Technical Report: FINAL

Keynsham Core Strategy Options: Highway Impact Assessment

Prepared for

Bath and North East Somerset Council

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Acronyms and Abbreviations

B&NES - Bath and North East Somerset Council
GFA - Gross Floor Area
GWML - Great Western Main Line
TRICS - Trip Rate Information Computer System

SECTION 1

Introduction

1.1 Background

This report describes highway assessment work using the Keynsham S-Paramics model to evaluate a number of development scenario options to inform the Core Stratagy. As a 'base-line' the 2022 situation without any additional Core Strategy development in place by this date includes the following:

- The full build-out of residential site K2A and K2B in SW Keynsham. The latter has planning permission and implementation is underway, whilst the former has a submitted planning application pending determination;
- The completion of the Keynsham Town Centre development; with the new Town Hall and the former Riverside offices converted to residential flats;
- The full completion of the recently consented Somerdale development; and
- In conjunction with the Somerdale development, the installation of a new traffic layout at the A4175/Somerdale access junction and further off-site improvement works to the A4175/Avon Mill Lane and the Bath Hill/Avon Mill Lane junctions.

Previous work undertaken for the Somerdale development in 2022 has show that, with this development in place, available highway capacity within the Town Centre will be extremely limited in the weekday peak hours. Operating conditions at the A4 Hicks Gate Roundabout are also expected to deteriorate in the AM peak hour by 2022, with congestion problems also starting to develop during the PM peak hour. Despite this fact the Core Strategy option tests do not assume further highway improvements over and above those expected to be delivered in conjunction with the Somerdale site. The only exception to this is the proposed option for development to the north of the Great Western Main Line (GWML) on land currently accessed by Pixash Lane and Broadmead Lane (Option 4). In this case the construction of a new link road connecting Avon Mill Lane and Pixash Lane has been assumed. The link alignment shown and junction arrangements are shown on Drawing Nos. 204269.BC.00.28-03 and 204269.BC.28-04 in **Appendix A**.

In terms of the timing of any extra Core Strategy development it is envisaged that this would be in place by 2022, as opposed to post 2022, with first delivery of housing in 2016/17.

1.2 Option Tests

Nine option scenarios have been assessed, which include an amended 'base-line' with 30,000sqm of B1, B2 and B8 development on a site east of Pixash Lane and south of the GWML added. This is thus included in all the 'further development' tests which were as follows:

- Option 1: 200 dwellings at Site KE4 in SW Keynsham and 250 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new single form primary school;
- Option 2: 450 dwellings at Site KE4 in SW Keynsham and 500 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new two form primary school;
- Option 3: 200 dwellings at Site KE4 in SW Keynsham and 600 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new two form primary school. In addition, a further 4.5ha of land developed for business units is included in the proposals for land at 'Keynsham East';

- Option 4: This comprises a mixture of proposed land uses on land to the north of the GWML being promoted by the Riverside Regeneration Trust, and termed the 'Broadmead Pennisula'. The Option B scenario outlined in a report issued by the Trust has been assessed. This envisages up to 714 dwellings and employment uses generating around 630 jobs. This report is fairly vague when it comes to anticipated access arrangements with the full development in place, so the completion of a link road connecting Avon Mill Lane with Pixash Lane has been assumed as previously described;
- Option 5: 450 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new two form primary school. No development at KE4;
- Option 6: 650 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new two form primary school. In addition, a further 4.5ha of land developed for business units is included in the proposals for land at 'Keynsham East'. No development at KE4;
- Option 7: 800 dwellings on land to the south of the A4 Bath Road at 'Keynsham East' (KE3A). The latter development includes a new two form primary school. In addition, a further 4.5ha of land developed for business units is included in the proposals for land at 'Keynsham East'. No development at KE4; and
- Option 8: 1000 dwellings at Site KE4 in SW Keynsham. No development at KE3A.

S-Paramics model 'runs' were undertaken for the weekday AM peak period (7:00-10:00am) and PM peak period (3:00-7:00pm). As such, it was necessary to estimate the development traffic generation for each of these hours and so the overall arrival and departure profiles within the two model time periods.

SECTION 2

Pixash Lane Employment Land

2.1 Traffic Generation

As previously stated the 2022 'base-line' includes the development of land to the east of Pixash Lane and south of the GWML for employment purposes. The 7.5ha site is intended to be accessed from Pixash Lane, which is assumed in the S-Paramics modelling. No secondary 'direct' access onto the A4 Bath Road has been assumed.

A development mix of B1, B2 and B8 has been cited, but for the purposes of estimating traffic generation, some more specific information on the likely split was sought from the B&NES Economic Development team. Information received suggested that 10,000sqm would be B8, with the remaining 20,000sqm split equally between B1(c) and B2. It was estimated that the site could employ between 570 and 800 people, with the worst case assumption assumed to be a full build-out as B2. Whilst trip generation prediction using TRICS can use GFA or employees for estimating vehicle generation from employment sites it was decided to use the GFA parameter. The trip rates obtained and applied are set out below. Note that separate rates were estimated for both light vehicles and HGV, but only the light vehicle rates and calculated traffic generations are shown in Tables 2.1 to 2.3 below.

