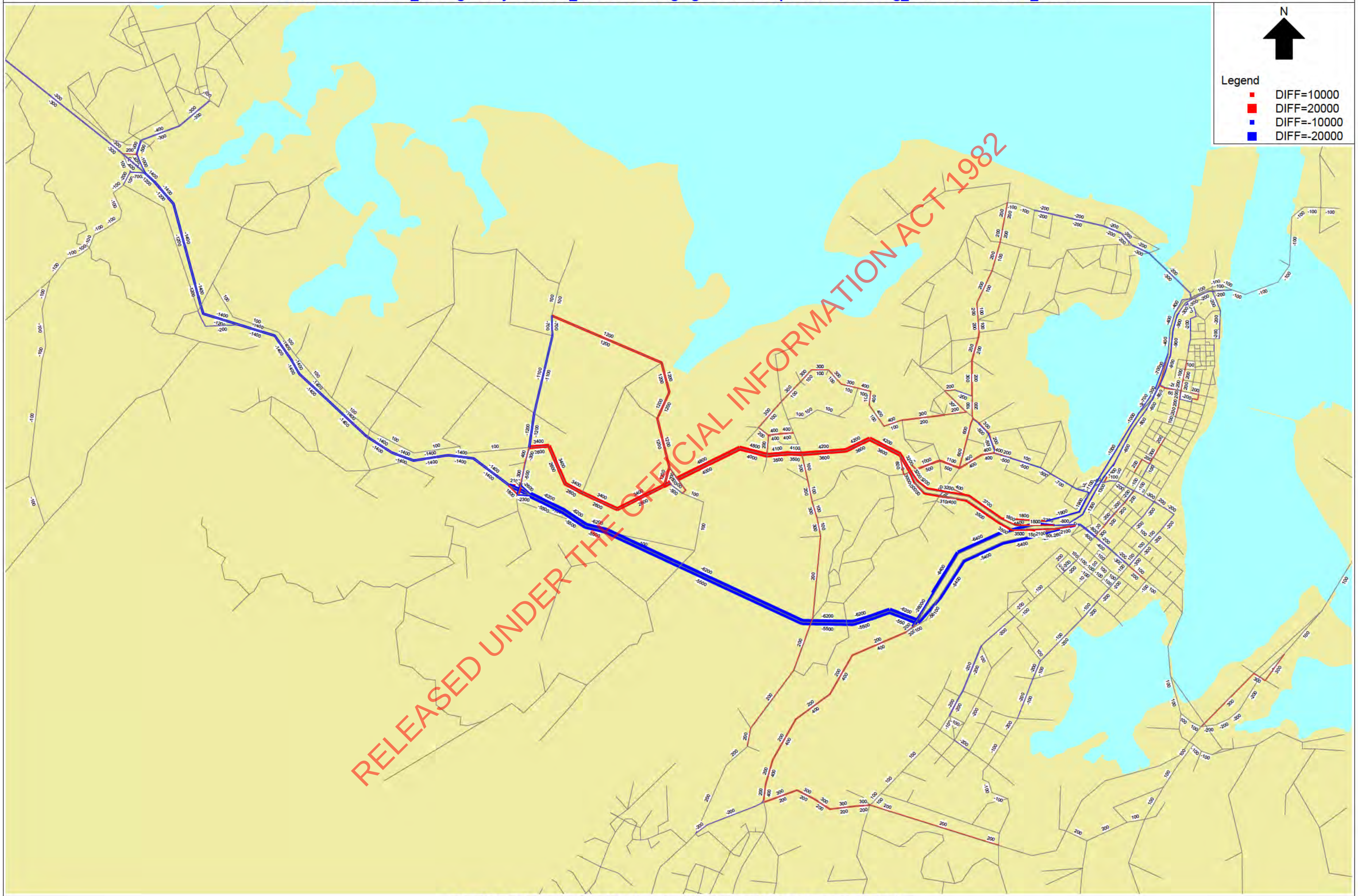
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 3 vs Existing_withToll Scenarios_Y2048



