THE CITY OF BRADFORD METROPOLITAN DISTRICT COUNCIL (A650 HARD INGS ROAD IMPROVEMENT, KEIGHLEY) COMPULSORY PURCHASE ORDER 2017

THE CITY OF BRADFORD METROPOLITAN DISTRICT COUNCIL (A650 HARD INGS ROAD IMPROVEMENT, KEIGHLEY) (SIDE ROADS) ORDER 2017

THE HIGHWAYS ACT 1980

-and-

THE ACQUISITION OF LAND ACT 1981

THE HIGHWAYS (INQUIRIES PROCEDURE) RULES 1994

COMPULSORY PURCHASE (INQUIRIES PROCEDURE) RULES 2007

National Transport Casework Team (REFERENCE: NATTRAN/YH/LAO/130)

In the matter of

a highway improvement scheme involving highway alterations to facilitate and widen the A650 Hard Ings Road, Keighley, from its junction with the A629 Beechcliffe Roundabout, generally eastwards to a point 75 metres west of its junction with Bradford Road, Roundabout, Bradford in the County of West Yorkshire

Proof of Evidence

of

Andrew John Bradshaw

Director, Fore Consulting Limited

MSci (Hons), MSc, MCIHT

presented as evidence in chief

on behalf of

The City of Bradford Metropolitan District Council

to

Local Public Inquiry – 30th January 2018

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1 Personal Details

1.1 My name is Andrew John Bradshaw and I hold the position of Director of Fore Consulting Limited (Fore), which is a consultancy specialising in transport planning. I have a First Class Master in Science (MSci) in Physics from the University of Nottingham. I also have a Master of Science (MSc) in Transport Planning Practice from the Institute of Transport Studies at the University of Leeds, for which I was awarded a Distinction. I am a member of the Chartered Institution of Highways and Transportation (CIHT).

1.2 I have over 15 years' experience in transport planning and modelling with a specialism in traffic microsimulation modelling, particularly using Aimsun software, which has been used by the Council in their modelling work in relation to the A650 Hard Ings Road Improvement Scheme (referred to hereon as "the scheme").

1.3 For the purposes of this inquiry, I confirm that I am familiar with the site and surrounding highway network.

2 Scope of Evidence

2.1 My evidence covers transport planning and traffic modelling maters in relation to the scheme and is structured as follows:

- Section 3 explains why I have been asked by the Council to present evidence to the Inquiry.
- Section 4 summarises existing conditions on the highway network and explains why the scheme is required in transport planning terms.
- Section 5 summarises the microsimulation traffic modelling work that has been undertaken by the Council in support of the scheme, including the findings of my independent review of that work.
- Section 6 summarises the TRANSYT junction modelling work that has been undertaken by the Council, including the findings of my independent review of that work.
- Section 7 summarises the economic assessment work that has been undertaken by the Council.
- Section 8 provides a detailed response to the Objections that are relevant to my evidence.
- Section 9 summarises and concludes my evidence.
- Section 10 presents my expert declaration.

3 My Appointment

3.1 I am appointed by City of Metropolitan District Council (**"the Council"**) to undertake the following:

- Undertake an independent review of the transport modelling work that has been undertaken by the Council in support of the scheme.
- To present evidence on behalf of the Council in relation to transport planning and traffic modelling matters in relation to the scheme.

4 Existing Situation

Traffic Flow and Capacity

4.1 The A650 Hard Ings Road carries a significant volume of traffic. It is a key commuter route carrying traffic from Keighley, Skipton and East Lancashire along Airedale to and from Leeds and Bradford. I have obtained average two-way weekday traffic flows for Hard Ings Road between the A629 Beechcliffe Roundabout and the Bradford Road Roundabout and have presented this in Table 1 below. Figure 1 identifies the locations of the various junctions.

Table 1: Existing Traffic Flows on A650 Hard Ings Road

Location	Source	Year	AM Peak Hour (0800 to 0900)	PM Peak Hour (1700 to 1800)
A650 East of the A629 Beechcliffe Roundabout	Derived from turning count data undertaken on 5 November 2014	2014	3,122	3,048
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	2,928	3,348
A650 West of Lawkholme Lane	Derived from turning count data undertaken on 5 November 2014	2014	2758	2947
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	2611	2891
A650 West of Bradford Road	Derived from ATC data from 17 to 19 March 2014	2014	2434	2491
	Derived from ATC data from 24 to 26 February 2015	2015	2557	2500
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	2346	2480

4.2 The table shows that, in some cases, the 2017 flows are lower than those surveyed in 2014. However, the differences are within typical day-to-day variation and such differences are to be expected when surveys are undertaken on different days.

4.3 TA 79/99[1] (Core Document 4) sets out typical capacities of urban roads based on their characteristics such as speed limit, number of side roads, access to roadside development, parking and loading restrictions, pedestrians crossings and bus stops. It is considered that Hard Ings Road in the vicinity of the scheme is a UAP3 (Urban All Purpose 3) road type which is defined as "*variable standard road carrying mixed traffic with frontage access, side roads, bus stops and at-grade pedestrian crossings*". The existing road is approximately 9.0m wide. TA79/99 suggests that the capacity of such a road is 1,530 vehicles in the busiest direction, assuming a 60/40 directional split. This therefore equates to a two-way peak hour flow of 2,550 vehicles per hour.

4.4 Paragraph 2.2 of TA79/99 notes that the capacity of urban roads can be affected by a range of factors that may not always be accurately predicted by the road features identified. For this reason, capacities may be up to 10% more or less than the values given. On this basis, the existing two-way capacity of the A650 Hard Ings Road in the vicinity of the scheme is likely to be in the range 2,295 to 2,807 vehicles per hour.

4.5 I have therefore highlighted the flows in Table 1 in green if they fall below this capacity range, amber if they are within this capacity range and red if they exceed this capacity range. This demonstrates that at the western end of the A650 under consideration, the existing traffic flows exceed the likely capacity of the road and towards the eastern end of the link that they are within the capacity range set out by TA79/99, with several of the flows being towards the upper end of that range.

[1] Design Manual for Roads and Bridges (DMRB), Volume 5, Part 3, *TA79/99 Traffic Capacity of Urban Roads*

4.6 Table 2 presents the average flow along the link (i.e. the average of the three locations identified in Table 1), with the same colour coding applied. This shows that in the AM peak hour, two-way average flows on the A650 Hard Ings Road are towards the upper end of the capacity range. Moreover, in the PM peak hour, the average flows exceed the highest value suggested by TA79/99.

Table 2: Existing Average Traffic Flows on A650 Hard Ings Road

Year	AM Peak Hour (0800 to 0900)	PM Peak Hour (1700 to 1800)
2014	2,771	2,829
2017	2,628	2,906

4.7 On the basis of the above, it is clear that the single carriageway section of the A650 Hard Ings Road between the A629 Beechcliffe Roundabout and the Bradford Road Roundabout is operating at or above its design capacity.

Traffic Speeds

4.8 The analysis presented above has compared observed traffic flows to a theoretical estimate of capacity. However, further evidence of the network operating over capacity can be seen by considering current queuing and delay on the A650 Hard Ings Road.

4.9 In particular, traffic speed data has been extracted from the Council's "strat-e-gis Congestion" system. This enables journey time data from third party data suppliers appointed by the Department for Transport (DfT) to be analysed. The data is obtained from vehicles equipped with GPS navigation systems and represents a large dataset collected throughout the year. The average weekday traffic speeds (excluding school holidays) for 2016 on the A650 Hard Ings Road between the A629 Beechcliffe Roundabout and the Bradford Road Roundabout are set out in Table 3, below.

Table 3: Existing Peak Hour Speeds on the A650 Hard Ings Road

Direction	Speed (mph)	
	AM Peak Hour (0800 to 0900)	PM Peak Hour (1700 to 1800)
Eastbound	14.2	14.6
Westbound	14.3	11.2

4.10 The above table demonstrates that the current peak hour speeds are significantly below the speed limit of 30mph, indicating that this section of road currently suffers from peak period congestion.

A629 and A650 Traffic Growth

4.11 It is also evident that that traffic flows do not appear to change over time despite traffic growth increasing both locally and nationally. This is symptomatic of a link operating at capacity. Once a link reaches capacity, it is not possible for any further traffic to pass down that link and the surveyed traffic flow remains broadly the same. However, this does not necessarily mean that there is no demand for that link and this would manifest as increases in flow, queueing and delay on the approaches to the link that is operating in excess of capacity.

4.12 To examine this, the Annual Average Daily Traffic (AADT) flows on key links approaching the A650 Hard Ings Road, derived from DfT data, are presented in Table 4. Also presented is the percentage change relative to the year 2005, which is the year for which data is available for all sites. The traffic count locations are shown on Figure 2.

