7.0 Appraisal of Long Term Infrastructure Proposals

Scope of the Appraisal

7.1 This chapter summarises the results of the output of the SATURN traffic model. The scheme options, together with a no-scheme 'reference case', have been assessed for a weekday AM peak hour and PM peak hour at an assumed assessment year of 2017.

7.2 Comparisons have been drawn between the options by using summary statistics from the traffic model as indicators of scheme performance against certain criteria. The performance indicators for each scheme option have been compared using a framework appraisal.

Content of the Scheme Options

7.3 Seven potential sections of new highway infrastructure have been identified which give consideration to planned developments, the Development Plan, the consultation process and liaison with officials of Kildare County Council. These are shown on Figure 19, and are:

- L1 - A new link from the R403 Dublin Road to R405 Maynooth Road at Castletown Gates, passing through the proposed Donaghcumper development and providing a new bridge crossing.
- L2 - A new distributor road from the R449 Crodaun roundabout to the R403 Clane Road / Shackleton Road traffic signals.
- L3 - A new link from Hazelhatch Park to Templemills.
- L4a - Upgrading of Oldtown Road from Church Road to the proposed L2.
- L4b - Upgrading of Oldtown Road from the proposed L2 to proposed L6.
- L5 - A new link from the proposed L3 to the R403 Clane Road, with a bridge across Newtown Road and the River Liffey.
- L6 - An outer southern bypass from Hazelhatch Station to the proposed L2, providing access via the R449 to the M4.

7.4 Five combinations of these links have been tested as scheme options in order to improve traffic conditions in Celbridge. Each option was also tested against a 'Reference Case' option 'construction of L1 only', in order to compare results. The option tests were:

- Option 1 - L1 + L2
- Option 2 - L1 + L3
- Option 3 - L1 + L3 + L5
- Option 4 - L1 + L2 + L3 + L4a + L5
- Option 5 - L1 + L2 + L3 + L4a + L4b + L5 + L6