TABLE 2.1
Employment: B1 Business Park – 10,000sqm
Trip Rates per 100sqm GFA and Estimated Generation –Light Vehicles

Time Period	Arrival Rate	Arrivals-IN	Departure Rate	Departures-OUT
AM: 0700-0800	0.53	53	0.084	8
AM: 0800-0900	1.679	168	0.265	27
AM: 0900-1000	1.041	104	0.335	34
PM: 1500-1600	0.335	34	0.541	54
PM: 1600-1700	0.271	27	0.907	91
PM: 1700-1800	0.240	24	1.437	144
PM: 1800-1900	0.079	8	0.454	45

TABLE 2.2
Employment: B2 Industrial Estate – 10,000sqm
Trip Rates per 100sqm GFA and Estimated Generation - Light Vehicles

Time Period	Arrival Rate	Arrivals-IN	Departure Rate	Departures-OUT
AM: 0700-0800	0.368	37	0.115	12
AM: 0800-0900	0.473	47	0.214	21
AM: 0900-1000	0.314	31	0.259	26
PM: 1500-1600	0.252	25	0.302	30
PM: 1600-1700	0.229	23	0.422	42
PM: 1700-1800	0.121	12	0.390	39

TABLE 2.2
Employment: B2 Industrial Estate – 10,000sqm
Trip Rates per 100sqm GFA and Estimated Generation - Light Vehicles

Time Period	Arrival Rate	Arrivals-IN	Departure Rate	Departures-OUT
PM: 1800-1900	0.056	6	0.114	11

TABLE 2.3
Employment: B8 Warehousing/Distribution – 10,000sqm
Trip Rates per 100sqm GFA and Estimated Generation –Light Vehicles

Time Period	Arrival Rate	Arrivals-IN	Departure Rate	Departures-OUT
AM: 0700-0800	0.129	13	0.019	2
AM: 0800-0900	0.177	18	0.049	5
AM: 0900-1000	0.082	8	0.06	6
PM: 1500-1600	0.055	6	0.103	10
PM: 1600-1700	0.066	7	0.117	12
PM: 1700-1800	0.043	4	0.170	17
PM: 1800-1900	0.002	0	0.038	4

The TRICS analyses predict that that the overall two-way light vehicle generation in the AM and PM model periods would be 619 and 674 vehicles, with the flows in the 8:00-9:00am and 5:00-6:00pm hours expected to be 286 and 240. The corresponding two-way HGV movements associated with this development in the two peak periods are predicted to be 48 and 41 vehicles respectively which, as stated above, are separately considered in the S-Paramics models using a separate matrix level and vehicle type allocation. This is of course based on the B1, B2 and B8 split assumed in this case.

2.2 Traffic Distribution

The employment trip distribution was the same as that used and agreed with WSP for the B1 'Office' development element at Somerdale. As was the case with Somerdale, this vehicle generation is largely associated with drivers coming from beyond Keynsham, with the percentage split associated with the 'key' routes as follows:

- A4 Bath Road (W) - Bristol: 21.34%;
- A4174 Avon Ring Road: 9.34%;
- A431(W) - Bristol: 10.05%;
- A431 (E) - Oldland Common/Bath: 9.60%;
- A4 Bath Road (E) - Saltford/Bath: 14.60%;
- Wellsway: 17.12%;
- Charlton Road: 4.34%; and
- Stockwood Hill: 2.34%

The above shows that external origins/destinations are predicted to account for circa 89% of the expected vehicle generation, although some traffic using the Wellsway or Charlton Road could be from within Keynsham.

2.3 Access Improvements

The existing A4 Bath Road/Pixash Lane junction is a 'major-minor' priority junction with a ghost island right turn lane on the main road. The existing flows into and out of Pixash Lane at this junction were counted in November 2013, and these incorporated in the base-line models. Whilst the existing junction type is adequate to cater for the low existing demand it was anticipated that the inclusion of the traffic associated with the proposed employment site could create operating problems. In view of this a replacement traffic signal junction was assumed in the S-Paramics tests. It was assumed that this improvement would be within the existing highway limits and, as such, the Pixash Lane approach was assumed to remain a single lane.

2.4 Travel Plan Effects

No reductions to the estimated traffic generations were made to reflect the possible effect of Travel Plan measures or initiatives.

SECTION 3

KE4 Development: SW Keynsham

3.1 Traffic Generation

The traffic generation rates used for the KE4 site in the various options were the same as those used for recent work agreed with the developer promoting the K2A residential site. These are shown in Table 3.1 below, together with the estimated generation expected with 200 dwellings under Option 1.

TABLE 3.1
KE4 Residential
Trip Rates per Dwelling and Estimated Generation - 200 dwellings

Time Period	*Arrival Rate*	Arrivals-IN 200 Dwellings	Departure Rate	Departures-OUT 200 Dwellings
AM: 0700-0800	*0.063*	13	0.270	54
AM: 0800-0900	*0.120*	24	0.390	78
AM: 0900-1000	*0.130*	26	0.201	40
PM: 1500-1600	*0.256*	51	0.181	36
PM: 1600-1700	*0.325*	65	0.184	37
PM: 1700-1800	0.360	72	0.200	40
PM: 1800-1900	0.342	68	0.221	44

Some of the above traffic will be associated with movements to/from the A37, and so are not considered in the S-Paramics models. This accounts for 17% of all the generated traffic from KE4.