Table 4: Traffic Growth in the Vicinity of A650 Hard Ings Road

Location	Distance from A6509 Hard Ings Road	Year	AADT Traffic Flow	Percentage Change between 2005 and 2015
A629 approximately 0.8km west of Keighley Road roundabout	5.0km	2000	22,936	+7.6%
		2005	25,786	
		2015	27,749	
A629 approximately 1.9km north of A629 Beechcliffe Roundabout	1.9km	2000	29,866	+4.8%
		2005	33,870	
		2015	35,497	
A650 Hard Ings Road	-	2000	28,674	+2.3%
		2005	28,659	
		2015	29,311	
A650 Aire Valley Road approximately 0.3km east of Bradford Road roundabout	0.3km	2000	20,029	+3.8%
		2005	20,350	
		2015	21,123	
A650 Aire Valley Road approximately 1.2km east of Marley Roundabout	1.8km	2000	-	+18.7%
		2005	30,336	
		2015	36,002	
A650 Aire Valley Road approximately 1.2km east of B6265 Roundabout	4.3km	2000	-	+38.7%
		2005	26,489	
		2015	36,737	

4.13 The above table clearly demonstrates that traffic flows on the A650 have increased significantly away from Hard Ings Road, do less so closer to Hard Ings Road, and increase hardly at all on the section of road itself. This is because traffic simply cannot pass through the A650 Hard Ings Road due the capacity bottleneck. This results in queuing and delay on the approaches to Hard Ings Road or traffic reassigning via alternative and unsuitable routes to avoid the bottleneck.

A629 and A650 Peak Hour Traffic Speeds

4.14 This is further demonstrated by considering the average speeds on the A650 approaches to Hard Ings Road. This is presented in Table 5, which demonstrates the low speeds on the A650 approach to the Bradford Road roundabout, and Table 6, which shows low speed on the A629 approach to the A629 Beechcliffe Roundabout. In particular, it is evident that speeds on the approaches to these roundabouts have also decreased significantly in recent years, suggesting increasing congestion despite no significant increase in traffic flow being observed on the A650 Hard Ings Road.

Table 5: A650 Speeds on the Approach to A650 Hard Ings Road from the East

Link	Year	Speed Limit (mph)	AM Peak Hour (0800 to 0900)		PM Peak Hour (1700 to 1800)	
			Average Speed (mph)	Percentage Change	Average Speed (mph)	Percentage Change
A650 between Bingley Road and B6265, Crossflatts	2012	70, 50	49.6	+1.0%	51.0	+2.9%
	2016		50.1		52.5	
A650 Between B6265, Crossflatts, and Marley Roundabout	2012	70	47.1	+2.8%	49.4	+2.6%
	2016		48.4		50.7	
A650 Between Marley Roundabout and Bradford Road	2012	40	16.1	-29.2%	9.8	-20.4%
	2016		11.4		7.8	

Table 6: A650 Speeds on the Approach to A650 Hard Ings Road from the West

Link	Year	Speed Limit (mph)	AM Peak Hour (0800 to 0900)		PM Peak Hour (1700 to 1800)	
			Average Speed (mph)	Percentage Change	Average Speed (mph)	Percentage Change
A629 Between Station Road, Steeton and Hard Ings Road	2012	70	45.8	-4.6%	29.4	-35.0%
	2016		43.7		19.1	
A629 between Skipton Road, Keighley and Station Road, Steeton	2012	70	-	-	-	-
	2016		48.9		44.1	

4.15 In summary, the above analysis demonstrates the significant existing congestion, both on the A650 Hard Ings Road, and on the approaches to the area. This is a result of the capacity bottleneck on Hard Ings Road as well as capacity constraints at the A629 Beechcliffe Roundabout. It is also apparent that this congestion is increasing over time, with increases in demand elsewhere in the network simply increasing congestion on the approaches to Hard Ings Road or taking alternative routes to avoid Hard Ings Road.

5 Microsimulation Traffic Modelling

Microsimulation Model

5.1 In order to develop and appraise potential solutions to the existing capacity bottleneck at Hard Ings Road, the Council has developed, in-house, an Aimsun microsimulation model of the area.

Benefits of Microsimulation

5.2 Microsimulation models use a comprehensive suite of car-following, lane-changing, merging and gap-acceptance models to model individual vehicles on a geometrically accurate representation of the highway network. The models implicitly take into account the effects of factors such as adjacent junctions, bus stops and pedestrian crossings, as well as junction geometry and gradient, and are ideally placed to model more complex junction arrangements. In particular, microsimulation models are able to model the effects of queues from one junction or merge blocking back through other junctions, which is something that occurs in the vicinity of the A650 Hard Ings Road. For these reasons, I considered that microsimulation is the best and most appropriate method to assess the impacts of the scheme.

5.3 Furthermore, microsimulation models are able to provide statistics relating to the operation of the whole network and can therefore be used to determine the network performance statistics that are required for economic analysis.

Independent Model Review

5.4 The development, calibration and validation of the Council's model has been set out in a Model Validation Report[2] (Core Document 5, Appendix 3).

5.5 I have undertaken an independent review of both the model and Model Validation Report, a copy of which is presented in Appendix A. The review highlighted a number of potential issues with the Council's modelling, which I summarise below:

- Pedestrian crossings on the exits arms of the Bradford Road roundabout have not been included. Including these could affect model performance.
- Vehicles are only disaggregated into cars, light and heavy goods vehicles and buses. Disaggregating goods vehicles into light goods vehicles (LGVs) and heavy goods vehicles (HGVs) would be preferable, since the proportion of HGVs can significantly affect network performance.
- No calibration results are presented for turning movements. If turning movements are not correctly represented, this could affect the findings from the model.
- A low number of replications were used in the model runs. This may result in the average results presented not being representative.

[2] *A650 Hard Ings Road: Model Validation Report*, City of Bradford Metropolitan District Council, 18 March 2015.

5.6 Having regard to the above points, I have reviewed the model to address the above issues, including using traffic survey data collected in 2017. I have also re-run the "Do Minimum" and "Do Something" assessments and compared the results to those produced by the Council. The comparison is presented in Appendix A. This demonstrates that the results from my amended model are not materially different from the Council's. If anything, it demonstrates that the Council has slightly underestimated the benefits of the scheme.

5.7 Having regard to the above, I conclude that the Council's Aimsun modelling can be relied upon for determining the benefits of the scheme in the AM and PM peak periods. As such, I have used the Council's modelling results in my Proof of Evidence.

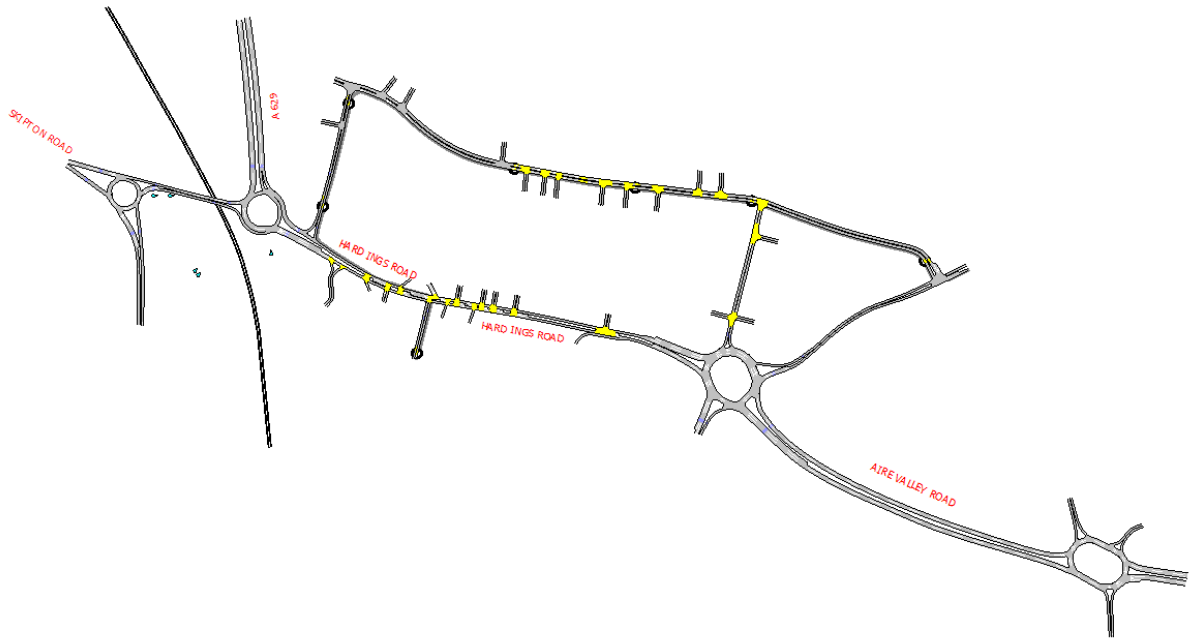
5.8 In addition to the above, although a Saturday model appears to have been developed, no calibration or validation is presented for this time period. As such, I have not considered the Saturday peak in my analysis below.

5.9 I summarise below the modelling that has been undertaken by the Council and discuss the findings.

Summary of Modelling Approach

5.10 A screenshot of the Aimsun model is shown in Screenshot 1. The roads shown in figure illustrate the extent of the modelled network. It comprises the A650 Hard Ings Road, A629 Beechcliffe Roundabout, Bradford Road roundabout, A650 Airevalley Road to the Wenning Road roundabout and also Royd Ings Avenue, which forms an alternative to Hard Ings Road.