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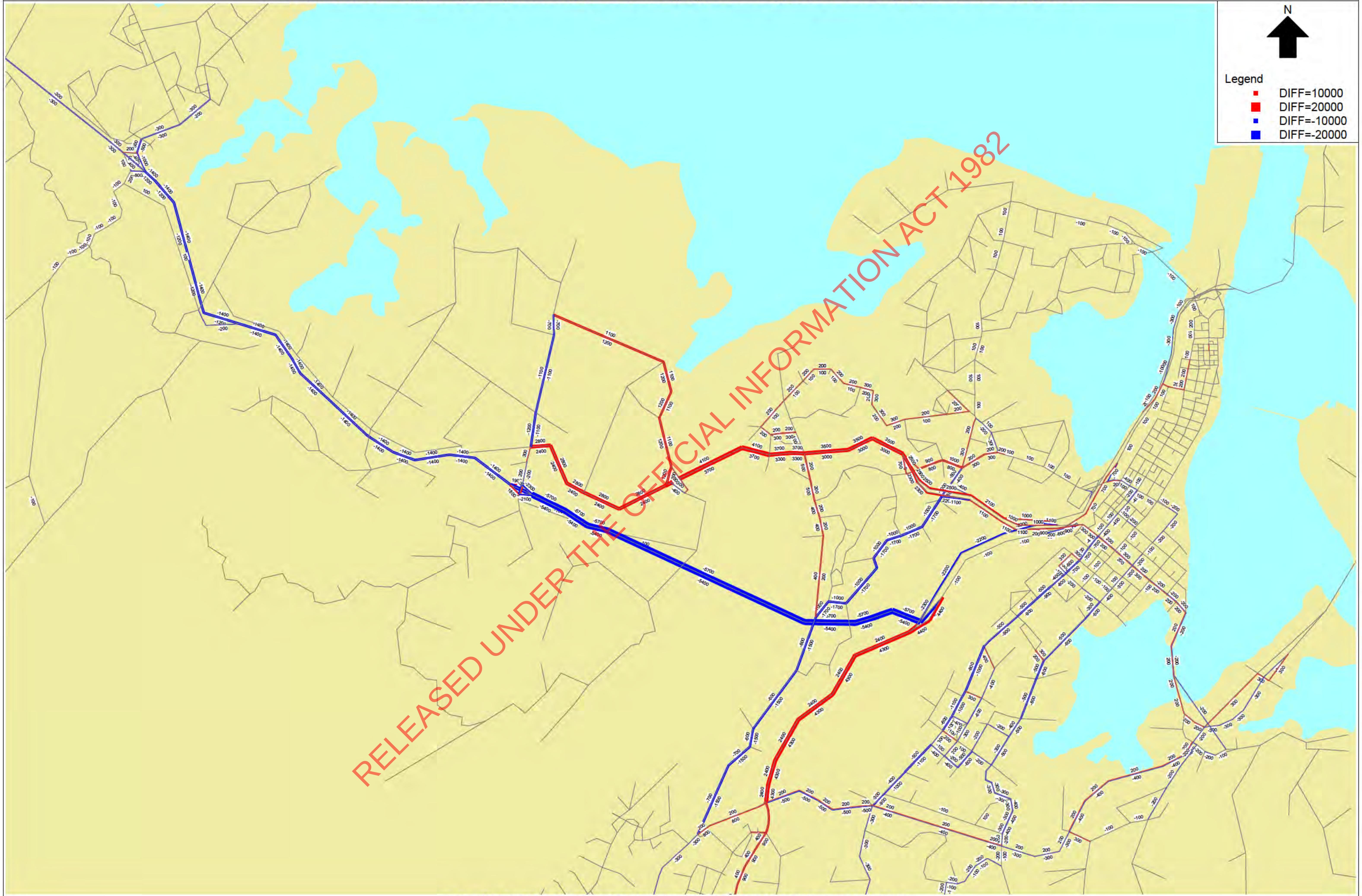
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 4 vs Existing_withToll Scenarios_Y2048