Within the S-Paramic model all KE4 traffic entering/leaving the Town Centre is assumed to do so via Charlton Road. As St Ladoc Road is included in the network traffic routing to/from the A4 Bath Road (W) and the A4174 Ring Road can use this link to avoid the High Street. However, drivers requiring the A4175 Keynsham Road and the A4 Bath Road (E) will be forced to route via the Town Centre. Under Option 8 it is proposed that 1000 dwellings are constructed at KE4. Using the same above rates this has the potential to generate 1174 additional two-way trips between 7:00-10:00am, of which 972 would impact on the Town Centre and St Ladoc Road. The corresponding figures between 3:00-7:00pm for Option 8 are expected to be 2070 and 1793 vehicle trips respectively.

As noted above it is anticipated that about 17% of the generated traffic associated with development at KE4 will route south along Charlton Road towards the A37. This may be problematic at the A37/Woollard Lane junction with the larger development allocation options at KE4, particularly Option 8. Potential weekday peak period operating conditions here are clearly a material consideration, but outside the scope of the S-Paramics work which considers only the potential operational impacts within Keynsham and along the A4 Keynsham Bypass.

3.2 Traffic Distribution

The residential trip distribution applied to KE4 was the same as that used and previously agreed with developers promoting the K2A land. This vehicle generation is again largely associated with origins/destinations outside Keynsham, with the percentage split associated with the 'key' routes as follows:

- A4 Bath Road (W) - Bristol: 22.8%;
- A4174 Avon Ring Road: 14.4%;
- A431(W) - Bristol: 4.0%;
- A431 (E) - Oldland Common/Bath: 5.1%;
- A4 Bath Road (E) - Saltford/Bath: 14.1%;
- Wellsway: 0.0%;
- Charlton Road (South) - to/from A37: 17.0%; and
- Stockwood Hill: 0.0%.

In the case of the Wellsway drivers are assumed to use Redlynch Lane as a short-cut to avoid routing via the Town Centre.

3.3 Access Improvements

This site lies well outside the network covered by the S-Paramics model. Whilst a suitable vehicular access or accesses onto Charlton Road would need to be provided, this is not considered in this work. No ancilliary off-site highway improvements within the network considered have been assumed.

3.4 Travel Plan Effects

No reductions to the estimated traffic generation for KE4 were made to reflect the possible effect of Travel Plan measures or initiatives.

SECTION 4

Keynsham East Development: KE3A

4.1 Traffic Generation

4.1.1 Residential Development

The residential trip rates used for Keynsham East were the same as those used for the Somerdale site. These are set out in Table 4.1 below, with the resultant traffic generation with 250 dwellings under Option 1 also presented for the various hours.

TABLE 4.1
Keynsham East - KE3A : Residential
Trip Rates per Dwelling and Estimated Generation - 250 dwellings

Time Period	Arrival Rate	Arrivals-IN 250 Dwellings	Departure Rate	Departures-OUT 250 Dwellings
AM: 0700-0800	0.072	18	0.23	58
AM: 0800-0900	0.156	39	0.402	101
AM: 0900-1000	0.162	41	0.176	44
PM: 1500-1600	0.280	70	0.209	52
PM: 1600-1700	0.288	72	0.192	48
PM: 1700-1800	0.363	91	0.213	53
PM: 1800-1900	0.281	70	0.222	56

This site has a primary school proposed which will 'internalise' some of the car trips associated with pupil drop-off. In order to estimate this, the same approach and source documentation used to establish the effect of the primary school proposed on the Somerdale site was applied. The methodology applied is summarised as follows:

- From the National Travel Statistics (NTS): 47% of AM peak car trips associated with education purposes; so 47 of the 101 departures between 8:00-9:00am with Option 1;
- Again, from NTS: 46% of education car trips are typically 'Primary' school trips, so 22 of the 47 above with Option 1;
- Transport Trends 2000 suggests that 20%-60% of education drop-off trips are 'Linked', so 40% has been assumed equating to 9 of the 22 trips. These assumptions suggest 13 of the two-way residential trips between 8:00-9:00am would be wholly internal as a result of the primary school present on the site; and
- In examining the same effect during the afternoon 'pick-up' it is assumed that the same number of internal car trips would be involved, and the reduction in external movements applied to the 3:00-4:00pm period.

This principal has been applied in calculating the internal trip component associated with the larger proposed housing allocations at Keynsham East with other options.

4.1.2 Primary School

TRICS was used to estimate vehicle trip rates/pupil, with a single form primary school assumed to have 210 pupil spaces and a two form 420 spaces. The resultant rates and the estimated vehicle trip generation associated with a single form entry primary school is shown in Table 4.2 below:

TABLE 4.2
Keynsham East - KE3A : Primary School
Trip Rates per Pupil and Estimated Generation - Single Form

Time Period	Arrival Rate	Arrivals-IN Single Form	Departure Rate	Departures-OUT Single Form
AM: 0700-0800	0.021	4	0.009	2
AM: 0800-0900	0.369	77	0.282	59
AM: 0900-1000	0.026	5	0.058	12
PM: 1500-1600	0.247	52	0.291	61
PM: 1600-1700	0.032	7	0.054	11
PM: 1700-1800	0.008	2	0.027	6
PM: 1800-1900	0.004	1	0.011	2

Note: A single form entry primary school has 210 pupil places

The above traffic generation was adjusted to remove estimated internal car trips between 8:00-9:00am and 3:00-4:00pm as previously described.