Screenshot 1: Extent of Aimsun Model



5.11 The Aimsun model has been calibrated and validated to be representative of a 2014 base year. The following time periods are modelled:

- AM peak period (0730 to 0930)
- PM peak period (1630 to 1830)

Future Year Modelling

5.12 The future year Do Minimum scenarios have been developed by applying TEMpro growth factors. TEMpro (Trip End Model Presentation Program) is computer software that allows the user to view travel forecasts from the National Trip End Model (NTEM) datasets. NTEM forecasts growth in trip origins and destinations taking into account changes in:

- Population
- Employment
- Housing
- Car Ownership
- Trip rates

5.13 The growth factors used are identified in Table 7 and have been applied to the base year matrices to create 2017 and 2026 future year matrices.

Table 7: TEMPro Growth Factors

Scenario	TEMPro 6.2 Growth Factors	
	2014 to 2017	2014 to 2026
AM Peak Period	1.0455	1.1550
PM Peak Period	1.0454	1.1552

5.14 For situations where future year demand is not taken from a strategic transport model, WebTAG[3] does not recommended the direct use of TEMPro (NTEM) growth factors as they do not take into account the impacts of fuel cost, values of time and changes in trip length. Rather, it is recommended that the TEMPro growth factors are used to factor National Transport Model (NTM) growth factors to local circumstances. The NTM is used by DfT to produce national forecasts of the growth in road traffic. Adopting NTM growth factors would result in traffic growth factors that are approximately double those presented in Table 7.

5.15 The Council considered using the WebTAG recommended approach, but concluded that the levels of growth would be unrealistic in the context of historical growth across the District over the past ten years, which has remained broadly static.

5.16 However, there are several reasons why there has been no traffic growth across the District over the past ten years, contrary to growth forecasts, including the effects of the economic downturn and the lack of investment in infrastructure to facilitate economic growth. Furthermore, the analysis of traffic flows presented in Section 4 demonstrates that there has been significant local growth on the approaches to the Hard Ings Road bottleneck.

5.17 The WebTAG recommended approach would normally be applied for the purposes of scheme appraisal. The consequence of not adopting the WebTAG recommended approach is that the assessment undertaken by the Council is conservative and underplays the benefits associated with the scheme.

[3] *TAG Unit M4: Forecasting and Uncertainty*, Department for Transport, 2014

5.18 Notwithstanding the above, the Council's approach to future traffic growth represents a realistic middle ground between the historic trend of broadly static growth and the national growth forecasts.

5.19 A number of options have been coded into the future year Do Minimum models to create future year Do Something models. The alternative options are as follows:

- Dual Carriageway (Option L3A)
- One-Way System
- Composite Part Dual (Option L5)

Aimsun Model Results

5.20 Network-wide statistics have been outputted from the model. These show the overall impact of the scheme and are used in economic appraisal. For simplicity, I have presented the total travelled time (i.e. the sum of all the time spent travelling by vehicles in the model) for each of the options assessed in Table 8.

Table 8: Aimsun Modelling Results: Network Statistics

Scenario	Total Travelled Time (Hours)		
	AM Peak Hour (0730 to 0930)	PM Peak (1630 to 1830)	Saturday Peak (1200 to 1400)
2017 Opening Year			
Do Minimum (Option L2)	516	557	698
Dual Carriageway (Option L3A)	471	411	-
One-Way System (Royd Ings Road)	462	430	-
Composite Part Dual (Option L5)	428 (-17.1%)	362 (-35.0%)	387 (-44.6%)
2026 Assessment Year			
Do Minimum (Option L2)	813	830	830
Dual Carriageway (Option L3A)	-	-	-
One-Way System (Royd Ings Road)	-	-	-
Composite Part Dual (Option L5)	574 (-29.4%)	511 (-38.4%)	456 (-45.1%)

5.21 The above results demonstrate that all options assessed would provide some benefit. However, the greatest benefit is achieved for Option L5, which is the option that has been taken forward.

5.22 The benefits associated with the preferred option are significant with an overall reduction in total travelled time of between 17.1% and 45.1%, depending on the scenario considered.

5.23 In addition to the network statistics, the Council has also outputted detailed journey times with and without the scheme for key routes through the modelled network and the results are presented in Table 9. This demonstrates that the scheme would give rise to significant journey time benefits, with reductions in journey times of up to five minutes.

Table 9: Journey Time Benefits

Link	Journey Time (s)			
	Do Minimum		Do Something	
	AM Peak	PM Peak	AM Peak	PM Peak
2017				
Route 1: A650 Airevalley Road to A629	234	302	151 (-35%)	166 (-45%)
Route 2: A629 to A650 AireValley Road	299	349	173 (-42%)	169 (-52%)
Route 3: A629 Skipton Road to A629	74	121	67 (-9%)	62 (-48%)
Route 4: A629 to A629 Skipton Road	85	165	65 (-24%)	67 (-60%)
2026				
Route 1: A650 Airevalley Road to A629	485	587	186 (-62%)	336 (-43%)
Route 2: A629 to A650 AireValley Road	315	359	249 (-21%)	183 (-49%)
Route 3: A629 Skipton Road to A629	114	212	70 (-39%)	64 (-70%)
Route 4: A629 to A629 Skipton Road	132	203	70 (-47%)	69 (-66%)

Summary

5.24 In summary, the traffic modelling shows that without the scheme, conditions on the highway network in the vicinity of the A650 Hard Ings Road will continue to deteriorate, with drivers being subject to severe congestion. The scheme is shown to deliver significant journey time benefits of up to five minutes in some cases.

6 TRANSYT Junction Modelling

6.1 In addition to the microsimulation modelling, the Council has also prepared individual junction models of the A629 Beechcliffe and Bradford Road roundabouts using TRANSYT 15 software to ensure that these junctions would operate within capacity with the improvement scheme in place.

6.2 TRANSYT is computer modelling software for modelling and optimising signal controlled junctions and networks of signal controlled junction including signalised roundabouts.

6.3 I have undertaken an independent review of these models, the findings of which are presented in Appendix B. A number of issues were identified with the Bradford Road Roundabout TRANSYT model as follows:

- The westbound exit to the A650 Hard Ings Road is modelled as two lanes, with traffic assumed to use both lanes equally; given the merge on the exit from 2 lanes to 1 lane, this is considered unrealistic in practice.
- Flared approaches to the junction have been modelled as long lanes, with multiple traffic lanes modelled as one stream.
- Existing pedestrian crossings on exits from the roundabout have not been modelled.

6.4 I have amended the Bradford Road Roundabout TRANSYT model to address these issues as follows:

- 80% of traffic towards the A650 Hard Ings Road exit is assumed to use the nearside lane, with the remaining 20% assumed to use the offside lane, to better reflect the likely tendency of drivers to predominantly use the nearside lane approaching the existing merge (rather than assuming lane usage is even, as would be more appropriate assuming merging is not required on leaving the junction).

- Where modelled as a single stream, flared lanes on approaches have been split into separate streams, to allow the flare usage to be observed.

- No allowance is made to incorporate the operation of pedestrian crossings on the junction exits, as it is assumed that these run infrequently, and do not materially affect the operation of the wider junction (i.e. associated queues would discharge satisfactorily). This is confirmed through the Aimsun modelling discussed previously.

6.5 The revised model is considered to be fit for the purpose of assessing the capacity of the Bradford Road Roundabout. The results from the revised TRANSYT model are used in the following analysis.

6.6 The review found that the approach taken to model the A629 Beechcliffe Roundabout is appropriate.

TRANSYT Modelling Results

A629 Beechcliffe Roundabout

6.7 A model of the existing situation at the Beechcliffe Road roundabout in the year 2017 has been developed as well as with and without the scheme in place in 2026. The results are summarised in Table 10, below. The following statistics are presented:

- **Performance Index:** this is an economic cost based on stops and delays and provides an overall indicator of the performance of network (unit: £ / h).
- **Average Speed:** this is the average speed that vehicles would travel through the modelled network (unit: km / h).
- **Total Delay:** this is the total delay that is incurred by all the vehicles travelling through the network (unit PCU-h / h).
- **Highest DoS:** The degree of saturation (DoS) is a measure of how close to capacity each individual link in the network is operating. Links with a DoS exceeding 90% are operating over practical capacity and those with a DoS over 100% are operating over absolute capacity (unit: %).

Table 10: A629 Beechcliffe Roundabout: TRANSYT Modelling Results

	2017 Base	2026 Do Minimum	2026 Do Something
AM Peak Hour			
Performance Index (£ / h)	336.49	786.64	339.41
Average Speed (km / h)	17.76	12.02	20.26
Total Delay (PCU-h / h)	23.7	54.7	20.31
Highest DoS (%)	98	107	82
PM Peak Hour			
Performance Index (£ / h)	1189.04	1892.39	302.88
Average Speed (km / h)	8.58	6.3	21.04
Total Delay (PCU-hr / hr)	82.96	132.46	17.82
Highest DoS (%)	114	125	80

6.8 The above table shows that the roundabout currently operates in excess of practical capacity in the AM peak hour and significantly over capacity in the PM peak hour. Conditions at the roundabout are set to deteriorate further by 2026, with the highest DoS increasing to 125% and with a considerable level of delay. However, the proposed scheme would result in the roundabout operating well within practical capacity with significant benefits in terms of reduced delay.