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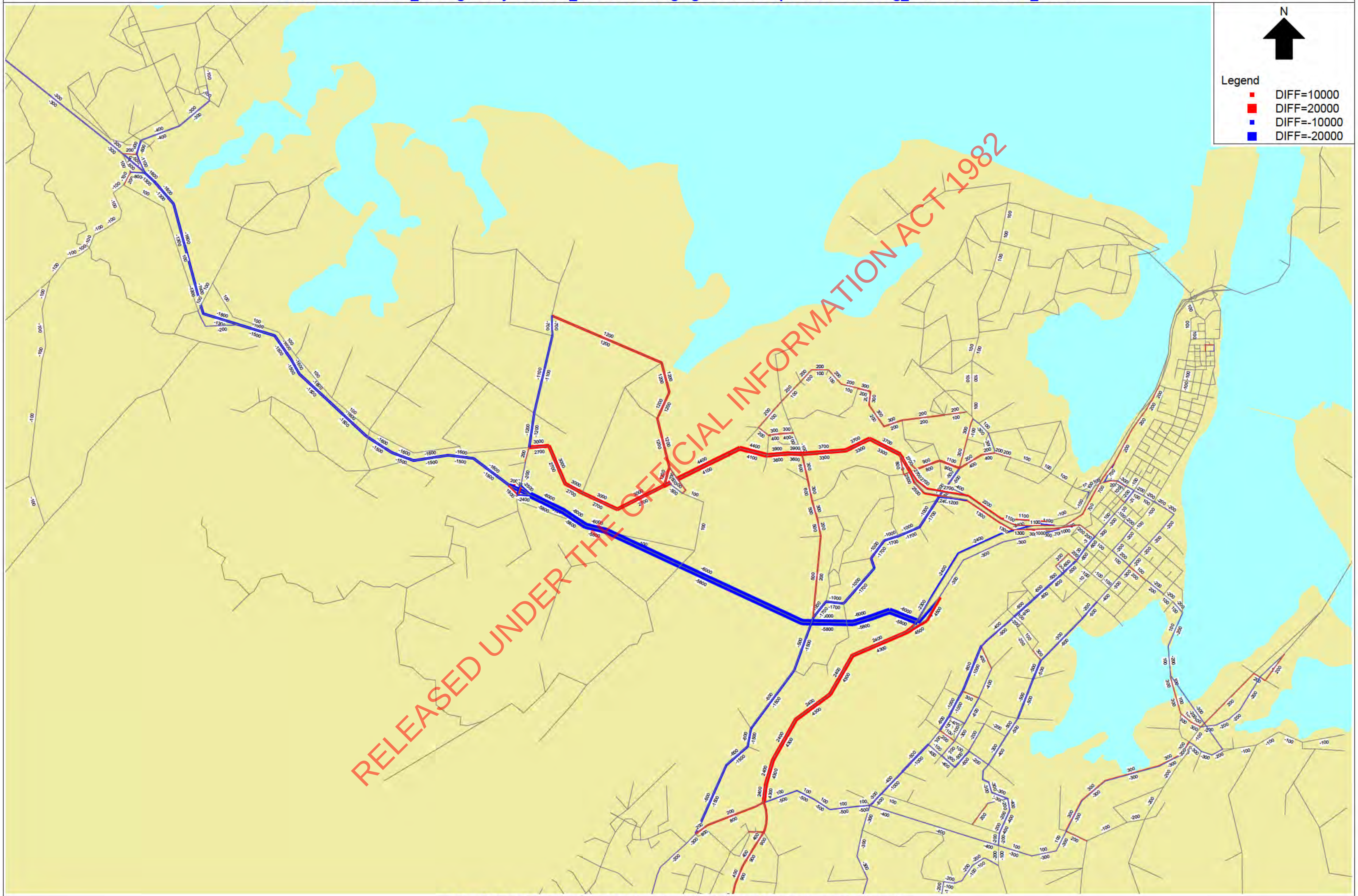
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 5 vs Existing_withToll Scenarios_Y2048



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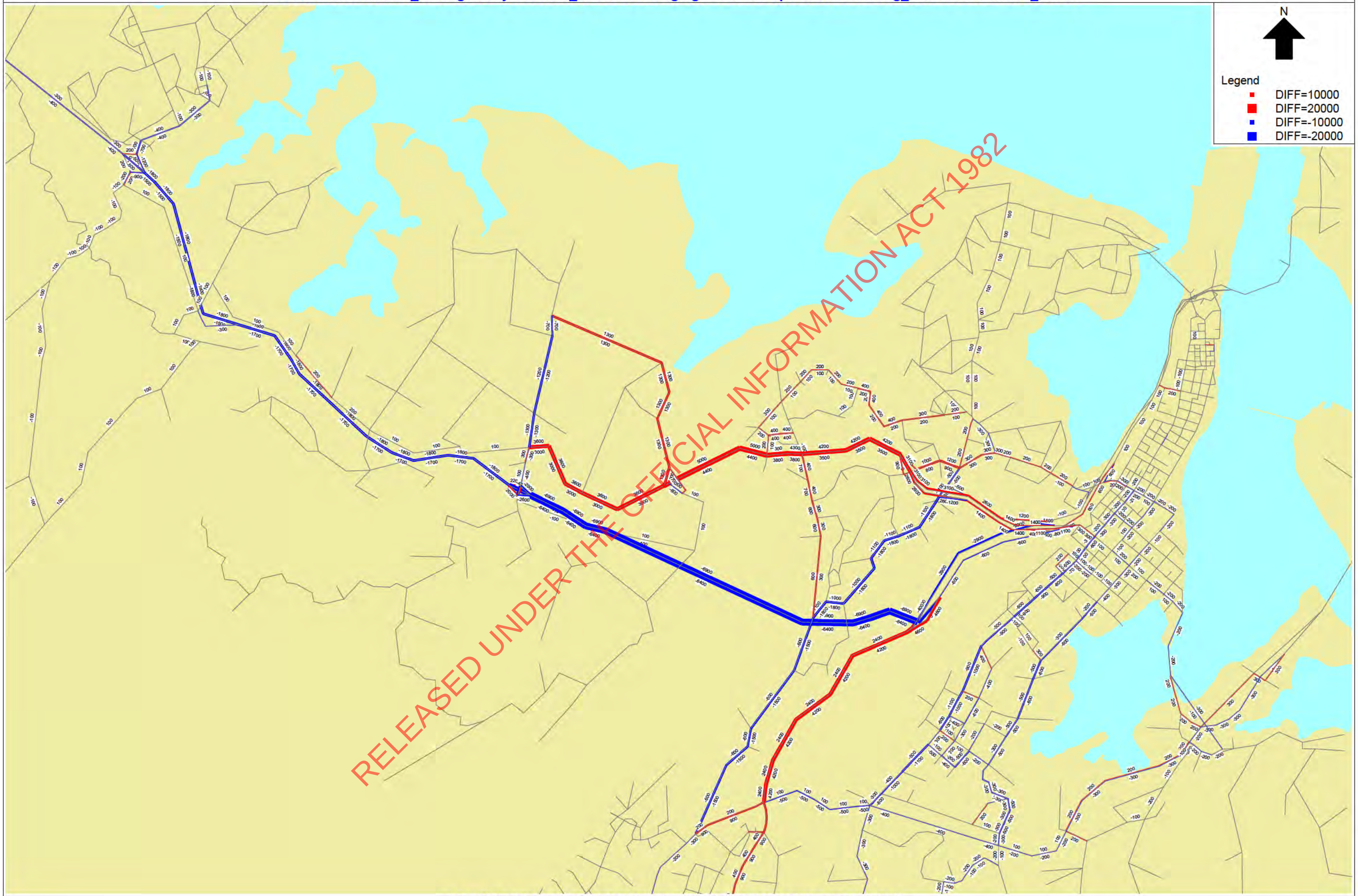
Flow Difference Plot_Average Daily Vehicles_TNL Toll Emerging Preferred Option 6 vs Existing_withToll Scenarios_Y2048



