TRAFFIC AND ECONOMICS

11.1. TRAFFIC ASSESSMENT

11.1.1. Introduction

An assessment of the traffic performance and operational differences between the Do-Minimum network and the two Transmission Gully alignment options (Unconstrained and In-Designation Alignments) has been made. In addition to providing important design guidance, the traffic assessment it is also critical in assessing the benefits of the project and the relationship between these benefits and the project costs.

The traffic assessment of the alignment options is provided together with the economic assessment undertaken for the project. An analysis of incremental benefits and the costs of providing various connections to the local road network are also provided.

11.1.2. Network Effects

The strategic importance and scale of the Transmission Gully project is such that a specific traffic model has been developed to assess changes in network performance. The outputs from the model have been used to compare the Unconstrained Alignment and the In-Designation Alignment with the Do-Minimum network.

In addition to the network performance assessment carried out using the SATURN traffic model, the Wellington Transport Strategy Model (WTSM) was also used to determine changes in travel mode and time of travel. The economic evaluations undertaken for both the Unconstrained Alignment and the In-Designation Alignment utilise these network statistics in the assessment of project benefits.

The network effects associated with this project not only relate to Transmission Gully, but also impact on other state highways and local roads. In order to understand and assess the effects of the project on the network it is important to have robust Do-Minimum assumptions. These have been derived from the Regional Land Transport Strategy (RLTS) and are documented in 5.6.11 of this report.

The Do-Minimum assumptions include four lanes along Mana Esplanade and the retention of both Paremata Bridges. These features have also been included in the networks for the Unconstrained and In-Designation Alignments. Initial sensitivity tests have been undertaken in WSTM and SATURN in order to understand the impact of the removal of two lanes and the original Paremata Bridge. As would be expected, the differences in operational performance are insignificant after Transmission Gully is constructed, but significant for the Do-Minimum network.

Description	Do Minimum		In Designation Alignment		Unconstrained Alignment	
Period	AM	PM	AM	PM	AM	PM
Network average travel speed (kms/hr)	52.4	53.1	55.3	56.4	55.4	56.4
Total trips assigned (pcu's)	38,450	49,030	38,570	49,210	38,570	49,210
Total vehicle distance (pcu-kms)	376,570	418,360	396,320	441,330	395,880	441,260
Total travel time (pcu-hrs)	7,190	7,880	7,160	7,820	7,150	7,820
Total delayed time (pcu-hrs)	440	377	412	354	412	356
Total queued time (pcu-hrs)	533	608	512	552	505	546

Table 11.1: 2016 Network Performance

Induced traffic effects, changes in land use and modal shifts associated with projects also impact on the network and have been considered.

Network performance for the Do-Minimum and the two Transmission Gully alignments is presented in Tables 11.1 and 11.2 for 2016 and 2026 respectively.

Description	Do Minimum		In Designation Alignment		Unconstrained Alignment	
Period	AM	PM	AM	PM	AM	PM
Network average travel speed (kms/hr)	51.6	50	54.5	53.7	54.5	54.3
Total trips assigned (pcu's)	42,220	53,160	42,290	53,310	42,290	53,310
Total vehicle distance (pcu-kms)	404,790	440,380	423,830	466,970	423,270	465,220
Total travel time (pcu-hrs)	7,840	8,800	7,780	8,700	7,770	8,560
Total delayed time (pcu-hrs)	528	469	496	455	498	433
Total queued time (pcu-hrs)	579	821	560	716	556	677

Table 11:2: 2026 Network Performance

Constructing either of the Transmission Gully alignments results in an improvement in average travel speeds, and a reduction in delays. There is also a small increase in the number of trips on the network and the distance travelled. The additional trips are largely due to the release of suppressed demand, changes in time of travel and modal shifts. The increase in distance travelled is largely due to the increase route length for Transmission Gully and the additional traffic on the network. It should be noted that these are network wide values and increases in traffic in one location might be offset by decreases in another. For example, the network values from SATURN show a small increase in overall trips; however the screenlines for locations north and south of Transmission Gully suggest much larger differences between the Do-Minimum and either alignment option. This implies these impacts are not significant on a network-wide basis.

As expected, there is a progressive deterioration of the wider network performance between 2016 and 2026. This is a trend in the Do-Minimum network and is replicated for the Transmission Gully alignments, albeit that Transmission Gully performs better than the Do-Minimum network. This illustrates that notwithstanding the construction of Transmission Gully, there are other locations on the network which are experiencing delay and disruption, such as the Ngauranga Interchange.

The difference between the two Transmission Gully alignment options at a network level is minimal, however the Unconstrained Alignment offers slightly better performance and less delay that the In-Designation alignment.

11.1.3. Traffic Demands

Information on traffic demands in 2016 and 2026 for both Transmission Gully alignment options and the wider network is shown in Figures 11.1 to 11.4. Detailed traffic demand information comprising breakdowns of AM, Interpeak and PM demands, together with full on and off ramp demands for each of the major intersections for each of the alignment options and the Do-Minimum network is presented in Appendix B.

Do-Minimum and Transmission Gully Scheme Comparison

The Do-Minimum traffic demands are presented in Figures 3.13 to 3.15 in Section 3. At the northern intersection of Transmission Gully with SH1 there is an increase between 2006 and 2026 of approximately 21% in the number of vehicles travelling in and out of the scheme area with Transmission Gully in place. Light vehicles make up the majority of the increase in vehicle trips while heavy vehicle trips stay relatively constant with the introduction of Transmission Gully. The majority of traffic is predicted to use the Transmission Gully route in preference to the existing SH1.

The introduction of Transmission Gully results in a significant decrease in flows by 2026 along the existing SH1 between MacKays Crossing and Linden. The percentage reduction at the various intersections is as follows:

- Paekakariki (70%),
- Plimmerton, north of Grays Road (65%),
- Paremata (41%),
- Papakowhai, north of Whitford Brown Avenue (40%),
- Porirua, on the Ramp Bridge (26%) and north of Mungavin Interchange) (39%).

In addition to a significant decrease in flows on the existing SH1, there is also a reduction in the number of vehicles on the local roads at the intersections listed above. The decrease in local road usage is greater in northern areas than southern due to the reduced attraction of Transmission Gully as an alternative route for traffic originating in southern parts of the scheme area. Consequently, greater proportions of local traffic continue to use the local road network.

The introduction of a number of new links to the west of the Transmission Gully route will inject additional traffic into different parts of the network at James Cook Drive, Warspite Avenue/Waitangirua and Kenepuru Drive.

The flows along SH58 decrease by approximately 50% to the west of Transmission Gully, i.e. towards SH1. This is due to vehicles, including those originating in Whitby and Porirua East accessing SH58 to the Hutt Valley via Transmission Gully in preference to SH58 between Paremata and Transmission Gully. Conversely, flows on SH58 east of Transmission Gully, i.e towards SH2, increase by approximately 30%. There is an associated increase of approximately 2 to 3% in traffic along SH2 south of the Haywards intersection due to Transmission Gully and SH58 providing a more attractive link to the Hutt Valley from Porirua and Kapiti than via SH1 and Ngauranga Gorge.

At the southern intersection of Transmission Gully with SH1 at Linden there is an increase in traffic flows between 2006 and 2026 associated with the introduction of Transmission Gully of approximately 9%. As at the northern end of the route the largest increase is in light vehicles. Heavy vehicle numbers remain relatively constant. At the Linden intersection 70% of all traffic is predicted to use the existing SH1 as opposed to Transmission Gully due to the concentrated land-use around Porirua and the heavy movements between Porirua and Wellington CBD.

Unconstrained and In-Designation Alignment Comparison

At the northern end of the project there is very little difference between the total number of vehicles entering, or leaving, the network with either of the Transmission Gully alignment options. The main difference is that the Unconstrained Alignment has slightly higher numbers of southbound heavy vehicles.

Similarly, the choice of alignment for the Transmission Gully route makes little difference in the traffic predicted on the existing SH1 and the major intersections between MacKays Crossing and Linden. The only significant difference is higher numbers of southbound heavy vehicles use the existing SH1 with the Unconstrained Alignment than with the In-Designation Alignment.

One of the significant differences between the Unconstrained Alignment and the In-Designation Alignment is the use of a single interchange at James Cook with the Unconstrained Alignment and interchanges at James Cook and Warspite with the In-Designation Alignment. Approximately 30% more traffic accesses Transmission Gully via the single James Cook interchange on the Unconstrained Alignment compared with the two interchanges provided in the In-Designation Alignment.

More traffic uses SH58 east and westbound between SH1 and Transmission Gully with the In-Designation Alignment than the Unconstrained Alignment. This is because the Unconstrained Alignment provides improved access to the northern part of Warspite Avenue at Waitangirua, and the surrounding Ascot Park network. East of Transmission Gully, traffic volumes on SH58 are very similar for both Transmission Gully alignment options.

At the southern end of the project the total flow in and out of the scheme area on SH1 south of Linden is similar for the two Transmission Gully alignment options. However, the In-Designation Alignment is predicted to attract 10% more traffic to Transmission Gully than the Unconstrained Alignment. The In-Designation Alignment also results in an increase in the number of vehicles using the Kenepuru link and more traffic on Transmission Gully to the south of Warspite. The Unconstrained Alignment attracts more traffic to the north of James Cook due to the location of the interchanges and their connections to local roads.

The difference in volumes on the existing SH1 between Linden and Grays Road (Plimmerton) vary slightly between the two alignments when Transmission Gully is constructed. This is related to the means by which the different alignments provide access to the area between Porirua and Plimmerton. The Unconstrained Alignment has slightly higher volumes using the existing SH1 south of Whitford Brown Avenue, while the In-Designation Alignment has higher volumes on SH1 north of Whitford Brown Avenue.