4.1.3 Business Units

Options 3, 6 and 7 include an additional 4.5ha developed for business units. The trip rates per hectare and estimated traffic generation associated with this land use component is shown in Table 4.3 below.

TABLE 4.3
Keynsham East – KE3A : Business Units
Trip Rates per Hectare and Estimated Generation - 4.5ha

Time Period	Arrival Rate	Arrivals-IN 4.5ha Site	Departure Rate	Departures-OUT 4.5ha Site
AM: 0700-0800	13.94	63	4.10	18
AM: 0800-0900	22.70	102	3.63	16
AM: 0900-1000	7.70	35	4.72	21
PM: 1500-1600	4.22	19	6.55	29
PM: 1600-1700	4.19	19	12.19	55
PM: 1700-1800	2.42	11	19.10	86
PM: 1800-1900	2.38	11	8.58	39

4.2 Traffic Distribution

The traffic distribution used for the residential development was the same as that originally agreed as acceptable for Somerdale. However, the latter was adjusted later on to allow the likely greater use of the A4175 and the A431, with reductions applied to trips using the A4174 and the A4 Bath Road (E). This was not done for the proposed Keynsham East site. The resultant percentage split associated with the 'key' routes was as follows:

- A4 Bath Road (W) - Bristol: 32.21%;
- A4174 Avon Ring Road: 12.34%;
- A431(W) - Bristol: 11.26%;
- A431 (E) - Oldland Common/Bath: 2.09%;
- A4 Bath Road (E) - Saltford/Bath: 21.24%;
- Wellsway: 4.6%;
- Charlton Road - 1.63%; and
- Stockwood Hill: 0.76%

The externally generated trips associated with the primary school were assumed to be relatively local; with the following zonal split used:

- Zone 3: Gaston Avenue/Unity Road area - 15%;
- Zone 4: Wellsway: from/to Chandag Estate/Keynsham East - 20%;
- Zone 27: Chandag Road: from/to Chandag Estate - 30%; and
- Zone 29: A4 Bath Road (E): from/to Saltford - 35%

Estimated vehicle trips associated with the business units used the same 'employment' distribution used for the Pixash Lane site. This was set out earlier in this report.

4.3 Access Improvements

Access to the Keynsham East was assumed to be via a fifth arm onto Broadmead Roundabout. This connection would be made to the south side of the junction where there is an existing access providing entry/exit to a lay-by.

4.4 Travel Plan Effects

No reductions to the estimated traffic generation for the Keynsham East site were made to reflect the possible effect of Travel Plan measures or initiatives in any option.

SECTION 5

Riverside Regeneration

5.1 Traffic Generation

5.1.1 Option B Development Mix

The part complete 'Scoping Study Report' issued by the Riverside Regeneration Trust has been used to estimate the likely total traffic generation associated with the mix of land uses proposed in the 'Broadmead Pennisula' area. The Option B land use mix has been assumed. The various components are set out below, together with comment as to how each has been treated in the traffic generation work on the basis of the information provided:

- 714 residential units, which is envisaged as comprising 400 houses, 95 1-bedroom flats, 140 2-bedroom flats and 80 houseboats. For the purposes of trip generation the houseboats have been considered as flats;
- 52,735sqm of B1 employment development providing 189 jobs. This level of floor space is very high considering only 189 jobs are created. It is further noted that the intended site area is 5.27ha, so it would seem that the 52,735sqm quoted refers to the total site area rather than GFA. Traffic generation estimates produced using GFA or 'Employees' produced very different totals. For example, in the 7:00-10:00am period the estimate based on GFA would be circa 2,100 two-way vehicle trips, compared to 288 trips using an assumed 189 employees. The latter has been assumed given the error concerned with the quoted 52,735sqm GFA figure;
- 17,220sqm of B2/B8 employment development providing 312 jobs. In the report the GFA figure is again equivalent to the quoted total site area of 1.72ha. In view of this the trip generation estimates are based on 'employees' as with the B1 allocation. The split between B2 and B8 is not stated, so assumed traffic generation is based on all B2;
- 18,313sqm of shops/hotels providing providing 48 jobs: The type of retail envisaged and its propensity to attract traffic external to the site is too vague to assess, so this component is ignored in the present work;
- 7,993sqm: Health & Education creating 20 jobs. Development 'type' too vague to assess;
- 1,478sqm: Leisure creating 17 jobs. Development 'type' too vague to assess;
- Open Space, Marina & Wetland: 151,237sqm creating 8 jobs. Ignored as negligible;
- Rail Station & Sidings: 17,857sqm creating 18 jobs. Ignored as negligible; and
- Waste Management Facilities: 45,499sqm creating 12 jobs. Ignored as negligible.