Bradford Road Roundabout

6.9 A model of the existing situation at the Bradford Road roundabout in the year 2017 has been developed as well as models without and with the scheme in place in 2026. The results are summarised in Table 11, below.

Table 11: Bradford Roundabout: TRANSYT Modelling Results

	2017 Base	2026 Do Minimum	2026 Do Something
AM Peak Hour			
Performance Index (£ / h)	426.29	532.53	419.43
Average Speed (km / h)	16.19	14.95	16.94
Total Delay (PCU-h / h)	25.41	32.17	24.64
Highest DoS (%)	86	93	69
PM Peak Hour			
Performance Index (£ / h)	550.15	770.29	531.69
Average Speed (km / h)	14.98	12.76	15.85
Total Delay (PCU-hr / hr)	31.85	45.97	30.41
Highest DoS (%)	93	100	75

6.10 The above table shows that the roundabout currently operates close to capacity in in the AM peak hour and slightly exceeds practical capacity (maximum degree of saturation greater than 90%) in the PM peak hour. By 2026, the roundabout is forecast to operate in excess of practical capacity in both peak hours, principally as a result of uneven lane usage resulting from the two-to-one lane merge on the exit to the A650 Hard Ings Road. With the proposed scheme in place, the approach lanes to the roundabout would be used more evenly and the roundabout would operate well within capacity, with better performance that in 2017.

6.11 Notwithstanding the above, because the TRANSYT model is a standalone junction model, it does not fully take into account the queuing that currently occurs on the two-to-one lane merge on the exit to the A650 Hard Ings Road. In practice, without the proposed scheme, traffic would block back from the merge through the roundabout resulting in significantly worse performance in the 2026 Do Minimum scenario than predicted. This behaviour has been captured in the Aimsun microsimulation modelling results presented in Section 5.

7 Economic Appraisal

Introduction

7.1 The Aimsun microsimulation modelling has been used to undertake an economic appraisal of the scheme. This was required for the Economic Case of the Gateway 1 Submission (Core Document 5) to the West Yorkshire Transport Fund (**"WYTF"**) and determines whether the scheme would represent good value for money and therefore whether it should be funded by the public purse.

7.2 The Gateway 1 Submission, now known as the Outline Business Case, has been independently peer reviewed in accordance with the West Yorkshire Combined Authority (**"WYCA"**) Assurance Framework. This led to the scheme receiving Development Approval (Gateway 1) in May 2014. The scheme appraisal has therefore been undertaken in accordance with the appropriate guidance.

Findings from the Economic Case

7.3 The Aimsun modelling has been used by the Council to calculate the ratio of benefits to cost (BCR), which is used to determine the value for money associated with the scheme. The derivation of the BCR is set out in the Economic Case of the Gateway 1 Submission. Based on the central levels of traffic growth assumed, the economic analysis shows that the scheme would result in a BCR of 5.96. In accordance with the Value for Money Framework published by the DfT[4], the scheme falls into the "very high" value for money category, which is for schemes where the BCR is greater than or equal to 4.

[4] Value for Money Framework, Department for Transport, July 2017, relevant extracts presented in Appendix C

7.4 In accordance with WebTAG guidance, the Council has also undertaken sensitivity tests with lower and higher levels of traffic growth, which provide a BCR of 3.53 and 5.1, respectively. Therefore, even in the low growth scenario, the scheme would still fall in, and towards the upper end of, the "high" value for money category.

7.5 The lower BCR reported for the high growth scenario is due to the with-out scheme model being so congested such that there was a fall in the level of traffic that could travel through the model. Delays to vehicles that could not travel through the modelled area were not taken into account in the analysis and hence the costs associated with the with scheme have been underestimated. If these costs were included, the scheme in the high traffic growth scenario would provide a much higher BCR.

8 Response to Objections

Objection from Fibreline Limited

8.1 An objection letter has been received by Secretary of State for Transport[5] on behalf of Fibreline Limited. A copy of the letter is presented in Appendix D. The letter raises two points that are relevant to my evidence. The first point is as follows:

"7. Our clients object to the principle of the A650 Hard Ings Road Improvement Scheme, which is not justified. Traffic data collected between 2000 and 2015 shows that the Annual Average Daily Traffic (AADT) on Hard Ings Road has not significantly increased and carried some 29,000 vehicles a day in 2015. At the time of the previous scheme to widen the A650 Hard Ings Road in 1996, the AADT was 26,000 vehicles a day. The increase of 3,000 vehicles over a 19 year period is much lower than predicted in the 1996 forecasts, which anticipated an increase from 26,000 to 46,000 over the 20 year period. Similarly, traffic data forecasts for the current scheme predict an increase of 3,200 vehicles over the period modelled from 2017 to 2026 to 34,237 vehicles. The historical traffic data does not support these anticipated increases in traffic."

8.2 As set out earlier in section 4.10 of my evidence, the relatively low level of growth observed on the A650 Hard Ings Road, is a result of the link operating at capacity. It is a bottleneck and it is simple not possible for the road to accommodate any more traffic at peak times.

[5] Letter dated 25 May 2017 from Walker Morris LLP to Secretary of State for Transport on behalf on Fibreline Limited.

8.3 The data cited by the Objector relates the level of traffic that is actually observed travelling along the link – it does not relate to the demand for the link. However, the increase in the demand can be seen on key links approaching the A650 Hard Ings Road pinch point (my Table 4), where growth in traffic over the last 15 years has been observed to be as much as 38.7%.

8.4 The Council's adopted traffic growth rate of approximately 15.5% between 2014 and 2026 is therefore a conservative assumption when compared the level of growth observed nearby on the dual carriageway sections of the A650 and is likely to be achieved once the A650 Hard Ings Road bottleneck is addressed.

8.5 The second point that I address in the Objection from Fibreline Limited is as follows:

"8. Finally, the statement of reasons indicates the alternative options which have been considered. All of the alternative options proposed the dualling of the A650 Hard Ings Road to provide 4 lanes. There were no alternative options for retaining and improving two lanes and improving the Beechcliffe and Bradford Road Roundabouts. The Department for Transport Advice Note TA79/99 "Traffic Capacity of Urban Roads" provides guidance on the maximum hourly flows that typical urban roads can carry. This note advises that a road of a similar width and character to Hard Ings Road can carry some 2,500 vehicles per hour two-way. The data provided by Axis Property Consultancy to our clients in support of the road widening scheme forecasts an increase in morning peak hour traffic flows from 2,189 vehicles (2017 model) to 2,418 vehicles (2026 model). Provided there were improvements to the two roundabouts, the existing 2 lane Hard Ings Road could have sufficient highway capacity to accommodate anticipated morning peak hour flows. All alternative options, including the option to improve the roundabouts without fully

widening Hard Ings Road, should be subject to examination to determine whether they could achieve the same or similar objectives as the proposed scheme with less impacts."

8.6 Paragraphs 4.2 and 4.4 of my evidence has demonstrated that the existing two-way capacity of the A650 Hard Ings Road in the vicinity of the scheme is likely to be in the range 2,295 to 2,807 vehicles per hour. Table 1 shows that at the western end of the A650 under consideration, the existing traffic flows exceed the likely capacity of the road and towards the eastern end of the link that they are within the capacity range set out by TA79/99, with several of the flows being towards the upper end of that range. This suggests that improvements to link capacity are required just based on the existing traffic flows.

8.7 I have established at Paragraphs 5.12 to 5.18 of my evidence, and further at Paragraph 8.4, that the Council's assumed growth rates are appropriate. If these growth rates are applied to the surveyed traffic flows in Table 1, then this gives the traffic flows in 2026, as set out in Table 12.

Table 12: 2026 Traffic Flows on A650 Hard Ings Road

Location	Source	Base Year	Traffic Flow (veh / h)	
			AM Peak Hour (0800 to 0900)	PM Peak Hour (1700 to 1800)
A650 East of the A629 Beechcliffe Roundabout	Derived from turning count data undertaken on 5 November 2014	2014	3,606	3,521
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	3,235	3,700
A650 West of Lawkholme Lane	Derived from turning count data undertaken on 5 November 2014	2014	3,185	3,256
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	2,884	3,195
A650 West of Bradford Road	Derived from ATC data from 17 to 19 March 2014	2014	2,811	2,878
	Derived from ATC data from 24 to 26 February 2015	2015	2,910	2,846
	Derived from an average of turning count data undertaken on 13, 14 and 15 March 2017	2017	2,592	2,740

8.8 As before, I have highlighted the flows in Table 12 in green if they fall below this capacity range, amber if they are within this capacity range and red if they exceed this capacity range. It is clear that this capacity range will be exceeded on all points along the A650 Hard Ings Road with the 2026 traffic flows. The only exception to this being the future traffic flows derived from the traffic count undertaken in 2017 at the eastern end of the link. However, even here, the projected 2026 traffic flows would exceed the TA79/99 capacity value of 2,550 vehicles.

8.9 The above table shows that, in some cases, the future traffic flows derived from 2017 data are lower than those derived from 2014 data. As set out in paragraph 4.2, some surveyed 2017 flows were slightly lower than those surveyed in 2014. In addition, smaller growth factors have been applied to project 2017 flows to the year 2026, resulting in the differences observed in the table.