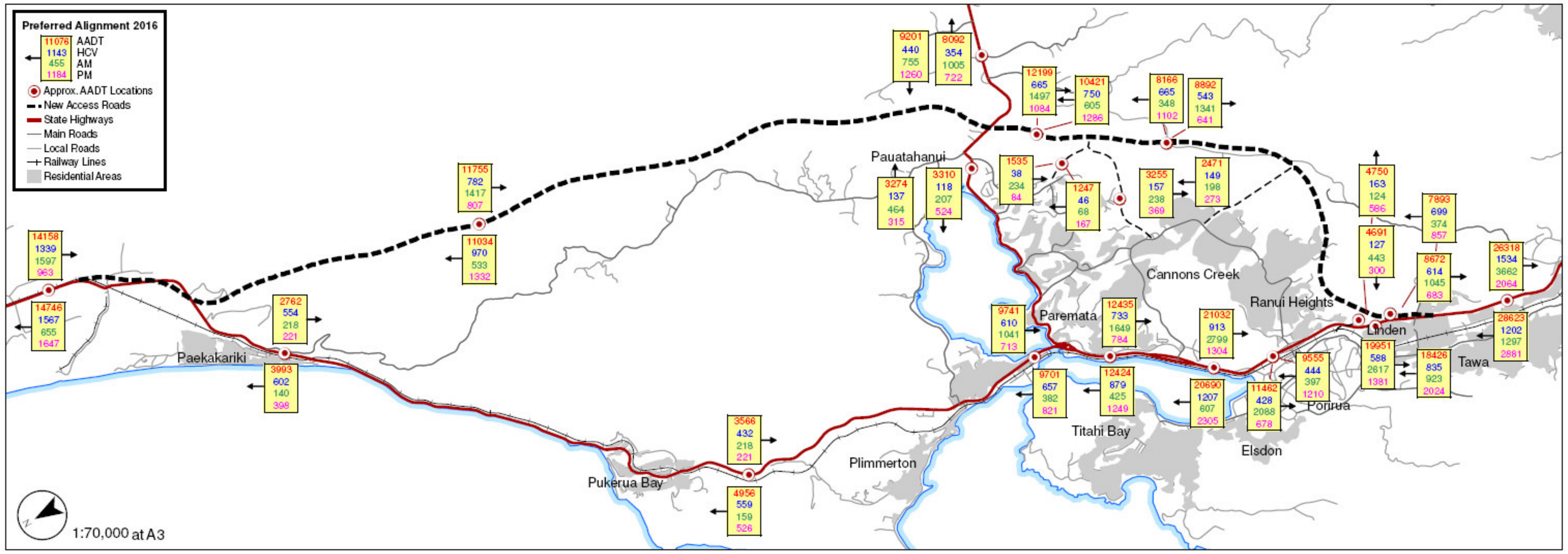

Figure 11.1: 2016 Traffic Flow Data – Unconstrained Alignment

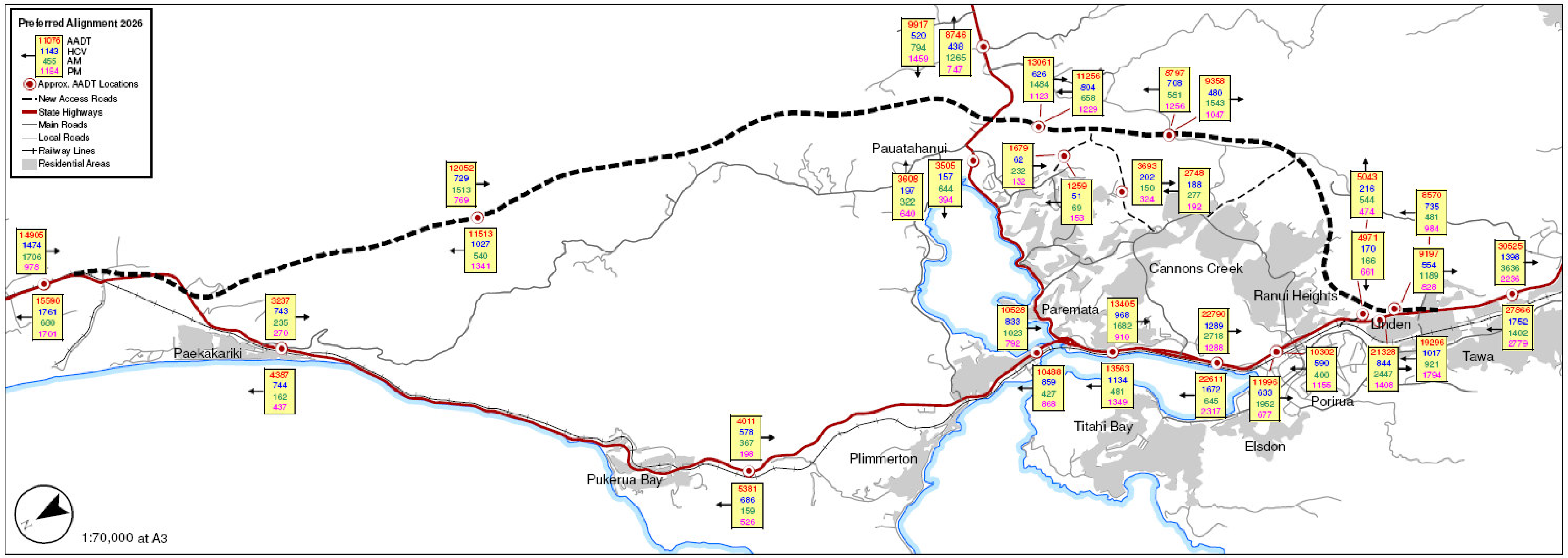

Figure 11.2: 2026 Traffic Flow Data – Unconstrained Alignment

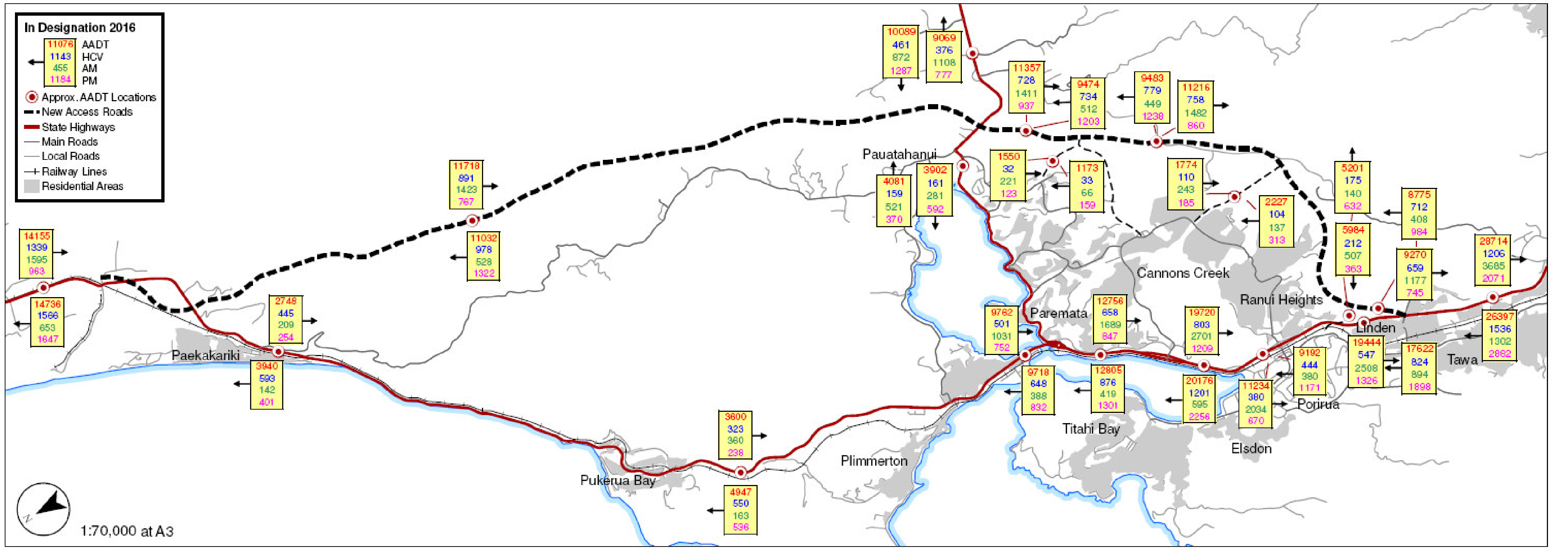

Figure 11.3: 2016 Traffic Flow Data – In-Designation Alignment

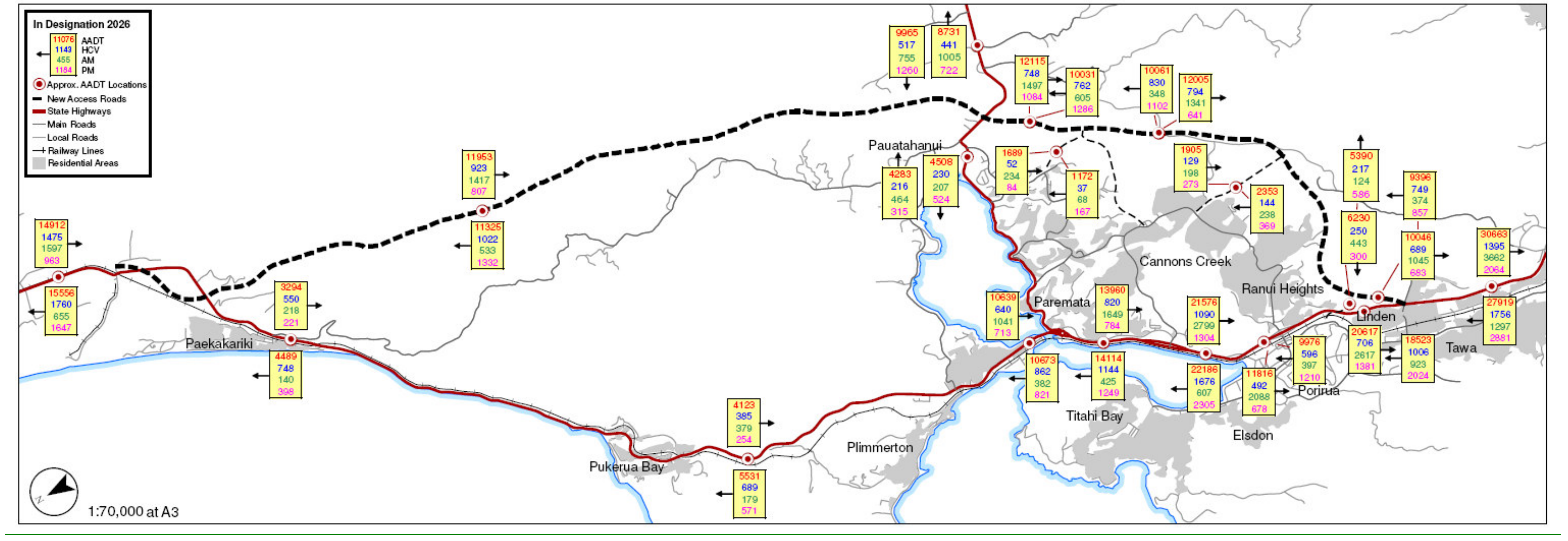

Figure 11.4: 2026 Traffic Flow Data – In-Designation Alignment

11.1.4. Journey Times

The change in journey times for the key strategic routes provides a clear indication as to the level of congestion and delay prior to the project, and the benefits provided by Transmission Gully. Three key strategic corridors have been identified for reporting purposes. Two-way journey times have been identified for the following routes:

- MacKays Crossing to and from Linden via SH1,
- MacKays Crossing to and from Linden via Transmission Gully,
- MacKays Crossing to and from Haywards intersection on SH2 via SH1and SH58,
- MacKays Crossing to and from Haywards intersection on SH2 via Transmission Gully and SH58,
- Linden to and from Haywards intersection on SH2 via SH1 and SH58,
- Linden to and from Haywards intersection on SH2 via Transmission Gully and SH58.

Details of journey times for these routes for Transmission Gully in place and the Do-Minimum case, are shown in Tables 11.3 and 11.4. The tables provide journey times in seconds for the AM and PM peak periods in each direction. A distinction has also been made between light vehicles (cars) and heavy vehicles (HCVs) in order to understand the difference between user type, and also variation in routes.

Do-Minimum 2016 compared to Do-Minimum 2026

The change in travel times for the Do-Minimum scenario between 2016 and 2026 is considered relatively minor with the maximum increase in travel time being approximately 2 minutes during the PM peak for the trip from SH2 to MacKays Crossing via SH58 northbound. Travel times for the Do-Minimum are presented in detail in Section 3.11.