5.1.2 Residential Development

The trip rates used for the residential houses and flats are set out in Tables 5.1 and 5.2 below, together with the expected traffic generation from 400 private houses and 314 private flats respectively.

TABLE 5.1
Riverside Regeneration: Residential – Private Houses
Trip Rates per Dwelling and Estimated Generation - 400 dwellings

Time Period	Arrival Rate	Arrivals-IN 400 Dwellings	Departure Rate	Departures-OUT 400 Dwellings
AM: 0700-0800	0.072	29	0.23	92
AM: 0800-0900	0.156	62	0.402	161
AM: 0900-1000	0.162	65	0.176	70
PM: 1500-1600	0.280	112	0.209	84
PM: 1600-1700	0.288	115	0.192	77
PM: 1700-1800	0.363	145	0.213	85
PM: 1800-1900	0.281	112	0.222	89

TABLE 5.2
Riverside Regeneration: Residential - Private Flats
Trip Rates per Dwelling and Estimated Generation - 314 Flats

Time Period	Arrival Rate	Arrivals-IN 314 Flats	Departure Rate	Departures-OUT 314 Flats
AM: 0700-0800	0.033	10	0.164	52
AM: 0800-0900	0.079	25	0.284	89
AM: 0900-1000	0.065	20	0.096	30
PM: 1500-1600	0.122	38	0.068	21
PM: 1600-1700	0.137	43	0.100	32
PM: 1700-1800	0.269	85	0.126	40
PM: 1800-1900	0.190	60	0.122	38

5.1.3 Employment Development

Calculated vehicle trip rates from TRICS per employee for B1 and B2 land uses are given in Tables 5.3 and 5.4 below. The expected traffic generation with 189 persons employed within the B1 type employment, and 312 employees associated with the B2 type undertakings, are also shown.

TABLE 5.3
Riverside Regeneration: B1 Employment
Trip Rates per Employee and Estimated Generation 189 Employees

Time Period	Arrival Rate	Arrivals-IN 189 Employees	Departure Rate	Departures-OUT 189 Employees
AM: 0700-0800	0.299	57	0.014	3
AM: 0800-0900	0.688	130	0.050	9
AM: 0900-1000	0.326	62	0.147	28

TABLE 5.3
Riverside Regeneration: B1 Employment
Trip Rates per Employee and Estimated Generation 189 Employees

Time Period	Arrival Rate	Arrivals-IN 189 Employees	Departure Rate	Departures-OUT 189 Employees
PM: 1500-1600	0.160	30	0.289	55
PM: 1600-1700	0.100	19	0.388	73
PM: 1700-1800	0.066	12	0.424	80
PM: 1800-1900	0.084	16	0.140	26

TABLE 5.4
Riverside Regeneration: B2 Employment
Trip Rates per Employee and Estimated Generation 312 Employees

Time Period	Arrival Rate	Arrivals-IN 312 Employees	Departure Rate	Departures-OUT 312 Employees
AM: 0700-0800	0.276	86	0.101	32
AM: 0800-0900	0.337	105	0.175	55
AM: 0900-1000	0.248	77	0.197	61
PM: 1500-1600	0.199	62	0.233	73
PM: 1600-1700	0.173	54	0.313	98
PM: 1700-1800	0.090	28	0.272	85
PM: 1800-1900	0.045	14	0.094	29

5.2 Traffic Distribution

Traffic distribution for the residential houses and flats assumed the same spatial pattern as used for the residential development proposed for the Keynsham East site. The employment distribution previously used for the Pixash Lane site was similarly used for the B1 and B2 uses proposed here.

5.3 Access Arrangements

The Scoping Study Report prepared by the Riverside Regeneration Trust provides little detail as to the expected highway infrastructure and improvements deemed necessary to support the build-out of the full development. Mention is made of probable improvements being necessary to the A4 Bath Road/Pixash Lane junction and a new bridge where Pixash Lane crosses the GWML. For the purposes of the S-Paramics modelling it was agreed with B&NES officers that the construction of a link road connecting Avon Mill Lane and Pixash Lane should be assumed as previously discussed. It is considered unlikely that access arrangements based solely on the use of Pixash Lane and Broadmead Lane would be acceptable. The total vehicle trip generation based solely on the residential and employment designations in Option B is predicted to be 1400 two-way movements in the weekday 7:00-10:00am period. The two-way vehicle trips in the 3:00-7:00pm period are estimated to be nearly 2000.

5.4 Travel Plan Effects

No reductions to the estimated traffic generation for the Riverside Regeneration were made to reflect the possible effect of Travel Plan measures or initiatives.