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D

Appendix D – Emerging Preferred Toll Strategy Flow Difference Plots

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Appendix D – Emerging Preferred Toll Strategy Flow Difference Plots

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Level of Service_TNL Toll_Emerging Preferred Option 1_Y2031

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Level of Service_TNL Toll_Emerging Preferred Option 2_Y2031

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Level of Service_TNL Toll_Emerging Preferred Option 3_Y2031

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Level of Service_TNL Toll_Emerging Preferred Option 1_Y2048

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Level of Service_TNL Toll_Emerging Preferred Option 2_Y2048

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Level of Service_TNL Toll_Emerging Preferred Option 3_Y2048

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Level of Service_TNL Toll_Emerging Preferred Option 4_Y2048

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Level of Service_TNL Toll_Emerging Preferred Option 5_Y2048

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Level of Service_TNL Toll_Emerging Preferred Option 6_Y2048

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Appendix E – Preferred Toll Strategy Flow Difference Plots

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Appendix E – Preferred Toll Strategy Flow Difference Plots

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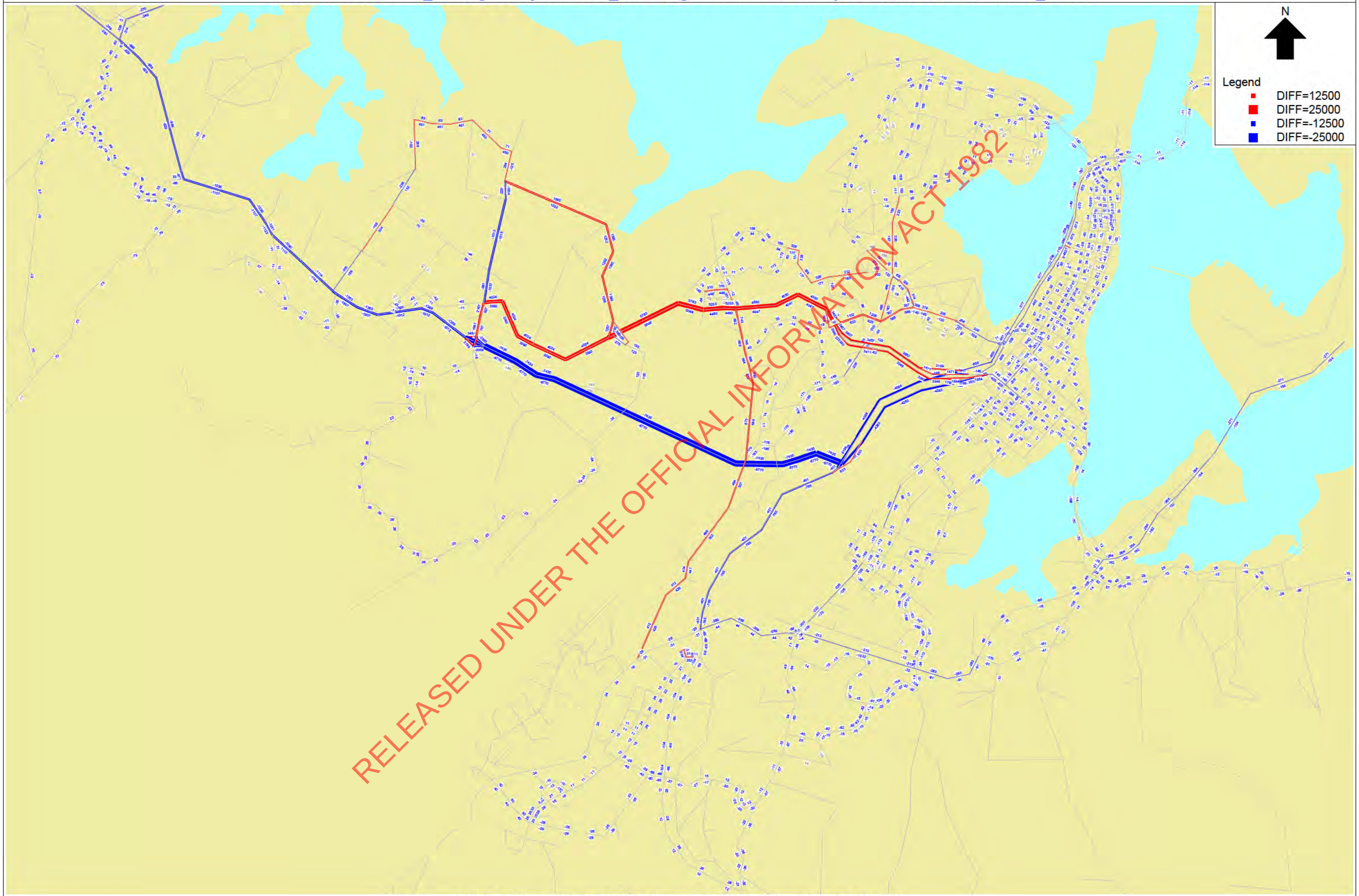
Flow Difference Plot_Average Daily Vehicles_TNL Stage1 Preferred Toll Option vs No Toll Scenarios_Y2031