	Transmission Gully In Place									
	Do-Minimum		In-Designation Alignment				Unconstrained Alignment			
	AM	PM	AM		PM		AM		PM	
			lights	HCVs	lights	HCVs	lights	HCVs	lights	HCVs
MacKays to Linden via SH1 (S)	30.5	25.5	27.4	27.4	24.9	24.9	26.8	26.8	24.3	24.3
Linden to MacKays via SH1 (N)	23.7	30.6	23.7	23.7	25.0	25.0	23.7	23.7	25.0	25.0
MacKays to Linden via Transmission Gully (S)	-	-	21.9	26.3	19.2	23.8	21.8	26.3	19.3	23.8
Linden to MacKays via Transmission Gully (N)	-	-	19.1	22.9	20.3	23.9	19.2	23.0	20.3	23.9
MacKays to SH2 via SH1 and SH58 (S)	34.3	31.9	32.4	32.4	32.1	32.1	31.8	31.8	31.5	31.5
SH2 to MacKays via SH58 and SH1 (N)	32.7	38.4	32.5	32.5	33.5	33.5	32.5	32.5	33.6	33.6
MacKays to SH2 via Transmission Gully and SH58 (S)	-	-	19.4	22.3	18.9	21.9	19.4	22.4	18.9	21.9
SH2 to MacKays via SH58 and Transmission Gully (N)	-	-	19.5	21.9	20.5	22.9	19.5	22.0	20.7	23.0
SH2 to Linden via SH58 and SH1 (S)	24.8	21.8	23.5	23.5	22.0	22.0	23.5	23.5	22.1	22.1
Linden to SH2 via SH1 and SH58 (N)	20.6	22.2	20.7	20.7	21.6	21.6	20.7	20.7	21.6	21.6
SH2 to Linden via SH58 and Transmission Gully (S)	-	-	18.4	19.9	16.8	18.4	18.4	19.9	17.0	18.5
Linden to SH2 via Transmission Gully and SH58 (N)	-	-	16.2	17.6	17.0	18.3	16.3	17.6	17.0	18.4

Table 11.3: Journey Times 2016 (minutes)

Do-Minimum 2026 compared to Transmission Gully 2026

For the purposes of this assessment, the small differences between the Unconstrained and In Designation Alignments have been ignored. The significant savings in travel time for vehicles using Transmission Gully compared to the existing SH1 in the Do-Minimum case are as follows:

- Southbound: Savings of 5.0 minutes in the AM and PM peak periods for light vehicles in 2026,
- Southbound: Savings of 0.5 minutes in the AM and PM peak periods for HCV's in 2026,
- Northbound: Savings of 4.5 minutes in the AM and PM peak periods for light vehicles in 2026,
- Northbound: Savings of 0.7 minutes and 1.0 minutes in the AM and PM peak periods respectively for HCV's in 2026.

It is important to note that the journey time savings for HCV's are significantly less as a result of their lower speeds on the steep gradients on Transmission Gully and the slightly greater length of the Transmission Gully route compared to the existing SH1. As a result, the time savings for HCV's using Transmission Gully is minimal. This reduces the number of HCV's likely to use Transmission Gully. However, greater journey time savings are achieved for the route from MacKays Crossing to SH2 via Transmission Gully and SH58 compared with the Do-Minimum route via SH1 and SH58.

The journey times for light vehicles and HCV's using the existing SH1 are the same. This is because there are few steep gradients of any length and passing is prohibited on a significant length of the existing SH1 route.

			Transmission Gully In Place							
	Do-Minimum		In-Designation Alignment				Unconstrained Alignment			
	AM	PM	AM		PM		AM		PM	
			lights	HCVs	lights	HCVs	lights	HCVs	lights	HCVs
MacKays to Linden via SH1 (S)	30.7	27.1	27.3	27.3	25.0	25.0	26.7	26.7	24.4	24.4
Linden to MacKays via SH1 (N)	23.8	31.8	23.7	23.7	25.0	25.0	23.7	23.7	24.9	24.9
MacKays to Linden via Transmission Gully (S)	-	-	21.9	26.3	19.3	23.9	21.8	26.3	19.3	23.9
Linden to MacKays via Transmission Gully (N)	-	-	19.2	23.0	20.3	23.9	19.2	23.0	20.3	23.9
MacKays to SH2 via SH1 and SH58 (S)	35.0	32.0	32.9	32.9	32.1	32.1	32.4	32.4	31.5	31.5
SH2 to MacKays via SH58 and SH1 (N)	32.8	40.2	32.5	32.5	34.8	34.8	32.6	32.6	34.3	34.3
MacKays to SH2 via Transmission Gully and SH58 (S)	-	-	20.1	23.0	18.9	21.9	20.1	23.1	18.9	21.9
SH2 to MacKays via SH58 and Transmission Gully (N)	-	-	19.6	22.0	21.9	24.2	19.6	22.0	21.4	23.7
SH2 to Linden via SH58 and SH1 (S)	24.9	22.8	23.5	23.5	23.4	23.4	23.5	23.5	22.8	22.8
Linden to SH2 via SH1 and SH58 (N)	21.0	22.2	21.2	21.2	21.6	21.6	21.2	21.2	21.6	21.6
SH2 to Linden via SH58 and Transmission Gully (S)	-	-	18.4	19.9	18.2	19.8	18.3	19.9	17.8	19.3
Linden to SH2 via Transmission Gully and SH58 (N)	-	-	16.7	18.1	17.0	18.3	16.8	18.2	17.0	18.3

Table 11.4: Journey Times 2026 (minutes)

Transmission Gully Journey Times

Variations in journey times along the route are important indicators of congestion and travel time reliability. Figures 11.5 and 11.6 show the change in journey times on Transmission Gully for the Unconstrained Alignment and In-Designation Alignment in both directions for the AM and PM peak periods in 2016 and 2026. Journey times are shown separately for light vehicles and HCV's

The difference between the southbound AM and PM journey times along the Transmission Gully route is minimal except for the southern end where the route merges with SH1 at Linden where the AM journey times increase due to downstream capacity constraints. Journey times for the Unconstrained Alignment and In-Designation Alignment are virtually identical for southbound traffic. There are significant differences between the journey times for light vehicles and HCVs in the southbound direction. The largest difference is in the section between Paekakariki and SH58 due to the steep grade up to Wainui Saddle.

There is a more significant difference between AM and PM journey times in the northbound direction because of the delays to traffic before the diverge from SH1 to Transmission Gully at Linden. Once traffic is on Transmission Gully, the difference between the AM and PM journey times is minimal. As with the southbound direction, there are significant differences between light vehicles and HCVs due to the steep grades. Also, there is little difference between journey times between the Unconstrained Alignment and In-Designation Alignment for northbound traffic. However, there is a slight increase in journey times between the Linden and Warspite intersections for the In-Designation Alignment resulting from the Warspite intersection. However, this time is made up between the Warspite and James Cook intersections.

As a result of the capacity available on the route there is virtually no difference between journey times on Transmission Gully between 2016 and 2026.

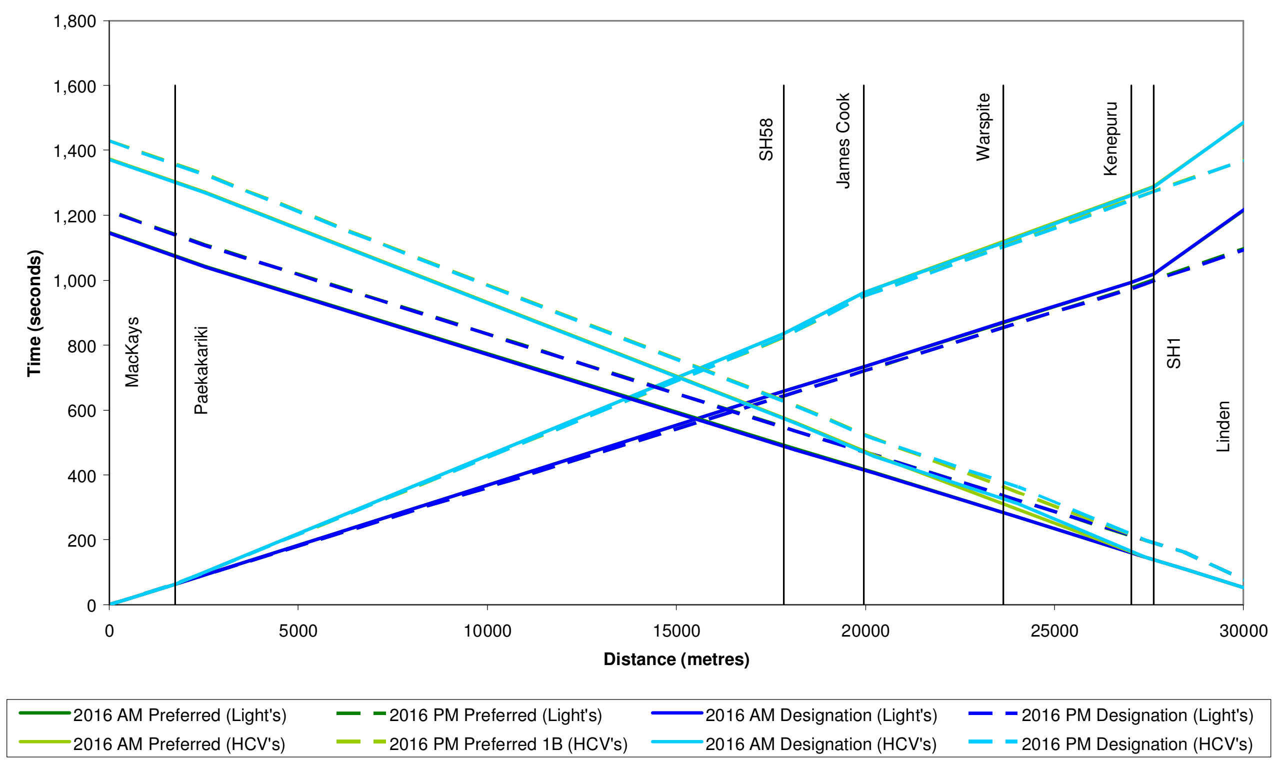

Figure 11.5: 2016 Transmission Gully Journey Times (minutes)