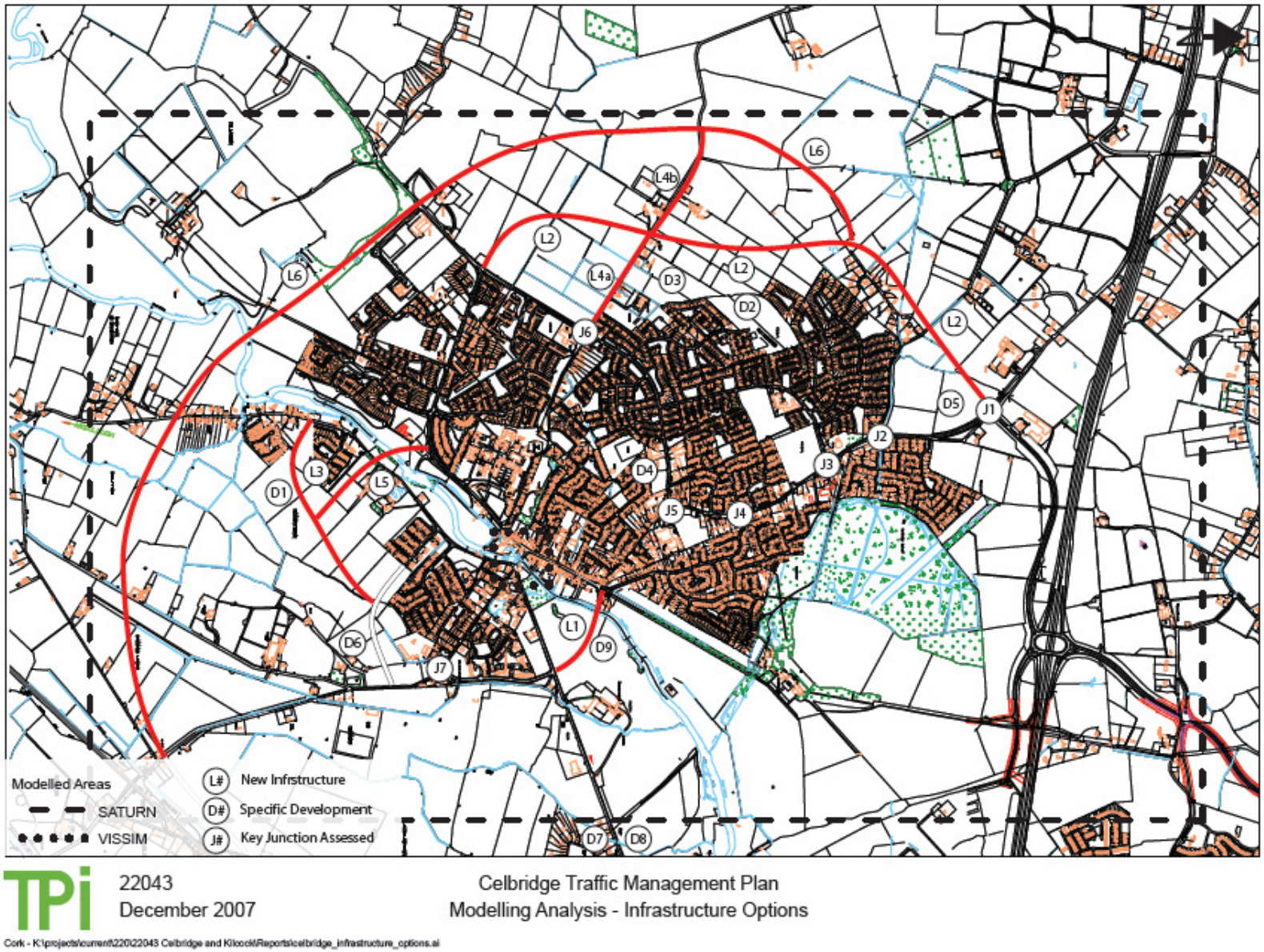

Figure 19: Modelled Infrastructure Options, Celbridge

The Appraisal Method

7.5 In essence, the method for assessing the scheme options consisted of the following stages:

- 2007 AM and PM peak base model validation;
- Derive traffic growth rates for the 2017 matrix;
- Produce forecast AM and PM trip matrices for 2017, based upon future development;
- Load the forecast matrices on to the existing network in the future assessment year, to produce a reference case situation;
- Add each of five options into the reference case network for 2017 and undertake assignments for each option;
- Extract summary statistics from the reference case and scheme option assignments, as indicators of performance against certain assessment criteria;
- Extract operational details for key town centre junctions for reference case and scheme options;
- Draw comparisons between the performance of each scheme option and the reference case at 2017 AM and PM peaks, for input to a framework appraisal; and,
- Gauge the relative merits of each option by applying a qualitative measure to each aspect of scheme performance.

7.6 **Performance Indicators and Appraisal Criteria**

Performance indicators, in descending order of importance and the criteria to which they relate have been assumed as shown in Table 8.

Performance Indicator from SATURN Model	Appraisal Criteria to be Assessed
Traffic inflows at key junctions	Network efficiency and safety
Vehicle trips within town centre cordon	Environmental quality and severance
Total travel time	Network efficiency
Total travel distance	Network efficiency and resource consumption
Average vehicle speeds	Network efficiency
Delay at key junctions	Network congestion and efficiency
Number of permitted turning movements at key junctions	Accessibility to premises and land uses
Fuel consumption	Environmental quality and resource conservation

Table 8: Traffic Model Outputs for Assessing Different Appraisal Criteria

7.7 A more detailed explanation of the scheme performance indicators and what they mean are:

- Traffic inflows arriving at key junctions - lower volumes indicate more efficient circulation and less conflict and safety risk;
- Vehicle trips within the town centre - lower volumes indicate greater traffic relief for the town centre;
- Travel time - shorter times indicate more efficient movement and less delay;
- Travel distance in the town centre - shorter distances indicate more efficient movement and less resource consumption;
- Vehicle speeds in the town centre – indicates less delay and more efficient movement;
- Delay at key junctions - shorter delays indicate more efficient movement and less congestion;
- Number of permitted turning movements at key junctions - more movements indicate greater accessibility to premises, car parks and land uses; and

- Fuel consumption - lower consumption indicates better resource conservation.

7.8 Details of travel time, travel distance and average vehicle speed have been extracted for all vehicles.

Appraisal Results

7.9 For the reference case and for each of the five scheme options, model output has been extracted from the SATURN model. The output comprises summary statistics that can be interpreted as indicators of performance against the aforementioned appraisal criteria. Summary statistics for the reference case and scheme options 1 to 5 are shown in Table 9 and Table 10, for the 2017 AM peak and 2017 PM peak, respectively. The Reference Case is notated as DM.