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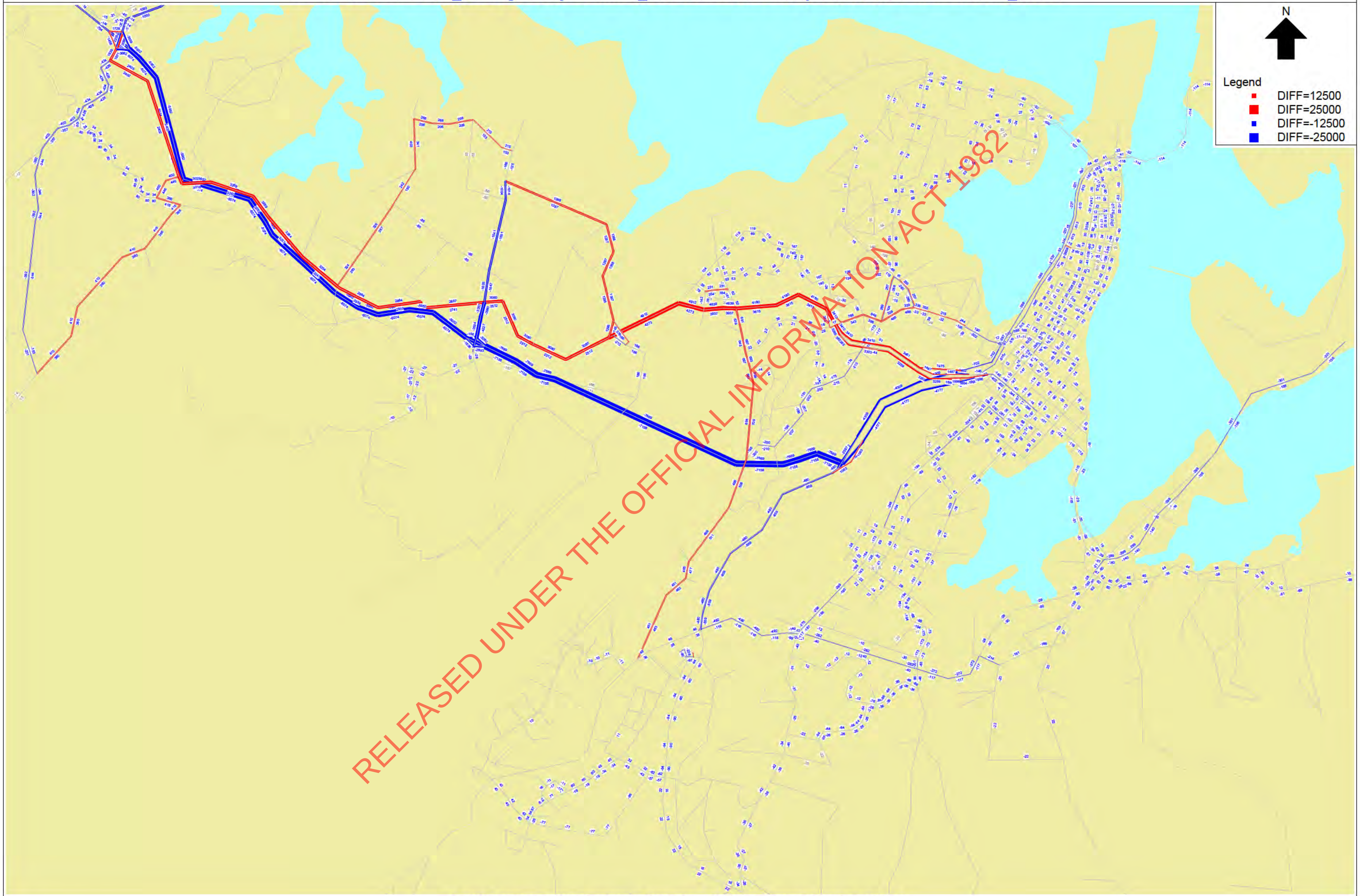
Flow Difference Plot_Average Daily Vehicles_TNL Preferred Toll Option vs No Toll Scenarios_Y2031