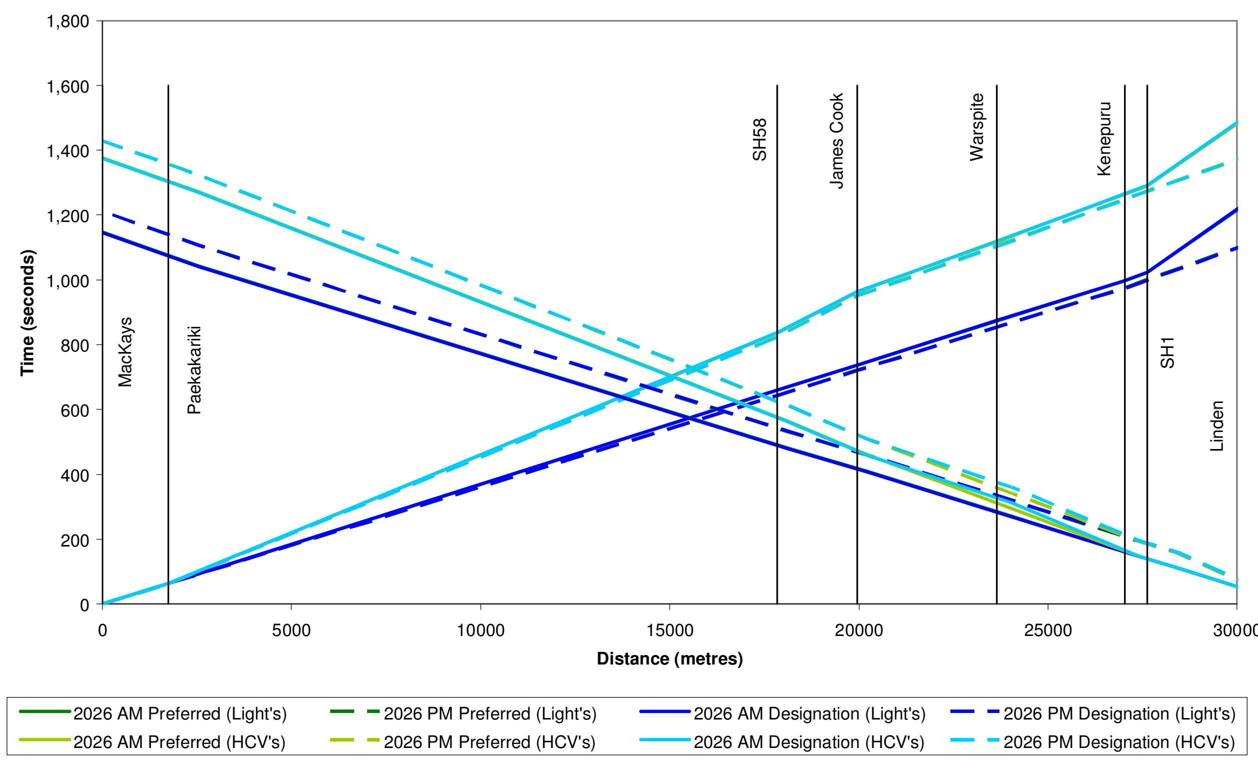

Figure 11.6: 2026 Transmission Gully Journey Times (minutes)

State Highway 1 Journey Times

Figures 11.7 and 11.8 show the change in journey times on SH1 for the Do-Minimum scenario and the Transmission Gully alignments in both directions for the AM and PM peak periods for 2016 and 2026.

For southbound flows in 2016 the AM Do-Minimum journey time is the greatest. Both Transmission Gully alignments show significant improvements over the Do-Minimum scenario, the Unconstrained Alignment shows slightly shorter journey times than the In-Designation Alignment for the AM peak. This is due to the free flow conditions to and from SH1 at Paekakariki. The PM peak shows much smaller variance between the Transmission Gully alignments and the Do-Minimum, with the Unconstrained Alignment again showing the shortest journey time. It is interesting to note that there is very little difference between the AM and PM southbound flows for the Transmission Gully alignments, except for increases in the AM journey times south of Porirua which are almost identical to the journey times for the Do-Minimum scenario south of Linden.

In 2016 the northbound AM journey times do not change with the introduction of either of the Transmission Gully alignments. This is because the southbound flows are greatest during the AM peak and northbound flows are below capacity, hence the route is uncongested. During the PM peak, however, the northbound journey times show significant improvements with the introduction of Transmission Gully. The greatest delay on SH1 for the Do-Minimum is from Whitford Brown Avenue to Plimmerton due to the demand approaching, or exceeding, the available capacity for this section. Even with the introduction of Transmission Gully, there is a small difference in journey times between the northbound AM and PM peaks on the existing SH1. This is due to significantly more traffic going north in the PM peak than the AM peak. The largest difference in journey times for the northbound AM and PM peaks occurs between the Transmission Gully intersection with the existing SH1 at Linden and the Mungavin Interchange. North of this point there is no significant difference in journey times.

In 2026 the journey times for the existing SH1 with Transmission Gully in place are virtually identical to those for 2016. The PM peak journey times for both northbound and southbound Do-Minimum flows show an increase in the PM peak from 2016. As before, the biggest increase in journey times is between Whitford Brown Avenue and Plimmerton.

In addition to the journey time assessments undertaken on the existing state highway and Transmission Gully network, a number of other routes have also been assessed in the development of the project. Consideration has been given to journey times between areas including Linden or Porirua to Porirua East or Whitby and Paekakariki to the Hutt Valley or Wellington. The Unconstrained Alignment offers the greatest journey time saving to the greatest number of road users.

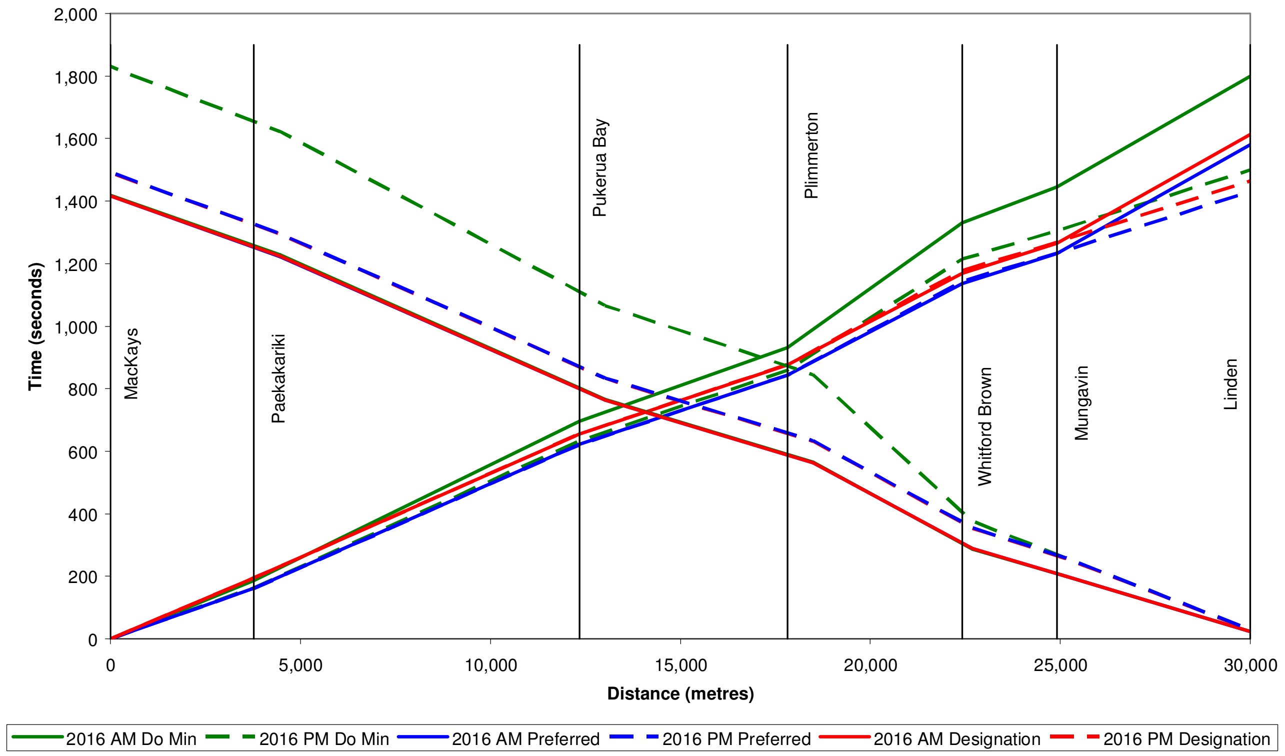

Figure 11.7: State Highway 1 Journey Times (minutes)

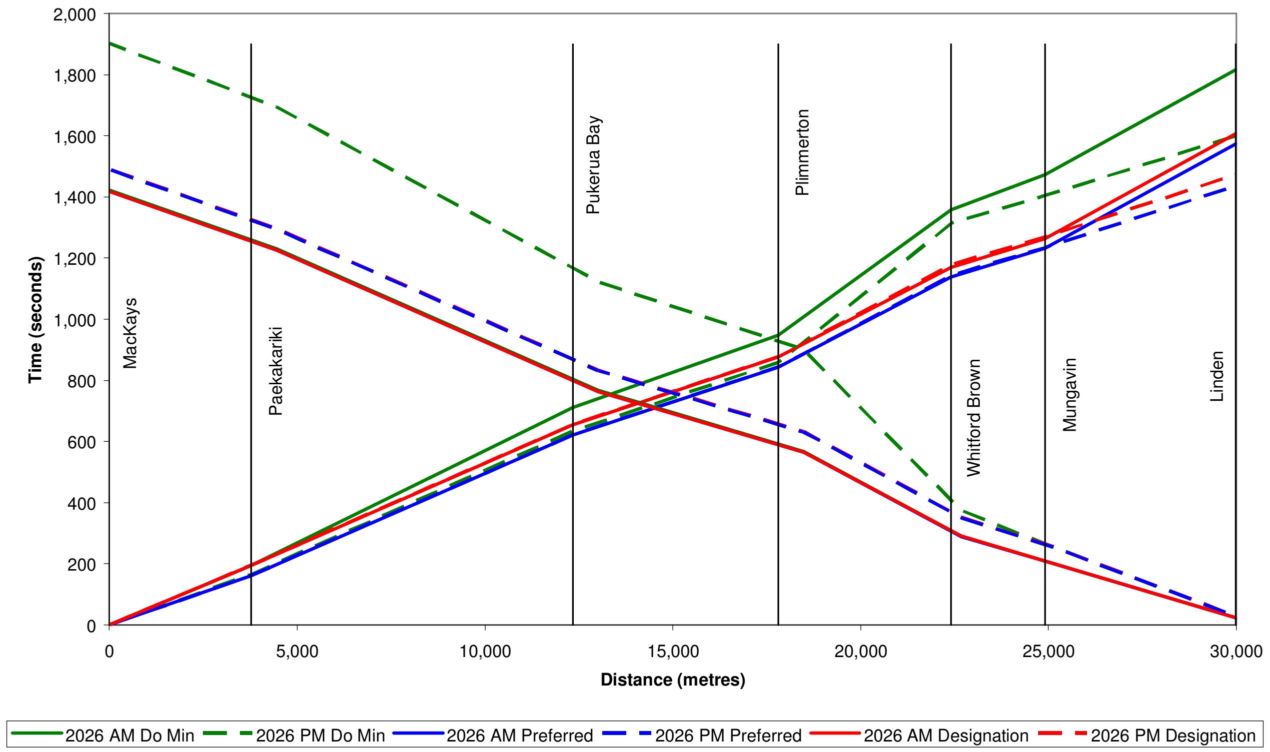

Figure 11.8: State Highway 1 Journey Times (minutes).

11.1.5. Intersection Performance

Intersection performance characterized by the volume:capacity (V/C) ratio has been determined for a number of key intersections throughout the network. Tabulated values of intersection performance are included in Appendix B. and summarised in Figures 11.9 and 11.10. Where intersection performance was considered critical, detailed intersection assessment was carried out using the SIDRA modelling package.

The information has been produced in order to understand the magnitude of change between 2016 and 2026, with and without the different Transmission Gully alignments. The calculated V/C ratios are the average for each intersection and one or more movements may be better or worse. The worst V/C ratios have been considered in the design process.

There is very little identifiable difference in intersection performance between 2016 and 2026 for the adopted intersection types.

Intersection performance south of Tawa on SH1 and on SH2 is virtually unaffected by the introduction of Transmission Gully. At MacKays crossing, and further north, intersection performance deteriorates slightly with Transmission Gully in place due to the higher traffic demands on the network.