Network Statistics	Scheme Option					
	DM	1	2	3	4	5
Total time (pcu hrs per hr)	684	526	682	657	501	458
Total distance (pcu km per hr)	20981	20922	20981	20876	20875	21545
Average. Speed (kph)	31	40	31	32	42	47
Total fuel consumption (litre per hr)	1879	1700	1875	1841	1671	1690
Total Town Centre Trips (pcu per hr)	5773	5368	5745	5828	5282	5223

Source: TPi

Table 9: Summary Statistics AM Peak 2017

Network Statistics	Scheme Option					
	DM	1	2	3	4	5
Total time (pcu hrs per hr)	974	689	971	956	641	585
Total distance (pcu km per hr)	23849	24765	23453	23336	24194	24894
Average. Speed (kph)	25	36	24	24	38	43
Total fuel consumption (litre per hr)	2368	2064	2341	2314	1965	1976
Total Town Centre Trips (pcu per hr)	6882	5690	6941	6939	6281	5818

Source: TPi

Table 10: Summary Statistics PM Peak 2017

7.10 It can be seen that the total volume of trips within the town centre cordon will be higher in the PM peak than in the AM peak at both 2007 and 2017. In 2007, the PM peak traffic volume will be approximately 10% greater in the PM peak than in the AM peak, whilst in 2017 the PM peak traffic volume will be approximately 15% greater in the PM peak than in the AM peak. The larger volume of traffic in the PM peak will tend to place greater stress on network capacity and junction operation in the PM peak than in the AM peak.

7.11 The results also show that the majority of scheme options 1-5 will discourage trips within the town centre when compared to the reference case, during both peaks. Options 1, 4 and 5 offer the greatest relief to the town centre whilst options 2 and 3 have no real effect and in the PM peaks perform worse than the Reference Case scenario.

Performance of Key Junctions

7.12 It is judged that there are 7 key junctions in the town, where effective operation will be critical to the success of the scheme options. These junctions shown on Figure 19 are:

- J1 – Maynooth Road / L2 (Model Node 1021)
- J2 - Maynooth Road / Ballygoran (Model Node 1022)
- J3 - Maynooth Road / Thornhill Road (Model Node 1016)
- J4 - Maynooth Road / Castletown Drive (Model Node 1012)

- J5 - Maynooth Road / Wolstan Haven Road (Model Node 1011)
- J6 – Clane Road / Church Road (Model Node 1009)
- J7 – Primrose Hill / Local Road (Model Node 1008)

7.13 Junction performance has been measured, principally, in terms of the Ratio of Flow to Capacity (RFC) associated with the busiest turning movements. Table 11 provides a summary of the junctions where flows will be at or above capacity in each network scenario at 2017. It can be seen that there are some key junctions where traffic flows will exceed capacity on at least one turning movement, in future year 2017, in the AM and PM peaks. Congestion will generally be most severe in the PM peak, when the traffic volume will be highest.

Junction Location	AM Peak						PM Peak					
	DM	1	2	3	4	5	DM	1	2	3	4	5
J1 - Node 1021												
J2 - Node 1022												
J3 - Node 1016												
J4 - Node 1012												
J5 - Node 1011												
J6 - Node 1009												
J7 - Node 1008												

Over Capacity
At Capacity
Under Capacity

Table 11: Summary of Congested Junctions at 2017

7.14 It can be seen from Table 11 that in both AM and PM peaks, the key junctions will be at or over capacity in the Do-Minimum Scenario. Options 2 and 3 perform in a similar manner and have congestion issues comparable with the reference Do Minimum scenario. Options 1, 4 and 5 eradicate congestion at all junctions in Celbridge during the AM Peak hour, and provide the greatest relief for Celbridge town centre. The increased traffic in the PM peak means that of the 3 best options, Option 1 performs worst but still performs considerably better than the Do-Minimum Scenario.

Framework Appraisal - Overall Impact of Scheme Options

7.15 Overall summary statistics have been taken from Table 9 and Table 10, and have been input to the qualitative framework appraisal of the scheme options. The quantitative values extracted from the traffic model have been ranked for each of the options (Table 12). The purpose of the framework appraisal is twofold:

- Firstly, to determine if any of the scheme options represents an improvement upon the reference case situation; and,
- Secondly, to identify which of the proposed scheme options performs the best.

7.16 The appraisal shows that, in terms of the performance values extracted from SATURN, there are large differences between the scheme Options 1-5 for any of the assessment criteria. The best performing scenarios being Options 1, 4 and 5, Option 5 slightly out performing the others.

7.17 Whilst the links tested in Option 2 and Option 3 are necessary stepping stones in achieving a desirable solution for Celbridge, they will not in themselves, be able to provide relief from traffic within the town by 2017.