8.10 I have also repeated the exercise, applying the growth factors to the flows that have been averaged along the length of the A650 Hard Ings Road and set out in Table 13, highlighting the flows as previously. This shows that the average flows exceed even the upper limit of capacity predicted by TA79/99.

Table 13: Existing Average Traffic Flows on A650 Hard Ings Road

Year	Traffic Flow (veh / h)	
	AM Peak Hour (0800 to 0900)	PM Peak Hour (1700 to 1800)
2014	**3,201**	**3,268**
2017	**2,903**	**3,211**

8.11 According to TA79/99, capacity could be improved further by minor widening of the link from 9m to 10m. This would increase the two-way peak hour capacity to 2,700 vehicles per hour. However, it is clear that the future demand for the link would be considerably greater such that the link would continue to operate over capacity.

8.12 To cater for the level of flow predicted, TA79/99 suggests that, as a minimum, the road would need to be upgraded to either:

- UAP2 standards (from UAP1) with four lanes (two in each direction);
- 6.75m wide dual carriageway with two lanes in each direction.

8.13 The Council's approach therefore, quite rightly, focussed on options that included the above components.

8.14 In addition to improving the link capacity, the Council have also considered options for complimentary improvements to the Beechcliffe and Bradford Road roundabouts.

8.15 The capacity of the Beechcliffe roundabout is improved in the Scheme by the remodelling of the roundabout to provide additional lanes on the roundabout itself, the implementation of traffic signals on all arms and an additional traffic lane on the approach to the roundabout from the A629. Crucially, two lanes have also been allocated for the exit to the A650 Hard Ings Road from the roundabout, which will increase the capacity of the junction. The current single lane exit to the A650 Hard Ings Road causes congestion to back up onto and through Beechcliffe Roundabout and beyond at peak times. The two lanes provided along the length of the A650 Hard Ings Road, enables the two-lane exit to be provided and avoids the need for vehicles to merge into a single lane, which would result in congestion queuing back to the roundabout and poor lane usage.

8.16 The Bradford Road roundabout is currently operating with spare capacity. However, in the current situation, vehicles exiting the Bradford Road roundabout onto the A650 Hard Ings Road westbound, merge into one lane adjacent to the ambulance station, causing congestion to back up on and through Bradford Road roundabout and beyond at peak times. The two full lanes along the length of the A650 Hard Ings Road avoids the need for vehicles to merge, directly addressing this issue.

8.17 The Aimsun and TRANSYT modelling confirm that these roundabouts will operate satisfactorily in 2026 with the assumed level of the traffic growth.

8.18 Considering the above, it is clear that two lane exits are required from the Beechcliffe and Bradford Road roundabouts onto the A650 Hard Ings Road and that layouts that require a two-to-one lane merge would still result in queuing and delay as the vehicles merge. Therefore, the roundabout improvements alone require the provision of two full lanes along the full length of the A650 Hard Ings Road.

9 Summary and Conclusions

Existing Situation

9.1 Existing traffic flow data for the A650 Hard Ings Road shows that the link is currently operating at, or over, capacity when compared to the theoretical link capacity set out in TA79/99. This results in significant congestion both on Hard Ings Road and on the roads in its vicinity, including the A650 westbound approach to the Bradford Road roundabout and the A629 southbound approach to the Beechcliffe Roadabout, as evidenced by considering average observed speeds on these links, which are significantly lower than the posted speed limit.

9.2 Traffic flows have not increased materially on the A650 Hard Ings Road over recent years and this is because traffic cannot simply pass through the A650 Hard Ings Road due the capacity bottleneck. However, traffic has increased significantly on other parts of the A650 and A629 where there is sufficient capacity to allow for growth. This growth in demand increases congestion on the approaches to Hard Ings Road or takes alternative routes to avoid the road.

Microsimulation Traffic Modelling

9.3 In order to develop and appraise potential solutions to the existing capacity bottleneck at Hard Ings Road, the Council has developed, in-house, an Aimsun microsimulation model of the area. I have reviewed the model and can confirm that it draws appropriate conclusions.

9.4 The level of traffic growth assumed by the Council represents a realistic middle ground between the historic trend of broadly static growth on Hard Ings Road (which results from the capacity bottleneck not permitting further traffic to use the road) and the national growth forecasts.

9.5 The Aimsun modelling shows that without the scheme, conditions on the highway network in the vicinity of the A650 Hard Ings Road will continue to deteriorate, with drivers being subject to severe congestion. However, the scheme relieves the congestion and is shown to deliver significant journey time benefits of up to five minutes in some cases, and therefore is clearly in the public interest.

TRANSYT Junction Modelling

9.6 In addition to the microsimulation modelling, the Council has also prepared individual junction models of the A629 Beechcliffe and A650 Bradford Road roundabouts using TRANSYT 15 software to ensure that these junctions would operate within capacity with the improvement scheme in place. I have reviewed the models and, subject to some changes that I have made, I can confirm that they are fit for purpose and that the associated modelling has been undertaken correctly and draws appropriate conclusions.

9.7 The TRANSYT model shows that the A629 Beechcliffe Roundabout currently operates in excess of practical capacity in the AM peak hour and significantly over capacity in the PM peak hour. Conditions at the roundabout are set to deteriorate further by 2026 with a considerable level of delay. However, the proposed scheme would result in the roundabout operating well within practical capacity with significant benefits in terms of reduced delay.

9.8 The TRANSYT model for the Bradford Road Roundabout shows that the roundabout will operate over practical capacity in 2026 without the scheme in place due to uneven lane usage resulting from the two-to-one lane merge on the exit to the A650 Hard Ings Road. However, the model does not fully take into account the queuing that currently occurs on the two-to-one lane merge on the exit to the A650 Hard Ings Road. In practice, without the proposed scheme, traffic would block back from the merge through the roundabout resulting in significantly worse performance in the without scheme scenario.

Economic Appraisal

9.9 The Aimsun microsimulation modelling has been used to undertake an economic appraisal of the scheme. Based on the central levels of traffic growth assumed, the economic analysis shows that the scheme would provide very high value for money with a BCR of 5.96, demonstrating that the scheme is in the public interest.

Response to Objections

9.10 I have identified the sections of the Objection by Fibreline Limited that are relevant to my evidence and provide a detailed response to these. In particular, I demonstrate that the lack traffic growth observed on the A650 Hard Ings Road is a consequence of the current bottleneck – it is simple not possible for the road to accommodate any more traffic at peak times.

9.11 I also demonstrate on parts of the network that are not affected by the bottleneck (e.g. dual carriageway sections of the A650 and A629 away from the A650 Hard Ings Road), traffic has grown considerably in recent years. On this basis, I conclude that the Council's growth projections are appropriate and are likely to be realised.

9.12 Finally, I have set out why four lanes (two in each direction) are required on the A650 Hard Ings Road, which is to address the current capacity bottleneck. Retaining two lanes and improving the Beechcliffe and Bradford Road roundabouts in isolation will not address the current problems, since the primary cause of congestion in the area results from the lack of link capacity on Hard Ings Road and need for traffic to merge from two lanes to one lane.

Conclusion

9.13 In summary, I am of the view that I have advanced a compelling case to justify the Orders being confirmed in the public interest to ensure that the Council, acting on its behalf, will be able to use compulsory purchase powers, should the use of such powers be required as a last resort, to acquire for the purposes of the Orders, all the land and rights needed to promote, deliver and facilitate the proper construction to improve and widen the A560 Hard Ings Road, Keighley in the County of West Yorkshire, from its junction with the A629 Beechcliffe Roundabout, generally eastwards to a point 75 metres west of its junction with Bradford Road Roundabout.