Between Paekakariki and northern Porirua intersection performance along the existing SH1 improves significantly with the introduction of Transmission Gully largely due to the reduction of through traffic. Around central Porirua the changes in intersection performance are not as significant; with only small improvements at Mungavin Interchange and the Ramp Bridge, and no change for the Kenepuru Drive / Titahi Bay Road intersection. Thus, Transmission Gully does not address the current congestion issues at Mungavin Interchange, but implementing Transmission Gully will mean the issues do not worsen, at least until 2026.

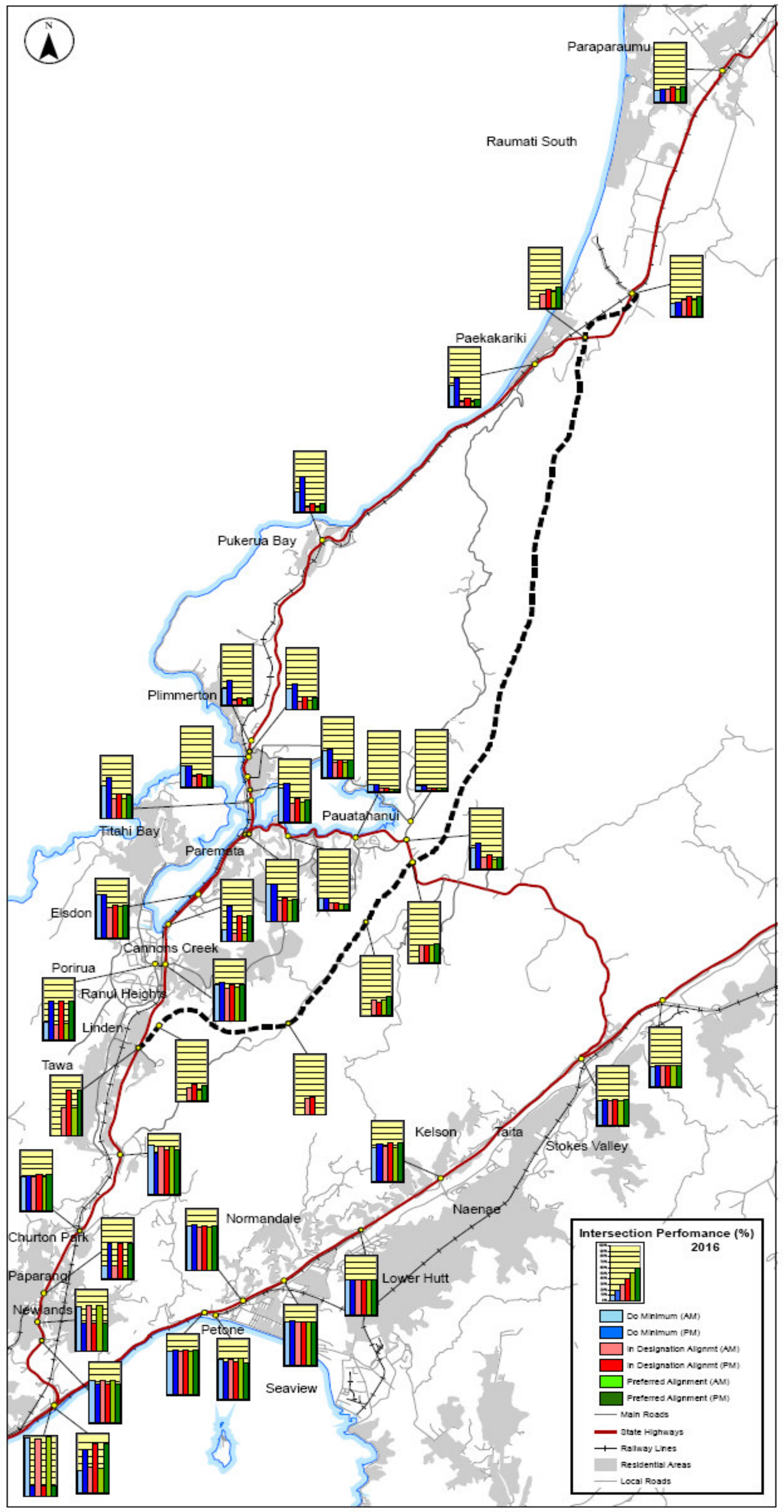

Figure 11.9: 2016 Do-Minimum and Transmission Gully intersection Performance

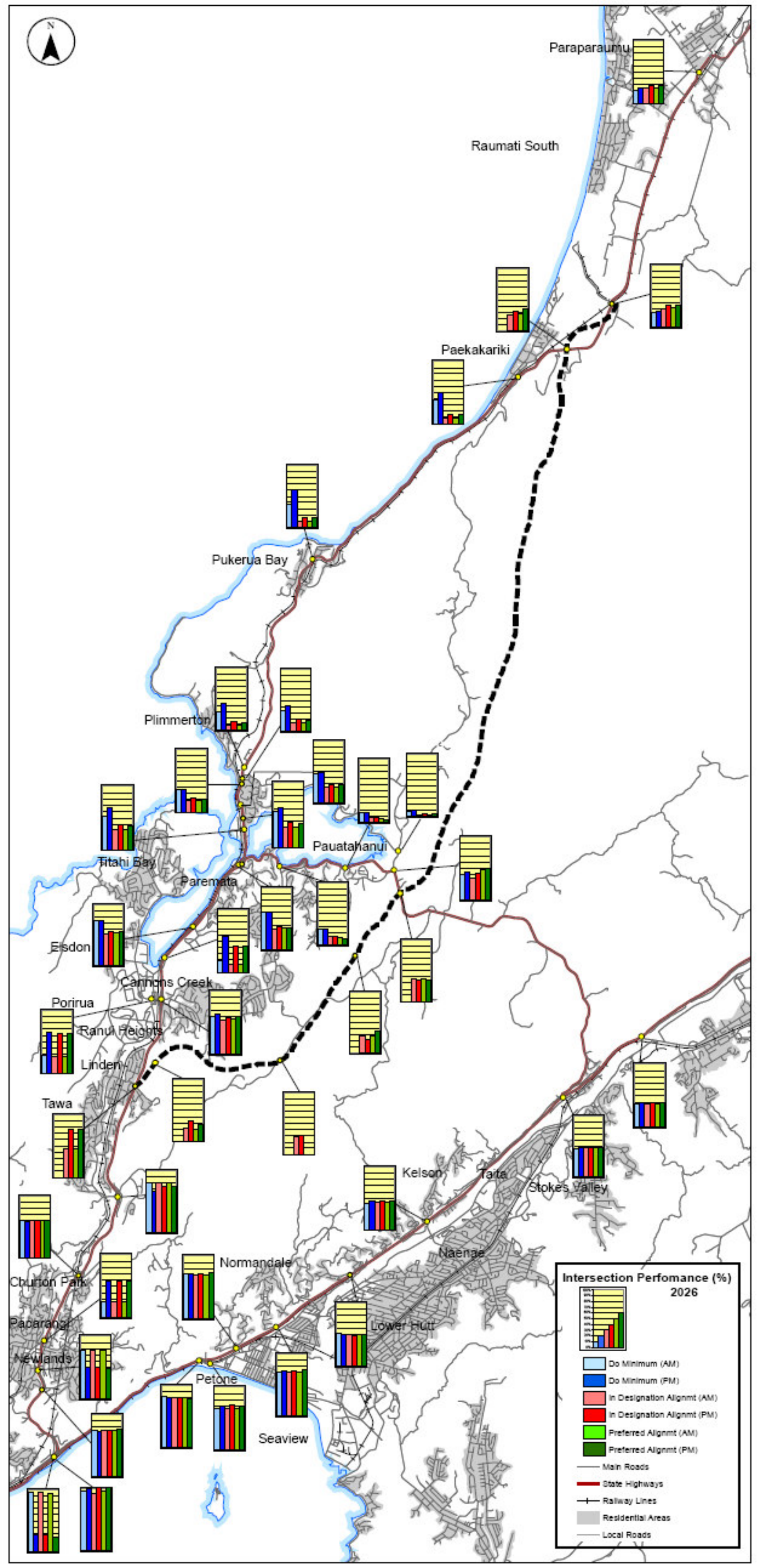

Figure 11.10: Do-Minimum and 2026 Transmission Gully intersection Performance

The Transmission Gully intersections show similar performance for both alignments. The James Cook interchange in the Unconstrained Alignment has a slightly reduced performance compared to the In-Designation Alignment due to the increased traffic using the intersection. However, it still provides Level of Service A.

11.1.6. Induced Travel

The issue of induced travel is commonly considered in the development of large road projects. The Economic Evaluation Manual (EEM) requires consideration be given to the level of induced traffic in particular. The EEM does not have a clearly defined definition of induced travel, however for the purposes of the assessment, induced travel will be made up of (but not restricted to) the following:

- A change in route choice,
- A change in mode split,
- A change in distribution,
- A change in peak spreading.

Negative induced traffic effects generally only occur when both the Do-Minimum and the post project network are congested. Under the project network, those trips that shift from a different route, mode, distribution or time period are doing so due to the fact that the network is less congested and the alternative has a high cost premium. For example, those trips that shift to the peak hour from off peak travel make the change due to the release of a suppressed demand as a result of lower congestion costs. Under the Do-Minimum scenario, a large amount of congestion occurs on SH1. However, the Transmission Gully project relieves congestion through the provision of additional road capacity and improved linkages between Kapiti, Porirua, Whitby and the Hutt Valley. This reduction in congestion under the project scenario suggests that negative induced traffic effects are not occurring; however detailed assessment of induced travel effects has not been undertaken as part of this report.

Another area of induced travel relates to the new trips that were not occurring prior to the project through changes in land use, these have not been considered in this assessment and are linked to District Plan controls. Kapiti Coast District Council and Porirua City Council both have mechanisms to control development and are looking to reinforce these through the use of urban constraint boundaries and similar mechanisms.

In order to look at the impact of induced travel Transmission Gully has on public transport (PT) and traffic numbers, the Wellington Transport Strategy Model (WTSM) has been used. The model allows for the assessment of different modes, trip types and travel over a 24 hour period. This assessment approach is consistent with current industry practice and provides the most effective tool available in the Wellington Region.

Changes in the total number of vehicle and PT users are summarised in Table 11.5. The change in matrix totals between the Do-Minimum and the Transmission Gully project are minimal, up by 0.24% for cars and up by 0.63% for PT (based upon peak and average interpeak period assessment). This shows that there is little or no induced traffic effect across the wider network, however zone by zone comparisons as discussed below have been undertaken to look into more detailed changes in travel patterns.