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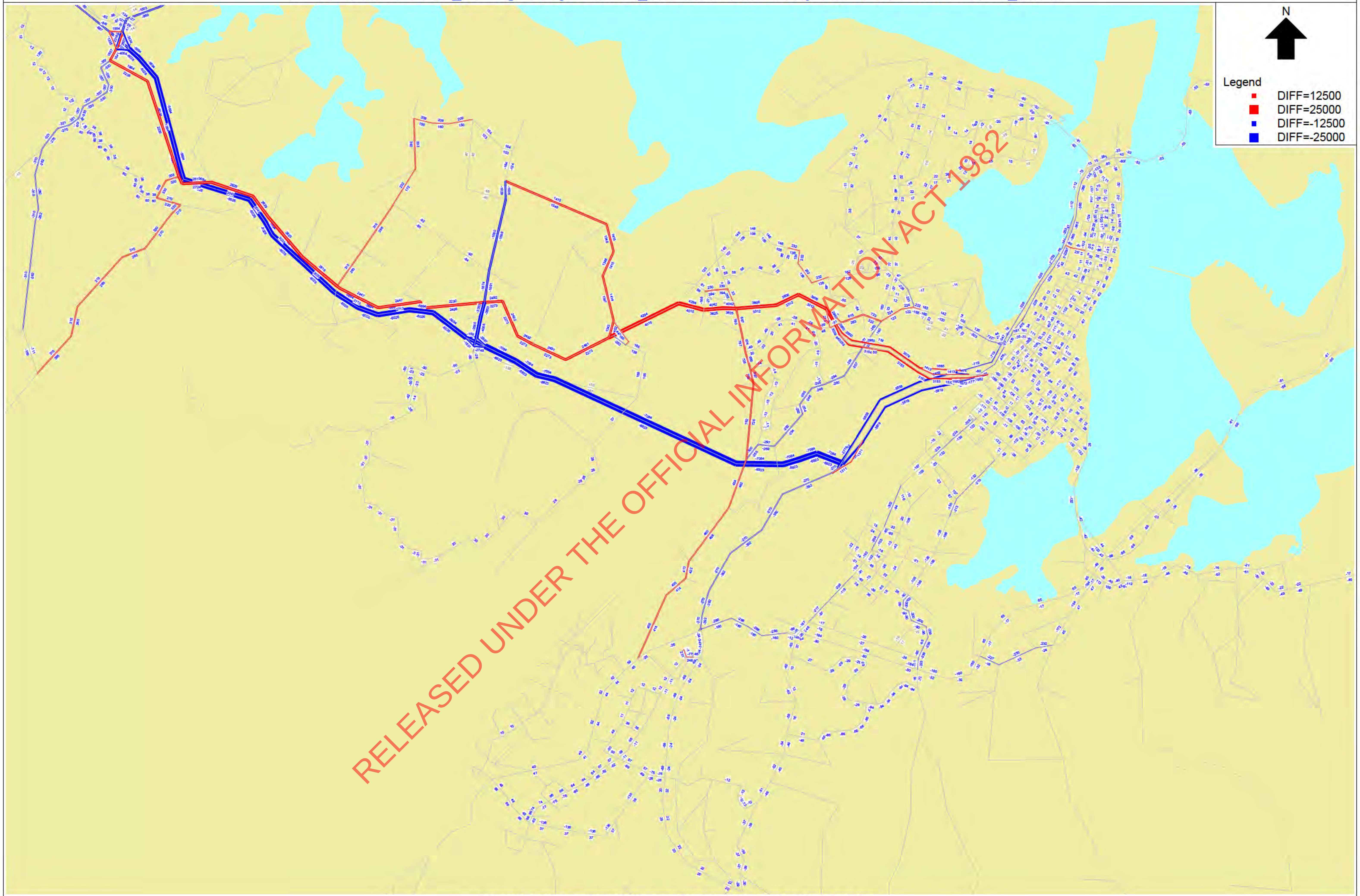
Flow Difference Plot_Average Daily Vehicles_TNL Preferred Toll Option vs No Toll Scenarios_Y2048



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Appendix F – Preferred Toll Strategy Level of Service Plots

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Appendix F – Preferred Toll Strategy Level of Service Plots

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Level of Service_TNL Stage 1 Preferred Toll Option Scenario_Y2031