10 Expert Declaration

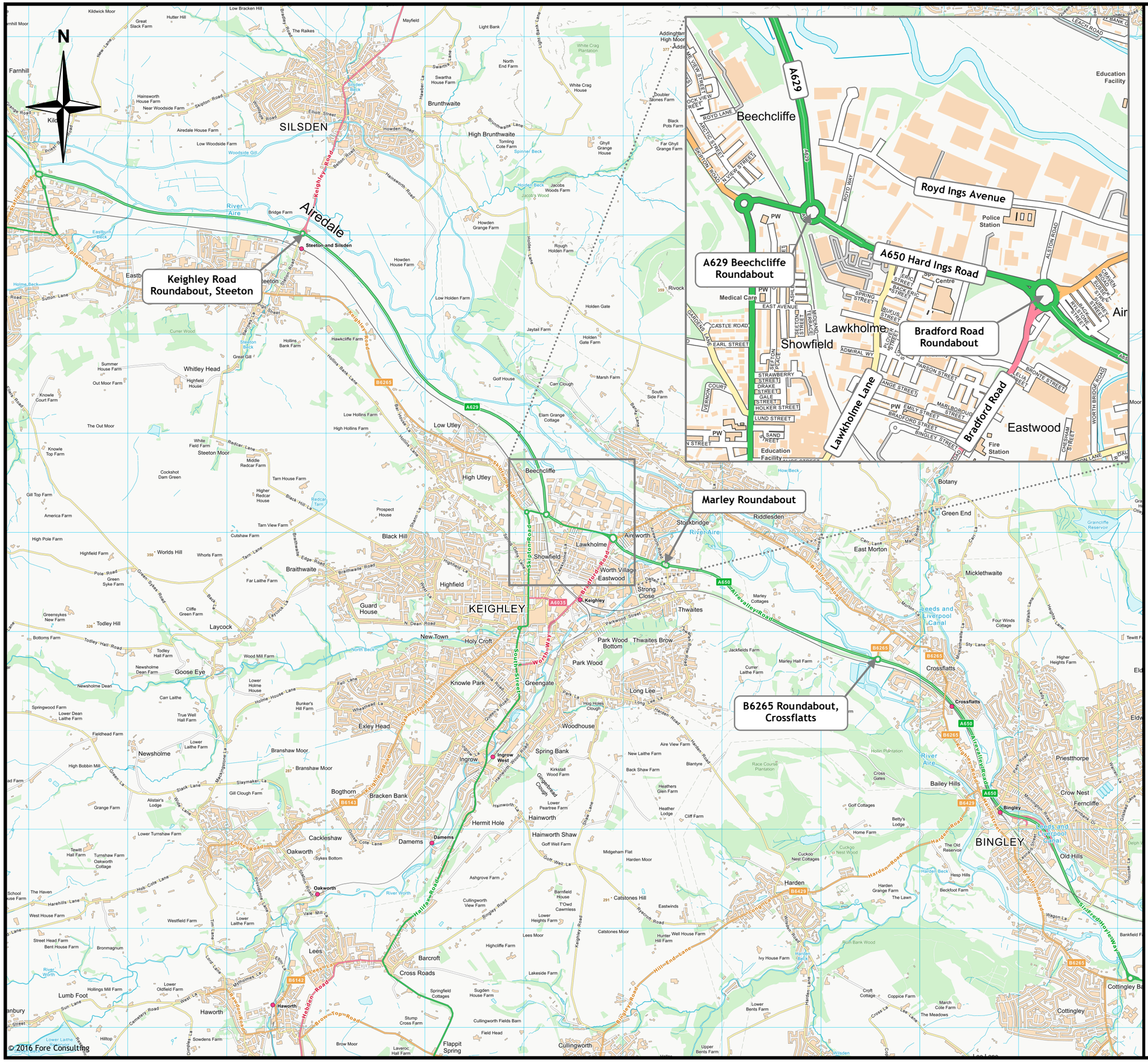
10.1 I confirm that my duty to the Inquiry as an expert witness overrides any duty to those instructing or paying me, that I have understood this duty and complied with it in giving my evidence impartially and objectively and that I will continue to comply with that duty.

10.2 I confirm that my expert evidence includes all facts which I regard as being relevant to the opinions I have expressed and that attention has been drawn to any matter that would affect the validity of those opinions.

10.3 I am not instructed under any conditional fee arrangement and have no conflict of interest.

10.4 I confirm that I have made clear which facts and matters referred to in this proof of evidence are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

Figures



Key:

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Client:
City of Bradford Metropolitan District Council

Project:
A650 Hard Ings Road Improvement, Keighley

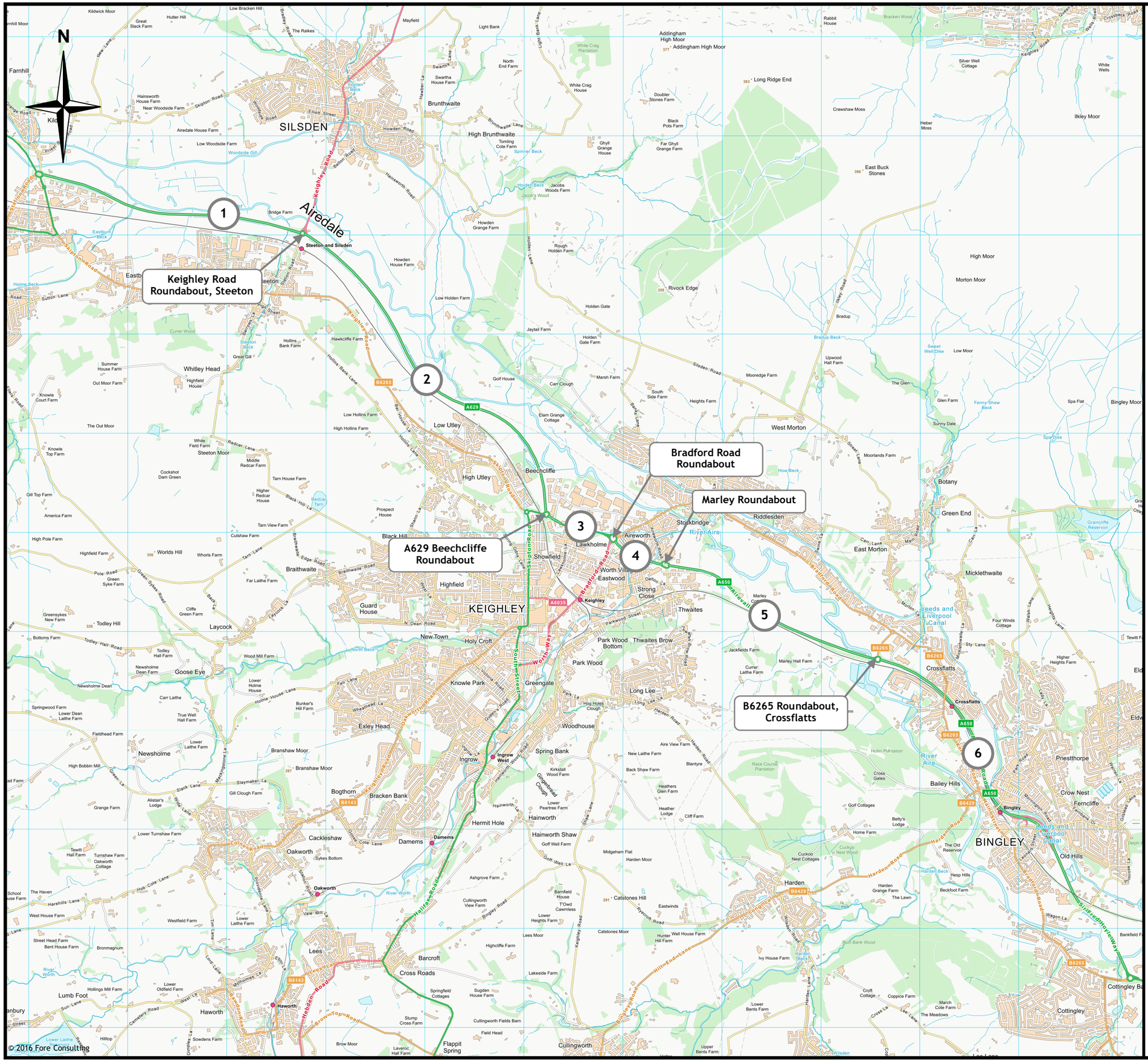
Figure Title:
Location Plan

Scale:
Not to Scale

Figure Status:
Issue

Job Number:
3616

Figure Number:
Figure 1



Key:

1. A629 approximately 0.8km west of Keighley Road Roundabout
2. A629 approximately 1.9km north of A629 Beechcliffe Roundabout
3. A650 Hard Ings Road
4. A650 Aire Valley Road approximately 0.3km east of Bradford Road roundabout
5. A650 Aire Valley Road approximately 1.2km east of Marley Roundabout
6. A650 Aire Valley Road approximately 1.2km east of B6265 Roundabout

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Client:
City of Bradford Metropolitan District Council

Project:
A650 Hard Ings Road Improvement, Keighley

Figure Title:
DfT Traffic Count Locations

Scale:
Not to Scale

Figure Status:
Issue

Job Number:
3616

Figure Number:
Figure 2

Appendix A

Review of Microsimulation Modelling

City of Bradford Metropolitan Council
Hard Ings Road Aimsun Model

Model Validation Report Review

1 December 2017
Version 1.0
Issue

1 Introduction

This technical note has been prepared in order to summarise and provide comment upon the A650 Hard Ings Road Model Validation Report (MVR) produced by City of Bradford Metropolitan District Council and dated 18 March 2015. The model has been built to investigate various transport schemes to improve Hard Ings Road.

2 Model Development

2.1 Extent of the Model

The model extent appears appropriate covering Hard Ings Road and two major roundabout junctions to the west (Hard Ings Road / A629 and Hard Ings Road / Skipton Road / B6265) and two to the east (Hard Ings Road / Airevalley Road / Bradford Road / Alston Road / A6035 and Airevalley Road / Wenning Street / / Aireworth Road / Marland Road). The model also includes Royd Ings Avenue which provides an alternative route to Hard Ings Road.

2.2 Aimsun Version

The model validation report refers to Aimsun version number 8.0.5 (R29862).

2.3 Modelled Year and Time Periods

The base year model is 2014 with peak periods during the weekday of 07:30 to 09:30 (AM Peak) and 16:30 to 18:30 (PM Peak) with a Saturday peak period of 12:00 to 14:00 are modelled and represent the peak traffic flow conditions on the network.