	Car			PT		
	AM	IP	PM	AM	IP	PM
2006 base	153,698	142,475	183,740	30,158	9,324.4	24,288
Do-Minimum	182,680	168,390	216,817	35,649	10,643	29,441
Transmission Gully	182,297	168,357	217,329	35,661	10,710	29,535
TG – DM difference	247.0	-33.0	512.0	12.0	67.0	94.0
TG –DM % difference	0.14%	-0.02%	0.24%	0.03%	0.63%	0.32%

Table 11.5: 2026 Matrix Totals

	Car						PT					
	AM		IP		PM		AM		IP		PM	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Wellington	85,256	81,972	74,753	74,491	94,942	97,217	27,978	18,471	6,606	6,800	16,443	22,810
Porirua	15,385	16,722	14,581	14,653	20,065	19,269	1,395	3,668	868	819	2,836	1,321
Kapiti	15,380	16,534	16,685	16,669	21,299	20,654	1,293	3,192	569	668	2,397	901
Lower Hutt	36,184	36,668	32,967	33,126	43,463	42,814	3,129	6,858	1,734	1,621	5,247	2,850
Upper Hutt	12,654	13,559	12,545	12,613	16,491	15,872	1,181	2,648	605	533	1,912	850
South Wairarapa	2,470	3,073	2,657	2,651	3,434	3,067	79	342	55	40	231	85
Carterton	2,710	2,599	2,455	2,437	3,082	3,098	164	170	63	38	105	177
Masterton	11,085	9,700	10,486	10,492	12,072	13,125	423	210	138	118	197	436
External	1,558	1,855	1,261	1,257	1,968	1,700	6	91	6	5	73	11
Total	182,682	182,681	168,390	168,389	216,817	216,816	35,648	35,648	10,643	10,643	29,442	29,442

Table 11.6 – 2026 trip ends by TLA for the Do-minimum

	Car						PT					
	AM		IP		PM		AM		IP		PM	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Wellington	85,315	81,775	74,706	74,420	94,879	97,419	28,001	18,662	6,664	6,865	16,645	22,890
Porirua	15,540	16,692	14,589	14,662	20,135	19,488	1,381	3,754	875	826	2,910	1,314
Kapiti	15,391	17,050	16,703	16,706	21,776	20,701	1,265	2,773	552	643	2,067	881
Lower Hutt	36,219	36,594	32,959	33,120	43,433	42,853	3,139	6,991	1,749	1,637	5,369	2,870
Upper Hutt	12,656	13,554	12,547	12,619	16,495	15,856	1,189	2,686	609	538	1,948	857
South Wairarapa	2,467	3,071	2,655	2,651	3,443	3,067	81	344	55	40	234	86
Carterton	2,704	2,598	2,453	2,436	3,088	3,101	169	170	63	39	106	182
Masterton	11,077	9,702	10,486	10,489	12,074	13,141	432	209	138	118	199	445
External	1,557	1,891	1,258	1,256	2,007	1,703	6	72	5	4	58	10
Total	182,927	182,927	168,357	168,358	217,329	217,329	35,661	35,661	10,710	10,710	29,536	29,536

Table 11.7 – 2026 trip ends by TLA for the Unconstrained Alignment

Zone to Zone Comparison

The WTSM model has 227 zones, and as such zone by zone analysis is difficult and complicated. To simplify this process the zones have been aggregated into the Territorial Local Authorities (TLA's) and analysis has been undertaken for each of the TLA's. The analyses presented in Tables 11.6 and 11.7 show there are minimal changes in 2026 total trip ends for each of the TLA's, with the highest overall change being 0.6% additional PT trips over the whole network in the 2026 inter peak Unconstrained Transmission Gully alignment when compared with the Do-Minimum.

The largest individual TLA change between the 2026 Do Minimum and the Transmission Gully option is that of a drop in outbound PT trips from Kapiti in the AM peak (down 13.2%) and a drop also of inbound PT trip to Kapiti in the PM peak (down (13.8%). This is connected to the increase in car trips outbound from Kapiti in the AM peak (up 3.1%) and the increase in car trips inbound to Kapiti in the PM peak (up 2.2%). The other changes are minimal, or not significant, for the Transmission Gully scheme.

Closer analysis of the difference between the Do-Minimum and Transmission Gully option in 2026 trip movements from Kapiti shows that car trips in the AM peak from Kapiti increase to Wellington (321), Porirua (159) and Lower and Upper Hutt (301). In the PM peak car trips increase to Kapiti from Wellington (323), Porirua (172) and Lower and Upper Hutt (282). The drop in PT trips in the AM peak from Kapiti is to Wellington (-379), Porirua (-24) and Lower and Upper Hutt (-21). Notably the biggest drop is to Wellington as would be expected given the commuter train services between Kapiti and Wellington with less commuting between Kapiti and Porirua, Lower and Upper Hutt. The PT trip pattern in the PM peak is a reduction in trips to Kapiti from Wellington (-296), Porirua (-19) and Lower and Upper Hutt (-16). Again the primary PT change is trips between Wellington and Kapiti.

It should be noted that the change in travel patterns between Porirua and other parts of the region (particularly Wellington) is the reverse, with PT trips increasing. This is largely due to the longer distance vehicle trips (those from Kapiti) replacing the shorter trips from Porirua and Wellington, while PT trips have increased in some time periods.

Public transport trips into and out of Kapiti are predicted to increase as a proportion of total trips between the base year (2006) and the 2026 modelled future year. For the Do-Minimum between 2006 and 2026 PT trips into Kapiti are predicted to increase by 0.4% in the AM peak and 3.3% in the PM peak. Outbound from Kapiti the PT share is up by 4.8% in the AM peak and 0.4% in the PM peak. In general, the other TLA inbound and outbound PT mode shares are reduced in the Do-Minimum when compared with the base, suggesting a small shift from PT back to car in the Do-Minimum in the AM and inter peaks. In the PM peak the shift is from car to PT with small increases in the PT mode share.

A comparison between the Do-Minimum and Transmission Gully shows that with the exception of Kapiti there are small, generally negative, PT changes inbound and outbound to all TLA's. Kapiti shows slightly lower outbound PT shares of between minus 0.1% and minus 2.2%. Similarly, the inbound PT share is down between minus 0.1% and minus 1.4%. This suggests a shift from PT back to car for the Kapiti trips. Overall the change is minimal.

Public transport percentage split changes occur between the base and the Do-Minimum, but there is little change between the Do-Minimum and the Transmission Gully options, i.e. Transmission Gully has minimal effect on public transport usage except for trips to and from Kapiti.

The minimal change in matrix totals and the small change in average trip length indicates traffic is not induced. Plots of the trip length frequency distribution show that there is no major switch between trip length bands which also leads to a conclusion of little, or no, induced traffic effects.

TLA to TLA comparisons show that overall there is little change in trip totals. The maximum change in movements is related to Kapiti with increases in outbound car trips in the AM peak along with associated decreases in PT movements, i.e. a shift from PT to car which also occurs in reverse in the PM peak with inbound movements to Kapiti. Otherwise, the changes are minimal. The major changes in PT modal share occurs between the base (2006) and the Do-Minimum (2026), the introduction of Transmission Gully has little effect.

It is evident that a shift from PT to car occurs together with some re-timing from the pre-peak hour to the peak. However, the re-timing cannot be confirmed due to the way WTSM runs the various modules together.

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Mode Split Across Screenlines

To ascertain if more trips use specific links in the network as a result of Transmission Gully, an assessment has been carried out of vehicle and PT trips across screenlines from the WTSM model. The screenline locations are shown in Figure 11.11 with screenlines intersecting roads as follows:

- K1 - SH1 south of MacKays Crossing,
- P1 - Airlie Road, SH1, Paekakariki Hill Road and Transmission Gully north of Plimmerton and Pauatahanui,
- P3 - Main Road Tawa, south of Kenepuru Drive and SH1 south of Transmission Gully,
- S1 – State Highway 58 and Akatarawa Road, east of Transmission Gully.

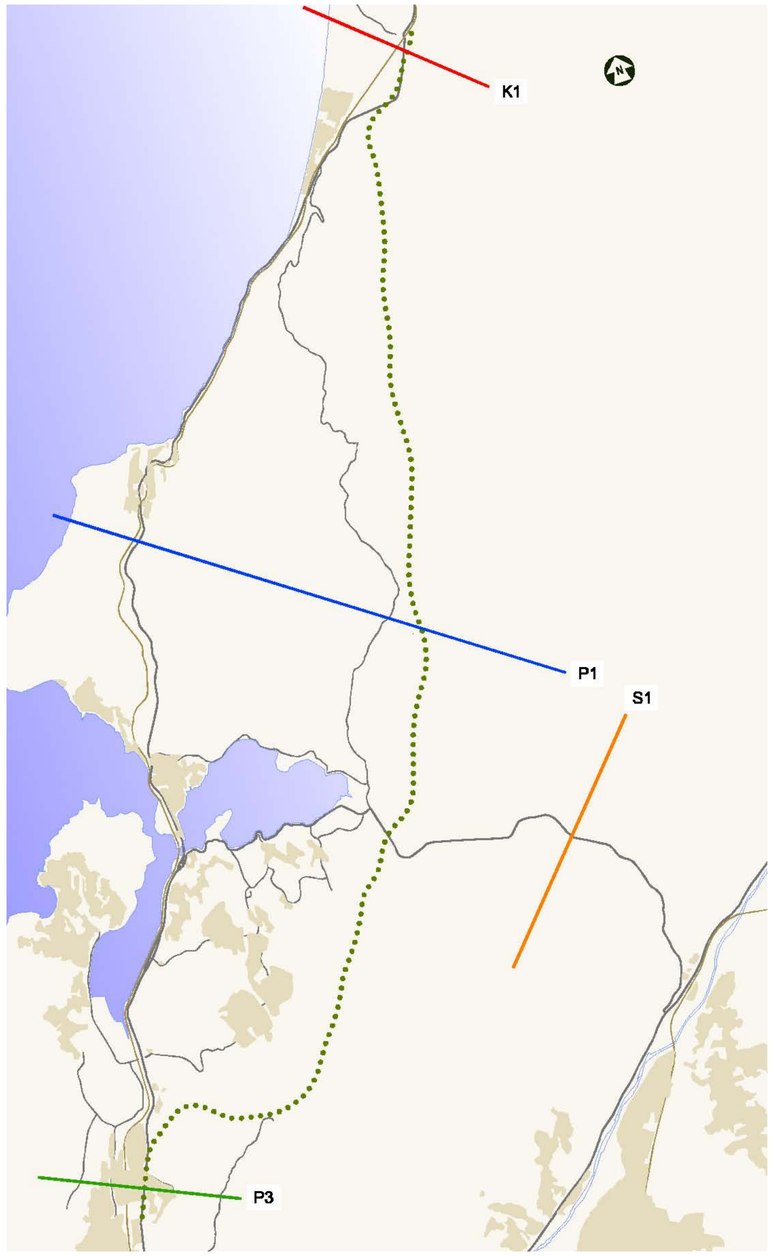

Figure 11.11: WTSM Screenlines

Table 11.8 shows the annual average daily traffic (AADT) (vehicles per day) figures across the screenlines by direction for 2006, 2016 and 2026 Do-Minimum and the Transmission Gully Unconstrained Alignment. Table 11.9 shows the same information for public transport trips.