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Level of Service_TNL Preferred Toll Option Scenario_Y2031

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Level of Service_TNL Preferred Toll Option Scenario_Y2048

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Appendix G – Risk analysis methodology and outputs from risk analysis

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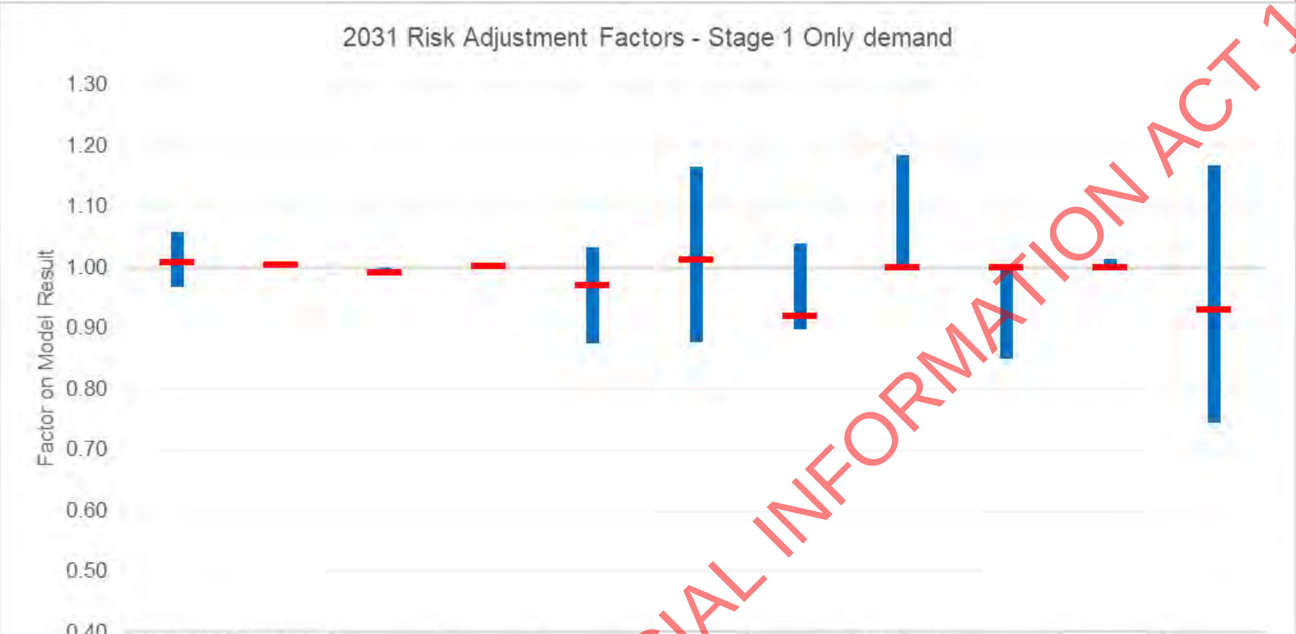
Appendix G – Risk analysis methodology and outputs from risk analysis

Risk Analysis Results



	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.06	1.00	1.00	1.01	1.03	1.17	1.04	1.18	1.00	1.01	1.17
5th	0.97	1.00	0.99	1.00	0.87	0.88	0.90	1.00	0.85	1.00	0.74
50th	1.01	1.00	0.99	1.00	0.97	1.01	0.92	1.00	1.00	1.00	0.93

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2031 Risk Adjustment Factors - Stage 2 Only demand

	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.06	1.03	1.00	1.16	1.05	1.02	1.03	1.00	1.00	1.01	1.24
5th	0.97	0.98	0.99	0.98	0.93	0.93	1.01	0.96	0.85	1.00	0.92
50th	1.01	1.00	0.99	1.13	0.99	0.98	1.02	1.00	1.00	1.00	1.10

2031 Risk Adjustment Factors - Through demand

	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.06	1.01	1.00	1.02	1.01	1.04	1.03	1.03	1.00	1.01	1.06
5th	0.97	0.98	0.99	0.97	0.94	0.90	0.97	1.00	0.85	1.00	0.82
50th	1.01	1.00	0.99	1.00	0.98	0.98	1.00	1.00	1.00	1.00	0.96

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	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.09	1.00	1.00	1.00	1.06	1.21	0.93	1.14	1.00	1.01	1.11
5th	0.91	1.00	0.99	0.99	0.73	0.89	0.90	1.00	0.85	1.00	0.64
50th	1.00	1.00	0.99	1.00	0.93	1.03	0.91	1.00	1.00	1.00	0.86

	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.09	1.00	1.00	1.02	1.05	1.09	1.01	1.00	1.00	1.01	1.13
5th	0.91	1.00	0.99	1.01	0.83	0.97	0.97	0.94	0.85	1.00	0.79
50th	1.00	1.00	0.99	1.01	0.96	1.02	1.00	1.00	1.00	1.00	0.97