2.4 Vehicle Types

The vehicle types modelled are light vehicles (cars), light and heavy goods vehicles and buses. It would be normally be more realistic to model Light Goods Vehicles and Heavy Goods Vehicles as separate vehicle types.

2.5 Network Development

There is no information as to how the network has been developed, however Figure 1 shows an image from Google Maps being used to ensure accurate coding of a roundabout junction. This approach is considered appropriate.

2.6 Traffic Signal Coding

The Councils Urban Traffic Control (UTC) Unit has been used to provide traffic signal data for the model. This is considered appropriate. However, the pedestrian crossings on the exits arms of the Bradford Road roundabout have not been included.

2.7 Public Transport

The provision of bus stops and routes in the model appears accurate.

2.8 Traffic Demand

The traffic data collection appears appropriate, with turning count data collected for model calibration. It should be noted that data collected at Bradford Road Roundabout was from 2012 and appears not to have been factored up to 2014.

Matrix estimation has used the survey data with 30 minute matrices created in order to capture the changing levels of traffic demand of the two hour peak periods. The demand profiles for the AM and PM peak are shown and appear reasonable, although would better reflect the observed changes in traffic patterns if 15 minute matrices had been used. No Saturday demand profile has been presented.

3 Model Verification

The approach to model verification seems good, with coding and visual checks of the model operation being used to ensure the model accurately represents on site traffic conditions.

4 Model Calibration

The model calibration of several Aimsun parameters has been detailed.

Section characteristics in the model have generally been set to default values, with slight changes made on some turns and sections to replicated on site conditions. This is generally considered acceptable.

Vehicle characteristics in the model have been set to the default values which is acceptable.

Simulation step and reaction time was sensitivity checked in the calibration process, and remains at the default values which is acceptable.

Behavioural models were set to default values which is acceptable.

For the Route Choice Model the 'fixed travel time in free flow conditions' model was used which reflects the lack of route choice in the model. However O-D Routes based on survey data were used to reflect the small amount of route choice that was available in the model. This approach appears appropriate in order to replicate on site conditions.

4.1 Calibrated Traffic Flows

In order to calibrate traffic flows modelled traffic flows have been compared to observed traffic flows with the GEH statistics used to compare the two. A GEH statistic of less than 5 is considered acceptable, and overall an 85% pass rate is required for the overall model. This method is acceptable and in line with DMRB and WebTAG requirements.

The calibration results show that the GEH criteria is met for sections in the AM and PM peak periods. However the turn flows have not been presented. The Saturday peak period is also not included for either section or turn flows.

4.2 Regression Analysis

The analysis demonstrates that there is a near perfect correlation between the modelled and observed data for the AM and PM peak periods. Again the Saturday peak period results are not presented.

5 Model Validation

The report notes that the validation is based on an average of nine model runs, however in the model file there are only seven replications. Whilst it would be preferable to have around ten replications to more effectively reflect typical traffic variations between days, in this instance seven is acceptable.

5.1 Journey Time Validation

CJAMS (TrafficMaster) journey time data was collected between September 2013 and August 2014 on weekdays during school term and an average was taken covering the AM and PM peak hours. The routes cover Hard Ings Road and Airevalley Road, which is considered appropriate.

Using WebTAG guidelines the journey times extracted from the model achieve a 100% pass rate for the AM and PM peak periods compared to the CJAMS data. No Saturday validation is presented.

It is noted that on Hard Ings Road in the PM peak westbound directions modelled journey times are significantly (49 seconds) lower than observed, suggesting the model is underestimating congestion. In the eastbound direction the modelled journey time is considerably higher (41 seconds), indicating the model is overestimating congestion on this route.

6 Model Changes

Having regard to the issues identified above, a revised model has been produced in order to understand the effects of addressing these issues. The following changes were made to the AM and PM peak models:

- 2017 traffic survey data was used in the model, including the separation of vehicle types to cars, light goods vehicle (LGV), heavy goods vehicle (HGV) and bus categories.
- Demand matrices were inputted as 15 minute matrices to reflect changes in traffic levels and traffic patterns over the modelled periods.
- The model was calibrated and validated to the average of ten model replications for each modelled period, reflecting the variation in traffic conditions on different days. Traffic flows were calibrated and validated at both section and turn levels.
- Pedestrian signal crossings located on the exits from the Bradford Road Roundabout have been included.

7 Updated Model Results

Table 1 and 2 present the model results from the original model produced by CBDMC and the updated model. The results show that, although the actual values of the statistics change, there is no material change in the overall findings between the revised model and the original model. If anything, the revised modelling demonstrates that the scheme would provide greater benefits than predicted by CBMDC.

Table 1: AM Peak Model Results

Scenario	Delay (sec/km)	Travel Time (h)	Speed (km/h)	Vehicles Waiting to Enter
2026 Do Minimum	186	813	22	1029
2026 Do Something	93	574	30	95
Sensitivity 2026 Do Minimum	200	927	23	161
Sensitivity 2026 Do Something	95	538	28	0.8

Table 2: PM Peak Model Results

Scenario	Delay (sec/km)	Travel Time (h)	Speed (km/h)	Vehicles Waiting to Enter
2026 Do Minimum	214	830	21	1278
2026 Do Something	75	511	30	25
Sensitivity 2026 Do Minimum	222	976	19	1392
Sensitivity 2026 Do Something	96	585	26	150

8 Summary

Overall, some issues were identified with the original model prepared by CBMDC, as highlighted in this note. No calibration or validation has been presented for the Saturday peak hour and therefore it has not been considered. For the AM and PM peak periods the issues highlighted have been corrected and the model validated and calibrated. Revised outputs from this model have been prepared. Whilst the actual values of the statistics change, there is no material change in the overall findings between the revised model and the original model. It is considered that the initial modelling results prepared by CBMDC can be relied upon to determine the impacts of the proposed scheme.

Appendix B

Review of TRANSYT Modelling

Bradford Metropolitan District Council
Hard Ings Road CPO

Review of TRANSYT Models

6 December 2017
Version 1.0
Issue

1 Introduction

This technical note has been prepared to set out a technical review of TRANSYT models prepared for the purposes of appraising the proposed improvement scheme for the A650 Hard Ings Road, Keighley.

Two TRANSYT models have been prepared, covering the following junctions:

- A650 Hard Ings Road / Airevalley Road / A6035 Bradford Road / Alston Road roundabout ('Bradford Road roundabout').
- A629 / A650 Hard Ings Road roundabout ('A629 Beechcliffe roundabout').

2 Bradford Road Roundabout

From an initial review of the model, a number of issues were apparent, as follows:

- The westbound exit to the A650 Hard Ings Road is modelled as two lanes, with traffic assumed to use both lanes equally; given the merge on the exit from 2 lanes to 1 lane, this is considered unrealistic in practice.
- Flared approaches to the junction have been modelled as long lanes, with multiple traffic lanes modelled as one stream.
- Existing pedestrian crossings on exits from the roundabout have not been modelled. Although no evidence has been provided regarding the frequency that the crossings are demanded in practice, for the purposes of this review it is assumed that the crossings are not called sufficiently frequently to warrant including in the model.

A number of observations were also made, as follows:

- The modelled signal timings are optimised by TRANSYT.

- No observed data (for instance, queue lengths, saturation flows) has been provided to validate the modelled results. For the purposes of this review, it is assumed that the modelled junction operation has been validated satisfactorily.

- It is suggested that the TRANSYT Cell Transmission Model (CTM) would enable a more accurate assessment of interactions of queues on the circulating carriageway rather than the Platoon Dispersion Model (PDM) used. However, given that the circulating links are modelled to operate satisfactorily, for the purposes of this assessment use of CTM is not considered to be warranted.

The base models provided indicate that the junction currently operates with significant spare capacity during the peak hour. Notwithstanding this, the models have been amended to take account of the lane usage issues highlighted above, as follows:

- 80% of traffic towards the A650 Hard Ings Road exit is assumed to use the nearside lane, with the remaining 20% assumed to use the offside lane, to better reflect the likely tendency of drivers to predominantly use the nearside lane approaching the existing merge (rather than assuming lane usage is even, as would be more appropriate assuming merging is not required on leaving the junction).

- Where modelled as a single stream, flared lanes on approaches have been split into separate streams, to allow the flare usage to be observed.

- No allowance is made to incorporate the operation of pedestrian crossings on the junction exits, as it is assumed that these run infrequently, and do not materially affect the operation of the wider junction (i.e. associated queues would discharge satisfactorily).

The changes mean that the junction operates closer to capacity (with the highest DoS at around 86% during the PM peak hour). However, all approaches and circulatory links are modelled operating within the normal practical capacity thresholds, and with modelled queuing on flared approaches accommodated satisfactorily. As such, notwithstanding the amendments made to the model received, the junction operation is considered to be satisfactory.

Impact of the Proposed Scheme

In addition, the impact of the proposed dualling scheme has been tested using the model. The scheme means drivers would no longer be required to merge into the nearside lane on Hard Ings Road when leaving the roundabout. The impact has therefore been tested by increasing the assumed proportion of traffic using the offside lane on Hard Ings Road when exiting the junction to 40% (compared to 20% as assumed for the existing layout, as highlighted above).