Vehicles AADT

Screenline	2006	2016 Do-Minimum	2016 Transmission Gully	2026 Do Minimum	2026 Transmission Gully
K1 northbound	11,628	12,555	15,287	13,032	16,062
K1 southbound	11,450	12,065	14,714	12,407	15,370
P1 northbound	12,261	13,383	16,245	13,941	17,095
P1 southbound	12,021	12,810	15,580	13,200	16,280
P3 northbound	23,537	28,466	29,195	31,224	31,810
P3 southbound	24,075	28,979	29,615	31,707	32,403
S1 eastbound	8,485	12,611	14,715	12,817	14,803
S1 westbound	8,524	8,575	11,266	7,827	10,370

Table 11.8: Light and HCV AADT Screenlines Outputs (Vehicle Trips)

Public Transport AADT

Screenline	2006	2016 Do-Minimum	2016 Transmission Gully	2026 Do Minimum	2026 Transmission Gully
K1 northbound	1,819	3,090	2,575	3,618	3,064
K1 southbound	2,017	3,345	2,859	3,818	3,303
P1 northbound	2,203	3,537	3,001	4,095	3,523
P1 southbound	2,296	3,666	3,167	4,166	3,639
P3 northbound	5,564	7,662	7,195	8,179	7,845
P3 southbound	5,270	7,421	6,998	7,926	7,609

Table 11.9: Public Transport AADT Screenline Outputs (Passengers)

2016 Transmission Gully and Do-Minimum Comparison

With the construction of Transmission Gully, the demands north of the project area (Screenline K1) indicate an extra 2,700 trips northbound and 2,600 southbound over a whole day compared to the Do-Minimum. This equates to approximately 22% additional trips. Associated with this increase in vehicle demand is a drop in PT demand, with approximately 500 fewer trips both northbound and southbound (approximately 17% and 14.5%, respectively). The construction of Transmission Gully therefore results in approximately 4,400 additional vehicle trips per day at the northern end of the study area.

At the mid point of the study area (Screenline P1) the construction of Transmission Gully results in a daily increase of approximately 5,600 vehicles, with a similar percentage change to that of the northern screenline. Daily PT demand is down by a very similar figure to that at the northern screenline with approximately 540 and 500 fewer trips southbound and northbound, respectively. The overall increase in total trips is marginally higher at this screenline with approximately 4,600 additional trips per day.

At the location immediately south of Transmission Gully (Screenline P3) the additional vehicle trips resulting from Transmission Gully being in place are approximately 730 northbound and 630 southbound. This equates to changes of 2.5% and 2.2%, respectively. The reduction in PT trips is lower than at the other two screenlines with approximately 880 fewer trips with Transmission Gully in place. This equates to a much smaller percentage change on the Do-Minimum due to the high PT demand in this area of between 5.0% and 5.7%. The increase in total trips is therefore much smaller at this screenline with an additional 475 trips per day.

Screenline S1 was introduced in order to fully understand travel patterns impacted by the project. This screenline only displays vehicle travel as little or no PT provision exists on SH58. The construction of Transmission Gully results in a daily increase of approximately 2100 vehicles eastbound and 2700 vehicles westbound.

2026 Transmission Gully and Do-Minimum Comparison

By 2026 the flow patterns across the screenlines are similar to those for 2016, except the number of trips increases.

The northern and mid-point screenlines demonstrate the highest change in vehicle and PT demands as a result of Transmission Gully. The change at the southern screenline is relatively small and significantly less than the change in trip numbers at the other two screenlines.

In contrast, the total trips across the SH58 screenline reduce between 2016 and 2026 in both the Do-Minimum and with Transmission Gully in place, largely due to the influence of other transport projects such as Granada to Gracefield.

Conclusions

The total increase in trips between the Do-Minimum and the Transmission Gully project is significant for locations north of SH58. These increased numbers of trips are largely due to the improved accessibility to and from Kapiti, particularly during the peak periods.

It is evident that for 2016 and 2026 the introduction of Transmission Gully results in a significant increase in total trips over some screenlines on the network. It also results in a reduction in PT demand. The results suggest the impact of Transmission Gully is more one of long distance vehicle trips increasing between Kapiti and locations south, while the corresponding PT trips reduce. Shorter vehicle trips from Porirua appear to have reduced and been replaced by long distance trips between Kapiti and Wellington, while these shorter trips are reverting to PT.

As there are no realistic alternative routes available in the network at the northern screenline, it is considered the trips are either; re-timed to the peaks from the shoulders, reassigned from destinations that were previously more attractive, or have moved from PT to vehicle travel.

The large increase in vehicle trips on SH58 emphasises the attraction that Transmission Gully provides to travel to and from the Hutt Valley, while also highlighting the strategic importance of this link as an east / west vehicle corridor in the future.

11.2. ECONOMIC ASSESSMENT

The economic assessment has been undertaken in accordance with the requirements laid out in the Economic Evaluation Manual (EEM) October 2008. The wider economic benefits associated with land development and agglomerations are not part of this assessment process, neither are tolling options considered in the assessment process.

Salient points of the assessment are provided below. The full assessment worksheets are contained in Appendix O.

11.2.1. Traffic Model Background

A specific project traffic model has been developed in SATURN to assess the Transmission Gully project options. The 2006 base model was developed using the trip distribution and demand matrices from the Wellington Transport Strategy Model (WTSM) which is a regional model developed using the EMME/2 software platform. The SATURN and WTSM models are described in more detail in Section 5 of this report.

Both the Regional (WTSM) and project (SATURN) models include programmed network upgrades as part of the Base Case in accordance with the RLTS. Sections 5.6.12 and 5.6.14 and Appendix A outline these projects and describe how these projects have been modeled within the SATURN model.

Forecast vehicle trip growth matrices were extracted from WTSM for future years 2016 and 2026. Traffic growth provided by these matrices was added to the 2006 SATURN base trip matrices to provide the predicted future year traffic volumes. Future year traffic was calculated for the morning and afternoon peak periods, and the daily interpeak period. These matrices are vehicle based and do not include non vehicular trips such as pedestrians, cycling or public transport. For the assessment of project benefits, two additional matrices have been developed within SATURN to cover the evenings and weekend flow periods. These are based on a percentage of the WTSM Interpeak matrices using the Pukerua Bay telemetry data.

The 27km long Transmission Gully route is modelled as a four lane divided motorway with total access control, together with crawler lanes on the steep sections to facilitate heavy vehicle movements. By way of comparison, the existing SH1 Coastal route is 26.8km long measured between MacKays Crossing in the north and Linden in the south.

Vertical gradients on Transmission Gully vary between 0% and 8%. Whilst these grades are not specifically recorded within the project model, they are accounted for by setting the free speed of trucks to reflect the low speeds associated with grades over 3%.

The existing coastal route predominately remains in its current form to service the local communities. Mana Esplanade is modeled with four lanes but with reduced through capacity and increased side road capacity to reflect actual performance.

11.2.2. Determination of Transmission Gully Benefits

Determination of the project benefit cost ratio (BCR) in the EEM focuses on benefits arising from travel time savings, vehicle operating cost (VOC) savings, crash reductions, CO_2 emission reductions, improvements in trip reliability and route security. These are discussed below.

Hourly Time Periods & Annualisation Factors

The number of trip matrices used to determine the yearly operating costs is based on 10 time periods that reflect the average week. These periods are based on 2007 traffic data from the Transit monitored Pukerua Bay Telemetry Station, which provides traffic flows for the entire year in one hour intervals. Table 11.10 provides a summary of the annualisation factors used in conjunction with the model outputs to determine the yearly operating costs.

Time Period	Model	Representative Hrs/week	Annualisation factor
Weekday Evening	Even	55	2,695
Weekday Morning Preload Peak	Pre AM	5	245
Weekday morning peak	AM	10	490
Weekday Interpeak	IP	30	1,470
Weekday Preload Evening Peak	Pre PM	5	245
Weekday Evening peak	PM	10	490
Weekday PM Shoulder	67% of PM	5	245
Weekend Night	Even	14	1,680
Weekend/holidays Shoulder	IP	4	240
Weekend/holidays Interpeak	WIP	8	960

Table 11.10: Annualisation Factors

A review of holiday weekend demands was also undertaken for the same site, however this displayed no significant change for these time periods. This may be because capacity is constrained at the Pukerua telemetry station, and so flows cannot increase during holiday weekends despite higher demand. For this assessment however, we have taken a conservative approach, and not included a specific holiday time period. That is, the weekend flows are averaged over the full year. A sensitivity test on this assumption has been included in the assessment.

Crash Benefits

Crashes on key strategic routes within the study area have been extracted from the CAS database for the past 5 years. Figure 11.12 below indicates the routes selected. Crash benefits are determined using the unit crash cost per vehicle kilometre for the Do-Minimum scenario and forecast crash costs for the Transmission Gully route scenarios.

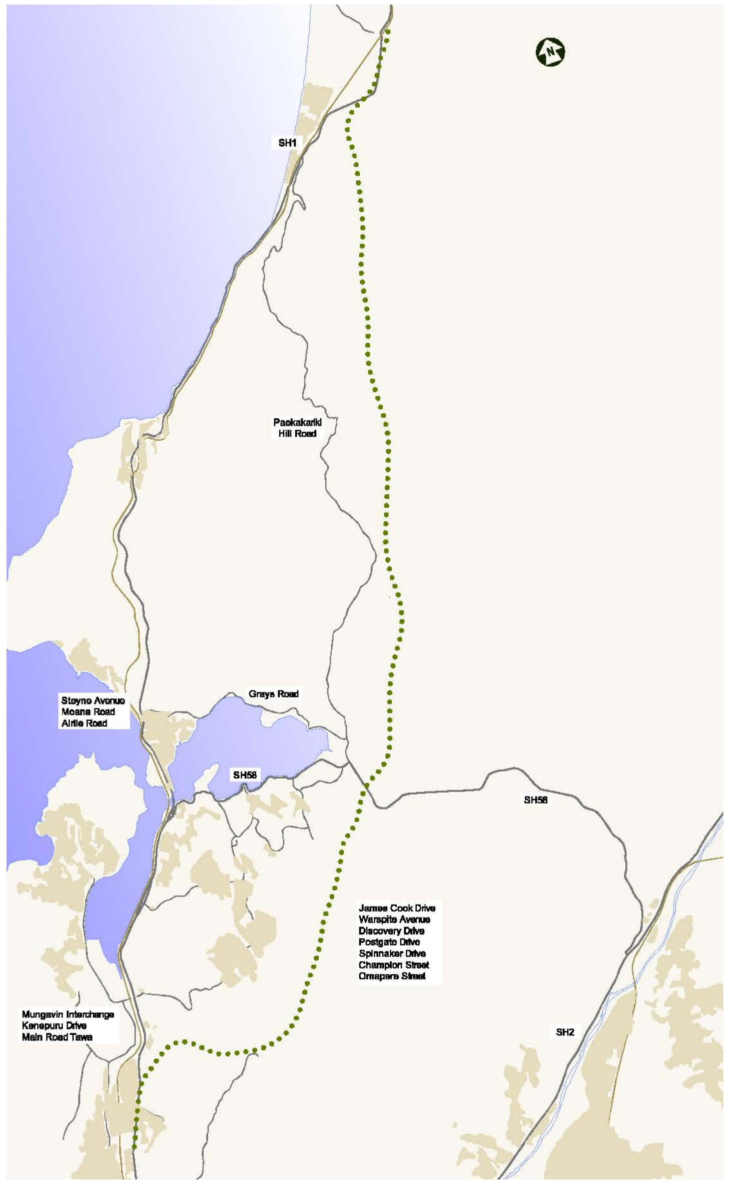

Figure 11.12: Crash Routes

Travel Time Benefits

Travel time benefits are determined using the aggregated system statistics output from the appropriate SATURN models. This includes the total hours/hour inclusive of congestion delays. Congestion costs have been determined by deducting the congested time from the free flow time.

The Pukerua Bay traffic count station indicates that the heavy vehicle content is 6.5% of total daily traffic (2007 value), whilst at the Ngauranga traffic count station it is 3.3% to 3.6%. Both of these are close to the standard Urban Arterial mix. For the assessment of this project, the Urban Arterial travel time values have been adopted for each time period as per the EEM.