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	City wide land Use assumptions	Omokoroa Growth assumptions	Mode shift	WtP - VoT	WtP - Escalation	ASC values	VOC	Takitimu Drive toll continuation	Logit model	Annualisation	Combined
95th	1.09	1.00	1.00	1.02	1.04	1.02	1.04	1.04	1.00	1.01	1.09
5th	0.91	0.99	0.99	0.97	0.92	0.96	0.97	1.00	0.85	1.00	0.82
50th	1.00	1.00	0.99	1.00	0.99	0.99	1.00	1.00	1.00	1.00	0.96

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Appendix H – SH29 Toll Scenario Flow Difference Plot

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Appendix H – SH29 Toll Scenario Flow Difference Plot

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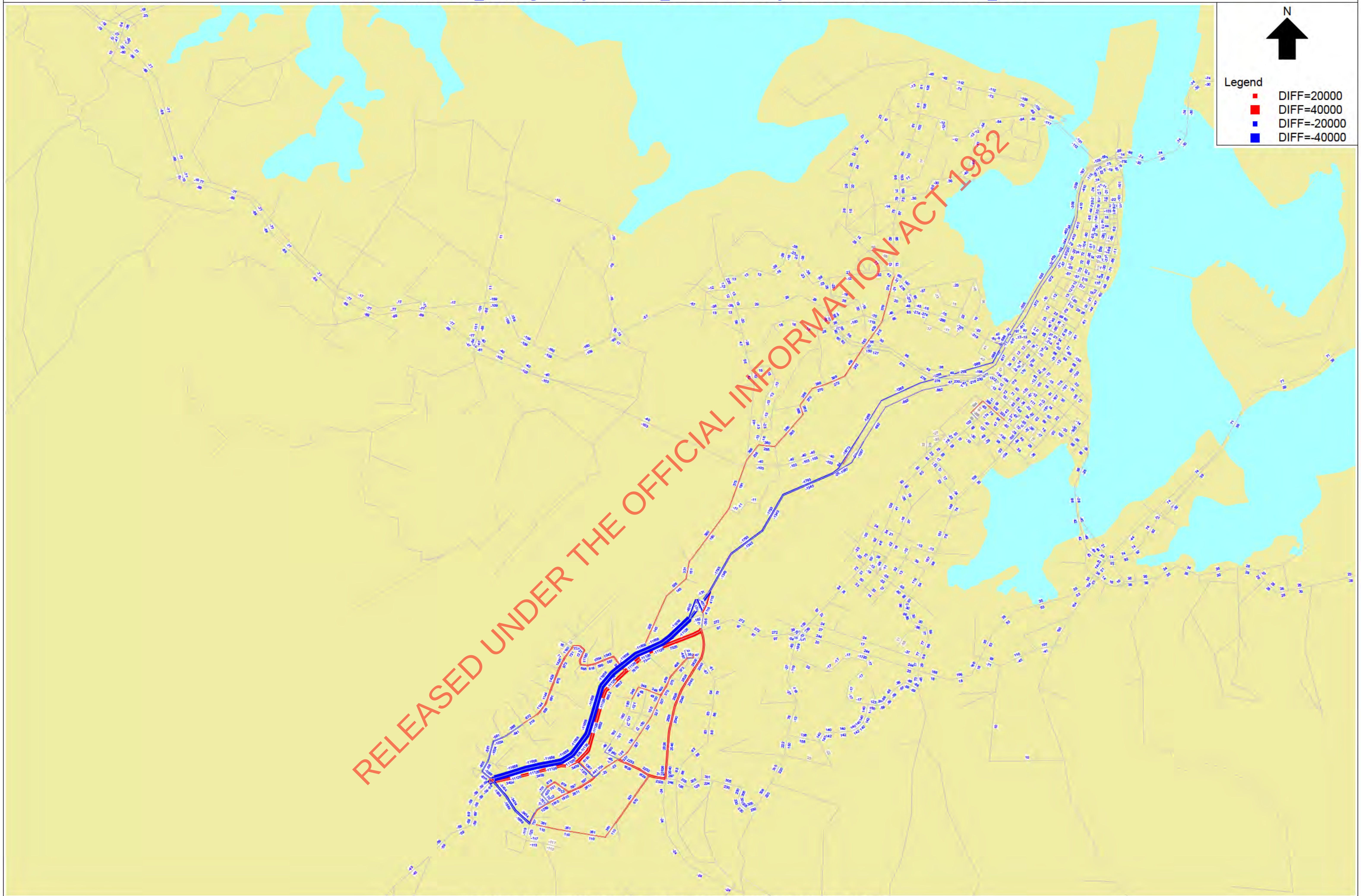
Flow Difference Plot_Average Daily Vehicles_TNL Sensitivity Test vs No Toll Scenarios_Y2048



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Appendix I – SH29 Toll Scenario Level of Service Plot

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Appendix I – SH29 Toll Scenario Level of Service Plot

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Level of Service_TNL Sensitivity Test Scenario_Y2048

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