SECTION 6

Scenario Comparison – Paramics

6.1 Comparisons Made

In order to assess the relative highway network impact of each of the Core Strategy options a series of comparisons have been made using the extensive outputs produced by S-Paramics. For each option test 30 'seed' runs or iterations were undertaken for the two model periods, and results from these averaged. The results obtained are included in **Appendices B to E** as follows:

- **Appendix B**: Global network statistics for the entire simulated time periods. For each option these provide information on the mean network delay and speed, the number of vehicles completing journeys through the network and, critically, the number of vehicles still present in the network at the end of the period. The latter will always include some vehicles in transit but, where substantial change is seen, this will be due to increased congestion resulting in additional queuing traffic unable to clear the network;
- **Appendix C**: Mean network journey times during each half-hour interval in the 7:00-10:00am and 3:00-7:00pm periods considered;
- **Appendix D**: Comparative journey times on selected journey time routes through the Town Centre, and along the A4 Bath Road/Keynsham Bypass. The routes selected are show graphically in **Figure 1.1;**
- **Appendix E:** This Appendix contains all the 'seed run' graph used to assess the stability of the network and its propensity to 'grid lock' or 'lock-up'. For each Option/Time Period the number of vehicles on the network is plotted against time for all 30 runs. For a network with no 'lock-up' it would be expected that the number of vehicles would rise to a 'peak', but then drop off. Where 'runs' result in 'grid-lock the number of vehicles in the network will tend to keep rising beyond this peak. This indicates that congestion and queuing has created a lock-up situation, stopping normal exit from the network and thus creating a continuing build-up of vehicles as more traffic arrives to exacerbate these queues which are unable to dissipate. The number of 'seed' runs affected by lock-up is also indicated in the tables in Appendix B.

6.2 Analysis of Results

6.2.1 Base-line Scenario

In the previous work done for Somerdale it was found that, whilst proposed highway mitigation works gave an acceptable degree of network stability in the weekday peak periods, the general change in typical delay for most drivers using the network at these times would be noticeably higher than now. This 2022 base-line adds the traffic generation effect of the 30,000sqm of employment development at Pixash Lane. However, the global results suggest that this additional development can be accommodated, although the fact that 1 of the 30 runs in the PM peak period resulted in 'lock-up' provides testimony as to how little spare capacity exists to accommodate further traffic. This employment site is on the edge of Keynsham and likely to have a traffic distribution pattern that will generally avoid a lot of additional traffic routing through the Town Centre. These are the probable reasons why this development does not create a larger operational impact. In the AM peak period the congestion on the westbound A4 Bypass approach to Hicks Gate Roundabout will not be materially exacerbated by this site, as most generated traffic routing through this junction will be travelling eastbound along the Bypass. However, this site could contribute to increasing queuing on the eastbound Bypass approach to Broadmead Roundabout, as slow moving traffic extending back from Saltford can affect this arm now in the AM peak period. This development will also add to westbound traffic routing through Saltford in the AM peak period, although potential impacts here lie outside the scope of this work.

6.2.2 Option 1

The results shown for Option 1 with the B&NES preferred Core Strategy housing sites added at KE4 and Keynsham East (KE3A) show that even this level of additional development can be expected to have an adverse impact on the network. The global statistics show that there is a noticeable increase in the average network delay experienced by drivers, and particularly so in the AM peak period. There is some increased network instability, with 'lock-up' conditions occurring in 4 of the 30 simulation runs in the AM peak period scenario and 2 of the 30 runs in the PM peak period. This instability contributes to the change in the mean journey time values.

Examination of the route journey time data shows that the largest change from the 'base-line' occurs on the route from the A431/A4175 junction to Charlton Road (south of St Ladoc Road) in both peak periods, although a number of other routes show noticeable increases. In the case of the former the operation of the A4175/Avon Mill Road junction is a key bottleneck. Whilst it is proposed that traffic signals are installed here, together with ancillary geometric improvements as part of the Somerdale development, the previous work showed that this junction would only just operate 'at-capacity'. Additional Core Strategy traffic using the A4175 Keynsham Road to get to/from the A431 will only add to pressure here.

6.2.3 Option 2

This option simply increases the quantum of development at both KE4 and Keynsham East (KE3A). In view of the comparative results already described for Option 1 this can only be expected to significantly worsen likely operating conditions in Keynsham in both peak periods. The results bear this out with exacerbated risk of network lock-up predicted in both periods. This is reflected in further large changes in the journey time delay on most of the routes evaluated.

6.2.4 Option 3

The overall results obtained for Option 3 are marginally worse than Option 2 in the AM peak period, with 10 of the 30 model runs giving rise to partial or total grid-lock of the network. The situation is improved compared to Option 2 in the PM peak period, but increases in journey times on most routes exceed those with Option 1, and certainly the 'base-line' by a considerable margin.

6.2.5 Option 4

With the addition of the Avon Mill Lane-Pixash Lane Link Road with Option 4 there was some expectation that this may help to maintain base-line operating conditions, despite the addition of the Riverside Regeneration development option. However the global network statistics show that this is not the case with route time increases very similar to Option 3 in the PM peak period. Examination of the network showed that the capacities of the terminal junctions providing access to/from the new link will be problematic. The 'bottleneck' A4175/Avon Mill Lane junction has already been mentioned but the fact that the Pixash Lane approach to the A4 Bath Road has only one lane assumed, as existing, will also serve to constrain capacity at this end of route. The fact that the 30,000sqm of development planned to the east of Pixash Lane can already be expected to impact upon this junction does not help the case for the Riverside Regeneration proposals. Available capacity from this area is more constrained than access capacity into the peninsula, with the assumed one-way northbound link under the GWML at Broadmead Lane providing an additional inbound linkage.