The highest DoS would be reduced to around 70% (compared to 86% under the existing layout) during the PM peak hour, with all approaches and circulating links operating satisfactorily in terms of DoS and queuing. On this basis, the modelling indicates that the impact of the Hard Ings Road scheme on the operation of the junction will be beneficial.

3 A629 Beechcliffe Roundabout

Models of the existing and proposed layout with introduction of signal controls have been provided. From an initial review of the model, the following observations are made:

- TRANSYT has been used to model the existing layout. Although priority-controlled junctions would typically be modelled using Junctions9 software, in this instance it is unlikely that lane usage on all approaches would be equal (given the layout of lanes for turning movements), and as such a Junctions9 model would need to be specifically adjusted to account for this behaviour. It appears that give-way parameters have been derived separately for use in the TRANSYT model. On the basis that these parameters correspond to the existing A629 Beechcliffe roundabout geometry and corresponding flows, it is considered that use of TRANSYT to model the existing layout is justified to adequately reflect the potential for uneven lane usage.

- Notwithstanding the above point, it is noted that grouped traffic streams have been used to model the movement from Hard Ings Road northbound to Skipton Road in the existing layout, and Hard Ings Road to Skipton Road and vice-versa in the proposed layout. Each of these movements assume the equal use of two lanes. Although drivers have a natural tendency to use the nearside lane in situations where two lanes are available, there is sufficient spare capacity modelled to accommodate uneven lane usage, and it is therefore not considered necessary to split the grouped traffic streams to make further specific allowance for this.

- No observed data (for instance, queue lengths, saturation flows) has been provided to validate the results of the base model. For the purposes of this review, it is assumed that the modelled junction operation has been validated satisfactorily.

- The models of the proposed layout assume that traffic signal timings are optimised. In practice, the precise signal timings would be a matter to be determined as part of the implementation of the scheme; however, the model demonstrates that a signal arrangement can be provided to satisfactorily accommodate the predicted flows.

Overall, it is considered the approach taken to model the junction is appropriate, and the modelled operation is satisfactory.

4 Summary

Notwithstanding that it has been considered necessary to address some concerns in the TRANSYT models presented, it is considered that the modelled operation of the junctions is generally satisfactory.

Appendix C

Extracts from the DfT's Value for Money Framework

Department for Transport

Value for Money Framework

Moving Britain Ahead

The Department for Transport has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the Department's website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact the Department.

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Category Definitions

Proposals with significant transport budget impacts

5.6 In **standard cases**, where Broad Transport Budget cost outlays exceed revenues or cost savings, the Department uses six value for money categories. The relevant categories are detailed in Box 5.1.

Box 5.1 Standard Categories

(Transport cost outlays exceed revenues or cost savings)

VfM Category	Implied by…*
Very High	BCR greater than or equal to 4
High	BCR between 2 and 4
Medium	BCR between 1.5 and 2
Low	BCR between 1 and 1.5
Poor	BCR between 0 and 1
Very Poor	BCR less than or equal to 0

**Relevant indicative monetised and/or non-monetised impacts must also be considered and may result in a final value for money category different to that which is implied solely by the BCR. This chapter provides guidance on how to select the final value for money category.*

5.7 Four additional categories have also been introduced to reflect special cases where the proposal will result in **cost savings** (see Box 5.2).

5.8 Proposals that could result in cost savings include reductions in service, projects being de-scoped, fare rises and tolling schemes.

Appendix D

Copy of Fibreline Limited letter to the Secretary of State for Transport dated 25 May 2017

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Secretary of State for Transport
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Our ref GGW/RMS/FIB.26-1

25 May 2017

Dear Sir/Madam

City of Bradford Metropolitan District Council (A650 Hard Ings Road Improvement Scheme, Keighley) Compulsory Purchase order 2017

The Highways Act 1980 -and- The Acquisition of Land Act 1981

Our Client: Fibreline Limited, Victoria Park Mills, Hard Ings Road, BD21 3ND

We refer to the above Compulsory Purchase Order ("**the Order**") and confirm that our client has an interest in Plot 12 described in the Notice of Making of the Compulsory Purchase Order ("**the Notice**") and Joint Statement of Reasons for making the Compulsory Purchase Order and Side Roads Order ("**statement of reasons**"). Plot 12 is described in the Notice as "941 square metres of private accesses and frontage grass verge of Fibreline Limited, Victoria Park Mills, lying to the north of the A650 Hard Ings Road, Keighley".

Our client objects to the Order on the following grounds: -

1 Fibreline raise objections to the proposed road widening scheme, which would have a significantly detrimental impact on the ability to operate from their business premises. The objectors reserve the right to supplement these objections and provide additional points in further detailed consultations and in any proof of evidence submitted in relation to any convened Public Inquiry.

2 Fibreline acquired their current property in 1989 and undertook substantial refurbishment and improvement works. The company has grown and now employs over 180 full-time staff and operates the factory/warehouse premises from Sunday 10pm to Friday 10pm on a 24 hour basis. Fibreline's main office sits adjacent to Hard Ings Road. The office block is single storey in construction and extends approximately 30 metres across the front elevation. In between the office building and the existing carriageway is a narrow buffer, with a stone wall and sloped grass verge. The office windows currently achieve adequate natural light. This grass verge is the land required for road widening and is the subject of the Compulsory Purchase Order, while the land hatched blue on plan ref: PTH/HS/103197/LAP-12B is also the subject of the Compulsory Purchase Order and is required for working space.

3 The proposed widening would necessitate the construction of a new retaining wall to the front of the office building and the loss of this grass verge. If the scheme was to proceed, the carriageway would then lie approximately 9 metres from the windows of the office building and the pavement/cycle

path 6 metres from the building. There are likely to be very significant affects on the usability of the office premises due to loss of light, noise, vibration, safety, security and general amenity concerns.

4 Appendix 3 in the statement of reasons is an Engineering Feature Plan showing the location of the proposed retaining wall, footpath and road. The scheme would result in the road moving 3 metres closer to the office windows, while creating a dual carriageway in this location. The resultant loss of amenity within the offices due to increased vibration, noise, loss of light, overbearing impact on amenity, safety and compromised security could render the only existing office space serving the business unusable, which could in turn threaten the entire Fibreline operation in Keighley.

5 The creation of a steep retaining wall outside the office window, with the relocated stone wall above, would invariably result in a reduction in the amount of natural light to these offices. There is presently a sloped grass verge which allows adequate levels of sunlight throughout the day. Removing this grass verge and replacing with a retaining wall much closer to the office block would impinge on the outlook of employees and presently enjoyed rights of light being diminished. These offices presently enjoy a partial outlook towards the road, albeit at a lower level. Any attempts to build a steep retaining wall closer to the offices would also have a deleterious effect on the outlook for occupants of these offices.

6 The objectives of the road widening scheme are to improve traffic flows and reduce traffic congestion on the A650 and in Keighley town centre. The consequences of increased traffic flows would be more frequent and faster moving vehicles across 4 lanes of traffic and a potential increase in noise and disturbance from these vehicles. Fibreline operate the only business with an office fronting Hard Ings Road. Employees work in these offices for over 10 hours a day (08.00-18.00). Persistent noise disturbances over a sustained period during working hours could be detrimental to health, productivity and the company's ability to retain and hire staff.

7 Our clients object to the principle of the A650 Hard Ings Road Improvements Scheme, which is not justified. Traffic data collected between 2000 and 2015 shows that the Annual Average Daily Traffic (AADT) on Hard Ings Road has not significantly increased and carried some 29,000 vehicles a day in 2015. At the time of the previous scheme to widen the A650 Hard Ings Road in 1996, the AADT was 26,000 vehicles a day. The increase of 3,000 vehicles over a 19 year period is much lower than predicted in the 1996 forecasts, which anticipated an increase from 26,000 to 46,000 over the 20 year period. Similarly, traffic data forecasts for the current scheme predict an increase of 3,200 vehicles over the period modelled from 2017 to 2026 to 34,237 vehicles. The historical traffic data does not support these anticipated increases in traffic.

8 Finally, the statement of reasons indicates the alternative options which have been considered. All of the alternative options proposed the dualling of the A650 Hard Ings Road to provide 4 lanes. There were no alternative options for retaining and improving two lanes and improving the Beechcliffe and Bradford Road Roundabouts. The Department for Transport Advice Note TA79/99 'Traffic Capacity of Urban Roads' provides guidance on the maximum hourly flows that typical urban roads can carry. This note advises that a road of a similar width and character to Hard Ings Road can carry some 2,500 vehicles per hour two-way. The data provided by Axis Property Consultancy to our clients in support of the road widening scheme forecasts an increase in morning peak hour (08.00-09.00) traffic flows from 2,189 vehicles (2017 model) to 2,418 vehicles (2026 model). Provided there were improvements to the two roundabouts, the existing 2 lane Hard Ings Road could have sufficient highway capacity to accommodate anticipated morning peak hour flows. All alternative options, including the option to improve the roundabouts without fully widening Hard Ings Road, should be subject to examination to determine whether they could achieve the same or similar objectives as the proposed scheme with less impacts.

We look forward to receiving acknowledgement of receipt of our client's objection in due course.

Yours sincerely,

WALKER MORRIS LLP

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