Vehicle Operating Costs

Vehicle Operating Costs (VOC) are directly calculated using the fuel usage statistics and vehicle kilometres travelled data from the SATURN models for each time period. This will encapsulate the fuel used whilst travelling on the links and at congested intersections, and provides a better reflection of VOC than using the average travel speed through the network.

Truck speeds have been adjusted to reflect the impact of grades within the SATURN Model. Although cars will notice some increase in fuel consumption when on steep gradients this has been omitted from the assessment. It is noted that the VOC component contributes about 5% of the total benefit and hence any adjustment for additional fuel will be negligible. Roughness costs are ignored as these will be immaterial to the overall project benefits.

CO_2 Emissions

Benefits associated with a reduction in CO_2 emissions have been determined using the standard EEM conversion rate for fuel used to CO_2 tonnes. It was not considered warranted to determine the CO_2 based on vehicle user classes given the number of transport models involved, and the overall low benefits derived from CO_2 (less than 1% of total benefits).

Trip Reliability

Trip reliability has been calculated using the SATURN model for all time periods as per the methodology outlined in the EEM. This identified a significant value for trip reliability equating to approximately 27% of the total travel time value. Trip reliability was calculated for the Unconstrained Alignment, and then the same trip reliability proportion of the travel time value was assumed to apply to the In Designation Alignment.

In determining the benefits some assumptions were made in order to assign the appropriate coefficients when calculating the standard deviation of travel time. These were:

- Links with speeds equal or greater than 70km/h – rural,
- Links with lower speeds than 70km/h – urban,
- All junctions signalised,
- All links on Transmission Gully to a motorway standard.

In accordance with the EEM, the factor for the benefit calculation is taken as 100% on the basis that the SATURN model represents the regional model. Hence, less than 20% of the trips are made outside of the modelled area.

Route Security

The existing SH1 coastal route and SH58 around Pauatahanui Inlet are prone to traffic delays as a result of road crashes, road maintenance and other incidents such as spillages. Transit records indicate that in 2007 the length of SH1 between MacKays Crossing and Linden was affected by these types of incidents 17 times. The existing coastal route is also susceptible to damage and closure during natural events such as earthquakes or floods.

The Transmission Gully project will improve regional route security by providing an additional alternative route to the north of Wellington, and by providing a route that is less susceptible to damage in a natural event. The travel time delays resulting from these incidents or natural events are additional to the travel time costs and trip reliability costs and have therefore been included separately in the assessment of the benefits. A full description of route security analysis and benefits is included in Appendix S.

Bottleneck Delays

A review of the SATURN model outputs indicates that the free-flow two-way speed over the existing SH1 route is in the order of 82km/h. Predictions of future speeds on the Do-Minimum network are shown in Table 11.11. Predicted speeds are significantly less than the free-flow speeds due to congestion on the network. This is because the model incorporates an allowance for congestion, thus there is no need to separately calculate bottleneck delays.

Route	2016			2026		
MacKays to Linden	AM	IP	PM	AM	IP	PM
Northbound	78	76	60	77	76	57
Southbound	60	75	72	60	75	68

Table 11.11: Average Route Speeds for Existing SH1Coastal Route in Do-Mminimum

Project Costs & Construction Period

Project costs (construction, fees and property footprint value) have been determined in accordance with Transit's SM014 procedures. The mean expected cost is used to determine the project BCR. The 95th percentile (including funding risk) project cost is used in the sensitivity tests.

Maintenance costs and reseals on the existing route are expected to be similar before and after the construction of Transmission Gully and hence are excluded from the assessment. This is a conservative assumption because the coastal route will have less traffic and hence less maintenance cost after construction of Transmission Gully, however the magnitude of any possible savings is overwhelmed by the project construction cost and hence does not warrant detailed assessment.

The costs to maintain the 27km Transmission Gully route and associated new facilities however, have been included based on historic maintenance rates from similar types of infrastructure. Likewise, the cost of resurfacing Transmission Gully is included based on a regular sealing cycle as provided from Transit's network maintenance consultants.

The estimated main construction period is in the order of seven years with an earliest physical works construction start date of May 2015. Some enabling works will begin earlier than this to relocate existing services. Property costs are assumed to be incurred when the main project construction starts. Investigation and design fees will be incurred over the preceding period.

Determining the Shape and Form of Transmission Gully

To assist in the process of determining what connections Transmission Gully should have with the surrounding road network, a series of incremental economic assessments using a simplified assessment process have been adopted. The framework for testing the connection details (not the main TG economics) included the following assumptions:

- Identification of the cost differences between connection options using the expected mean estimate,
- Crash benefits were excluded on the basis they would be similar for all options,
- Travel Time and VOC are based on outputs from the SATURN model for the AM, interpeak and PM peak periods only and extended to cover weekends. Night time periods have been ignored, as during this period the differences between the options would be minimal.
- Travel Time, VOC, and Trip reliability values are calculated in accordance with the EEM update October 2007, but use an 8% discount rate and 30yr analysis period as per the September 2008 EEM release.

The results of the incremental tests are shown in Table 11.12 and demonstrate the connection with SH58 is economically justified. The incremental analysis shows that, from a purely economic viewpoint, the additional inclusion of the Kenepuru, James Cook, and Waitangirua connections are not warranted at the assessed traffic volumes, benefits, and cost estimates.

Connections	Incremental Cost	Incremental Benefit	Incremental BCR
No Connections			Base Case
SH58	$6.6	$102.6	15.6
SH58 and Kenepuru *	$18.6	$4.5	0.2
SH58, Kenepuru, and James Cook *	$34.8	$7.0	0.2
SH58, Kenepuru, and Waitangirua *	$45.2	$26.2	0.6
SH58, Kenepuru, James Cook, and Waitangirua *	$54.7	$34.6	0.6

Table 11.12: Incremental Analysis of Connection Options

** incremental costs and benefits additional to SH58 connection*

Determination of the Transmission Gully BCR

The BCR assessment is based on a fixed trip matrix approach (FTM) using the SATURN traffic model matrices. Two BCR's have been calculated to determine the approximate upper and lower bound in which the true BCR lies. The lower bound BCR is based on the Do-Minimum vehicle matrix and the Do-Minimum and Transmission Gully networks. That is:

- Do-Minimum matrix on Do-Minimum network,
- Do-Minimum matrix on Transmission Gully network.

Whilst it could be argued that the lower bound could be less than the value calculated using a fixed trip matrix as used in this assessment, the fact that the network is not congested along the coastal route gives some comfort that the lower bound BCR value is probably close to its true value.

The maximum upper bound BCR has been calculated using the Option matrix and the same two networks. That is:

- Transmission Gully matrix on Do-Minimum network,
- Transmission Gully matrix on Transmission Gully network.

Undertaking a full induced traffic assessment approach as per the EEM is not considered warranted given the relatively low expected BCR value. The true upper bound BCR would be less than the maximum upper bound calculated if the assessment was undertaken using the impacts of induced traffic. Therefore, based on the rule of a half (a well established approximation that provides accurate results), the true upper bound BCR is likely to be midway between the calculated lower bound and upper bound BCR's. The BCR's presented below have been derived using this philosophy. As route security has been calculated using a separate risk model, the benefits apply equally to the lower bound and upper bound BCR calculations.

The tangible benefits consist of:

- Travel time (including CRV) – calculated from the project model system statistics,
- Vehicle operating costs – calculated from project model system statistics using fuel outputs and kilometres travelled,
- Crash reduction – using link by link crash rates and costs,
- Reduced CO_2 emissions,
- Trip reliability,
- Incidents,
- Route Security (National strategic benefit),
- External Impacts (noise).

External benefits stem from the removal of significant traffic volumes from the existing SH1 route which will reduce noise and emission levels and hence potentially improve the amenity value of properties. The noise impact has been monetised using the standard EEM worksheets and also takes into account the increase in noise along the Transmission Gully route.

The two BCR values are tabulated in Table 11.13 for the Transmission Gully Unconstrained Alignment network.

Benefit Type	Adopted Lower Bound BCR		Max Upper BCR	Adopted Upper Bound BCR	
	NVP Benefits $M	% of Total Benefits	NVP Benefits $M	NVP Benefits $M	% of Total Benefits
Travel Time	100	52	158	129	54
VOC	2	1	10	6	2
Crashes	27	14	36	32	13
CO_2	<1	<1	<1	<1	<1
Trip Reliability	27	14	43	35	15
Route Security *	34	18	34	34	14
Noise *	2	<1	2	2	1
Total Benefits	$193M	100%	$285M	$239M	100%
Total Transmission Gully Project NPV Costs	$519M		-	$519M	
BCR	**0.37**		-	**0.46**	
FYRR	**2.7%**		-	**3.3%**	

Table 11.13: Summary of Economic Assessment for the Unconstrained Alignment

BCR Sensitivity Tests

There are several key risk areas associated with the project BCR. These include:

- Construction costs,
- Land costs,
- Lower discount rates for projects of national significance,
- Land use assumptions,
- Supply/demand relationships,
- Impact of reduced lanes on Mana Esplanade (reduced capacity or TDM or local area traffic management).

To understand the impact of these, a number of sensitivity tests have been undertaken as follows:

- Use of the 95th percentile construction and land costs. The 95th percentile time-streams indicate a potential delay of 1 year for construction commencement and were not included in the test,
- Lower discount rates of 4% and 6% with a 30 year assessment period following completion of the works,
- Reduced capacity along the existing SH1 Mana Esplanade to two lanes in conjunction with Transmission Gully. (Note the Do-Minimum also reverts to two lanes in accordance with the commitments given at the hearing for the Mana Esplanade project). Crash benefits, reliability benefits and route security benefits are adopted from the unconstrained alignment assessment. If these values were to be calculated specifically for the test, it is considered that the results would be very similar.
- Transmission Gully In-Designation Alignment. This adopts the same benefits as the Unconstrained Alignment.

The results of these tests using the Do-Minimum and Option Trip matrix are shown in Table 11.14. With regard to the Mana 2 lane test it should be noted that the upper bound BCR is not available as the corresponding Option Trip matrix was not available.

Sensitivity Test	Lower Bound BCR		Upper Bound BCR	
	BCR	FYRR	BCR	FYRR
Base Case	0.37	2.7%	0.46	3.3%
Capital Cost increase to 95%ile	0.31	2.3%	0.39	-
4% Discount Rate	0.67	3.2	0.89	3.5
6% Discount Rate	0.54	2.9	0.67	3.3
Mana 2 lanes on Do Min and TG	0.38	2.9	-	-
TG Route along In-Designation alignment	0.32	2.4	0.40	2.6

Table 11.14: Sensitivity Tests on Lower & Upper BCR Value – Unconstrained Alignment

The largest impact on the BCR stems from the adoption of the lower discount rate with an associated economic return period of 30years after construction of Transmission Gully is complete.

If the discount rate of 4% (and 30 years post construction) was adopted for both the lower bound and upper bound BCR, then the true BCR range for the Unconstrained Alignment would lie between 0.67 and 0.89.

One further test was undertaken to determine the potential benefits associated with weekend traffic. An extra 20 minute delay to traffic on the coastal route during 1 hour periods on a Friday and Sunday afternoon throughout the year has been assumed. This equates to an additional $6.5M of discounted benefits relating to travel time savings with Transmission Gully over the 30yr analysis period. As expected, the impact on the base BCR is negligible (0.01).