6.2.6 Option 5

Option 5 reduces the quantum of development when compared to Options 3 and 4, and this has the effect of improving the situation relative to these. In this case development is concentrated at Keynsham East but, in terms of overall housing numbers, it is the same as Option 1. The only other difference is that Option 5 has a two form primary school on the Keynsham East site, as opposed to the single form entry school with Option 1. As might be expected, the results show that the stability of the network is similar to Option 1 in both the AM and PM peak periods. In the AM peak period the journey time from Charlton Road to Hicks Gate Roundabout via St Ladoc Road is reduced when compared with Option 1, but the journey along the A4 from Pixash Lane to Hicks Gate via the Bypass is increased. This is consistent with expectations as Option 5 will tend to concentrate impacts along the A4 corridor more.

6.2.7 Option 6

Option 6 again proposes concentrating development at Keynsham East, but increases housing to 650 units. In light of the results already discussed for Option 3 this level of development is totally untenable. The global statistics and level of journey time increase on most routes relative to the 'base-line' in both the AM and PM peak periods confirms this.

6.2.8 Option 7

Option 7 is similar in highway operating performance to Option 6 as might be expected. The network can be expected to be highly volatile and prone to 'lock-up' in both peak periods. In fact results for the PM peak period suggest that grid-lock conditions will be the norm. In consequence this quantum of development cannot be supported on highway grounds because of the severe predicted impacts on the network.

6.2.9 Option 8

In contrast to the other options this proposes a concentration of development at KE4 on the south-west edge of Keynsham. It was mentioned earlier that the 1000 dwellings proposed could have highway implications outside of those considered in the Paramics modelling, most notably at the A37/ Woollard Lane junction. Other issues might be a substantial increase in the use of Redlynch Lane as a route to the B3116 Wellsway, both to proceed south but also to 'short-cut' Keynsham Town Centre in getting to the A4 to the east of the town. The peak period operating conditions predicted in the Town Centre by 2022 make this ever more likely.

Notwithstanding the above the global results show that the network would be considerably more unstable and prone to grid-lock than both the base-line and Option 1 in both peak periods. Journey times through the Town Centre show a noticeable increase on movements between Charlton Road and Hicks Gate, the A431 and the A4 Broadmead Roundabout. In the AM peak the outbound time from Charlton Road to Hicks Gate shows the largest increase of all options, as does the reverse movement during the PM peak period. This is because a high proportion of the generated traffic from KE4 is expected to route to/from the A4 Bath Road(W) and the A4174, adding considerable pressure to already congested conditions along St Ladoc Road and Durley Hill.

Unlike Keynsham East, development at KE4 forces a high proportion of the expected generated traffic to route via the Town Centre to get to the A4, and thus other key routes such as the A4174. This is clearly undesirable given the Council's aspiration to reduce traffic using the High Street.

SECTION 7

Conclusions

7.1 Overview

This report describes the findings from highway assessments of a series of Core Strategy options using the S-Paramics model for Keynsham. Models for the weekday 7:00-10:00 and 3:00-7:00pm periods were previously developed to assist with consideration of the recently consented Somerdale development, the upgrading at this time including an extension of the simulated network to include the A4 Keynsham Bypass and a wider part of the internal network around the Town Centre.

The previous scenario tests undertaken for a 2022 horizon year with Somerdale showed that, even with the off-site highway mitigation works proposed, there would an expected deterioration in the weekday peak period highway conditions experienced relative to the 'base-line' case. In this earlier work this 'base-line' included the Town Centre Redevelopment and residential sites K2B and K2A, the latter assumed to be only part-completed. In contrast the base-line considered in this Core Strategy testing work includes all of the above, plus the Somerdale site and an additional 30,000sqm of employment development (B1/B2/B8) at Pixash Lane. Given the fragility of the expected network operation in the 'with Somerdale' scenarios tested prior to this work it perhaps comes as no surprise that this 'base-line' gives rise to some risk of occasional 'lock-up' conditions in both weekday periods.

In view of the above it is clear that the Keynsham network will have limited further capacity to absorb significant additional development. Even the lowest quantum of additional development identified in Option 1, the Council's preferred Strategy, shows that the potential step-change in additional congestion/delay could be noticeable. For example, in the AM peak period tests a 'lock-up' situation occurred in 4 of the 30 runs compared to 2 in the base-line case. This suggests that even a Strategy based on Option 1 will need to consider some highway improvements to the network as part of the 'package'. These would need to be targeted at the Town Centre, as 'lock-up' when it occurs is generally caused by continuous queuing affecting the High Street/Bath Hill/Avon Mill Lane/Station Road ring. However, Hicks Gate Roundabout is another critical 'bottleneck' where congestion occurs now in the AM peak period on the Bypass and Durley Hill approaches.

Other than Option 5 all the other options considered increase the quantum of development significantly, and the potential adverse impact this could have on the highway network is readily seen in the global output statistics and route journey times presented for comparison in this report. Making these 'work' in highway terms is likely to require a higher level of highway infrastructure investment aimed at providing 'effective' relief to the Town Centre whilst dealing with congestion problems affecting the Bypass. This is not considered in this work. The only scenario which did perhaps consider a change of this level is Option 4, which assumed the construction of a link connecting Avon Mill Lane with Pixash Lane. This link on its own has been shown to provide relief to the section of Avon Mill lane to the south of the GWML, and the length of Bath Hill/Bath Road between this junction and Broadmead Roundabout. However, the addition of the Riverside Regeneration proposals shows that this would simply create over-capacity problems at the terminal A4175/Avon Mill Lane and A4/Pixash Lane junctions.