Corridor Option	Travel Time	Travel Distance	Average Speed	Fuel Consum-ption	Town Centre Trips	Junction Delay	Overall
Do Minimum	6	4	6	6	5	6	33
1	3	2	3	3	3	3	17
2	5	5	5	5	4	5	29
3	4	6	4	4	6	4	28
4	2	3	2	1	2	2	12
5	1	1	1	2	1	1	7

Table 12: Ranked Global Scheme Option Comparisons 2017

Additional Analysis

7.18 The analysis presented in Table 11 and Table 12 raised a number of questions, which were worthy of further analysis.

In Option 1, which only provides the link through the proposed Donaghcumper development and the western link from Clane Road to the Crodaun roundabout, the network performs satisfactorily with the exception of nodes 1008 and 1022 in the PM peak hour. Can anything be done to increase the capacity of these nodes?

The capacity of Node 1008 on Hazelhatch Road could be increased with the introduction of an inbound right-turn lane, although the provision of this would require landtake and therefore raises the possibility of compulsory purchase. This solution would also be applicable to the performance of Node 1008 in Option 4.

Node 1022 is a relatively minor junction on Maynooth Road, the capacity of which could be increased sufficiently, either through the introduction of a mini-roundabout or traffic signals.

Option 4 includes a bridge across Newtown Road and a third bridge across the river to Clane Road, which together could cost in excess of €10 million to construct. Could Option 4 offer relief without these bridges (L5)?

Option 4 without the additional bridges would cause instability at a number of junctions on the network, including: The Bridge/Dublin Road/Hazelhatch Road/Newtown Road; Shackleton Road/Oldtown Road/Church Street; Dublin Road/St Wolstan's Link; and Maynooth Road/Aghards Road. It is likely, that with some work at these junctions, individual capacity constraints could be overcome, but sections of the network would be close to capacity and both maintenance and incident management would be problematic.

If the mixed use Donaghcumper development is constructed, it has been suggested that the environment of Main Street should be further improved and that through traffic should be limited. Could Option 4, with or without the bridge over Newtown Road and the third bridge across the river, cope with the removal of traffic from Main Street?

Option 4 with the additional bridges could cope with the removal of all of the traffic off Main Street between Castletown Gates and St Patrick's Park, whist without the bridges, additional pressure would be exerted on junctions including: The Bridge/Dublin Road/Hazelhatch Road/Newtown Road; Shackleton Road/Oldtown Road/Church Street; Dublin Road/St Wolstan's Link; and Maynooth Road/Aghards Road. It should be reiterated that *'the modelling exercise does not include an element of modal change ... to take account of the effects of policy and management measures'.* With the impact of such measures, it may be possible to introduce such a scheme on Main Street in advance of

constructing the additional bridges. A phased approach to reducing capacity and the introduction of a 'Pedestrian Priority Zone' (PPZ) could also be adopted, by which, Main Street could be open to traffic during peak hours, but effectively closed to traffic, for example, between 10:00 and 15:00 and is discussed in greater detail in Section 8.0.

What is the impact of the Options on the operation of the current junctions either side of the existing bridge?

All of the Options tested, with the exception of Option 2, offer some improvement over the Reference Case Option. Whilst the Reference Case Option provides a second bridge across the river, it is not enough in itself to eradicate peak hour congestion at the existing bridge if all of the other planned developments are progressed in the town. Option 4 with the third bridge provides a workable solution although minor alterations, will be required to ensure that the English Row/Main Street/The Bridge junction operates within capacity during the PM peak hour. Providing the additional 'Outer Southern Bypass' in Option 5 removes an additional 230 vehicles from the English Row/Main Street/The Bridge junction during the PM peak hour.

VISSIM Microsimulation Analysis of Preferred Option

7.19 As set out within Section 6.0 a number of recommendations have been set out to improve the safe and efficient flow of traffic at the 'Bridge Junctions' as shown in Figure 17. In order to test the efficiency of the recommendation a microsimulation traffic model was developed using the industry standard computer software package VISSIM. The VISSIM model was validated and tested under the following scenarios:

- 2007 – Base Year existing conditions;
- 2007 – Base Year incorporating recommendations; and
- 2017 – Forecast Year, incorporating recommendations plus longer term highway infrastructure.

7.20 The VISSIM model revealed that by incorporating the short term recommendations at the 'Bridge Junctions', the flow of traffic is improved. Furthermore that as traffic flow increases over a ten year period due to the continued growth of Celbridge that, provided the longer term highway infrastructures are in place, the short term junction recommendations will continue to handle the traffic flows at the 'Bridge Junctions'.

7.21 The VISSIM model inputs, together with the video clips of the three scenario's have been supplied to Kildare County Council under separate cover.