Appendix A

Concept Drawings: Avon Mill Lane to Pixash Lane Link Road

Appendix B

Option Comparison - Global Output Statistics

Appendix C

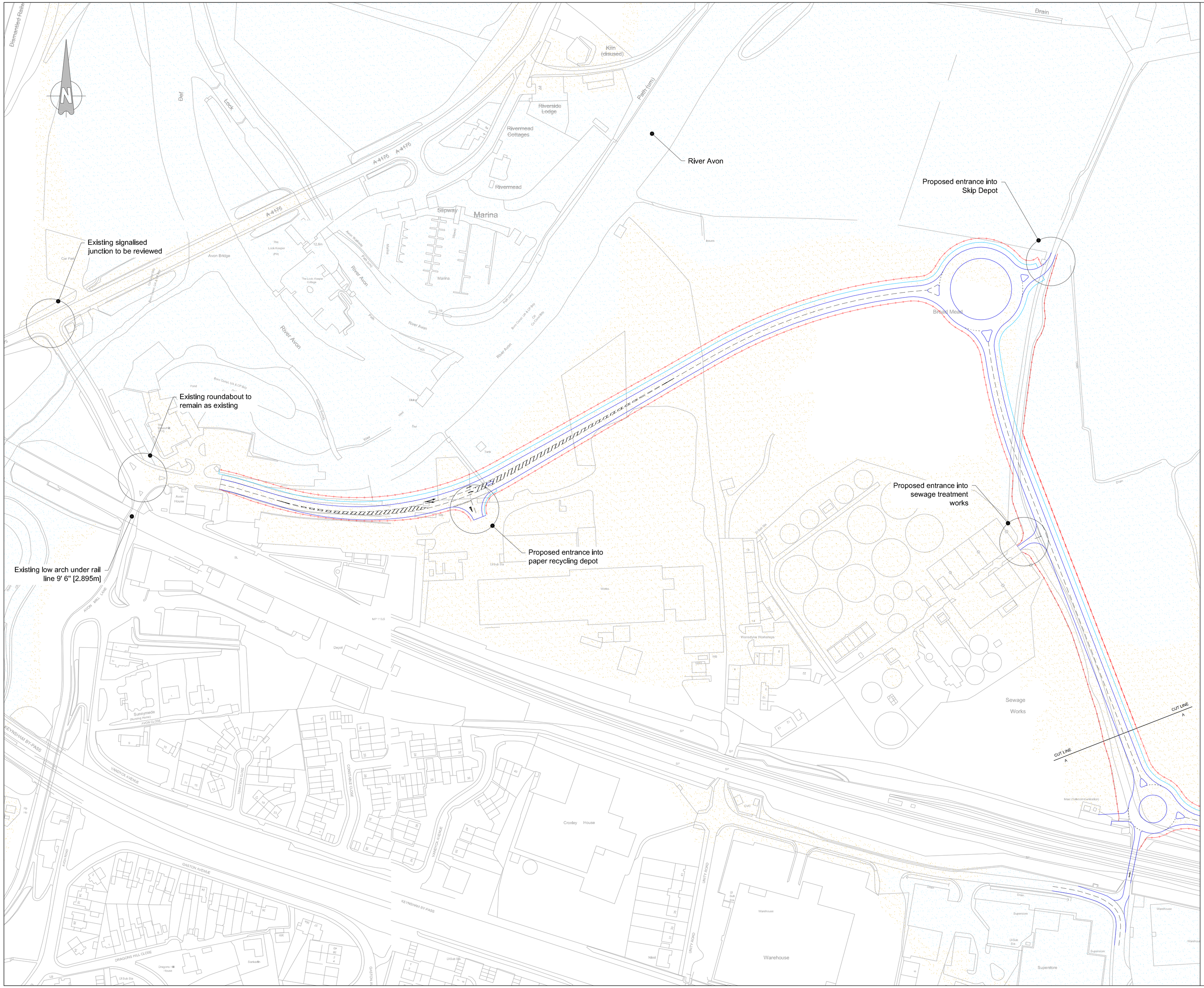
Option Comparison: Mean Network Journey Time by Time Interval

Appendix D

Option Comparison: Mean Journey Time on Selected Routes

Appendix E

'Seed Run' Check Graphs - Network 'Lock Up' Frequency/Risk



Notes:

KEY:

- Proposed highway alignment
- Proposed footway
- Potential highway boundary (To be confirmed post 3d design)
- Potential earthworks extents (To be confirmed post 3d design)
- Assumed area of flooding from River Avon
- Assumed area of extreme flooding

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Project

KEYNSHAM CORE STRATEGY
BROADMEAD LANE

Drawing

PROPOSED CONCEPT HIGHWAY ALIGNMENT OPTION 1

Drawn by:	ADS	Date:	02/10/2013
Checked by:	DL	Date:	09/10/2013
Approved by:	DL	Date:	09/10/2013

Drawing No.	Revision
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Drawing Scale: 1:1250 @ A1

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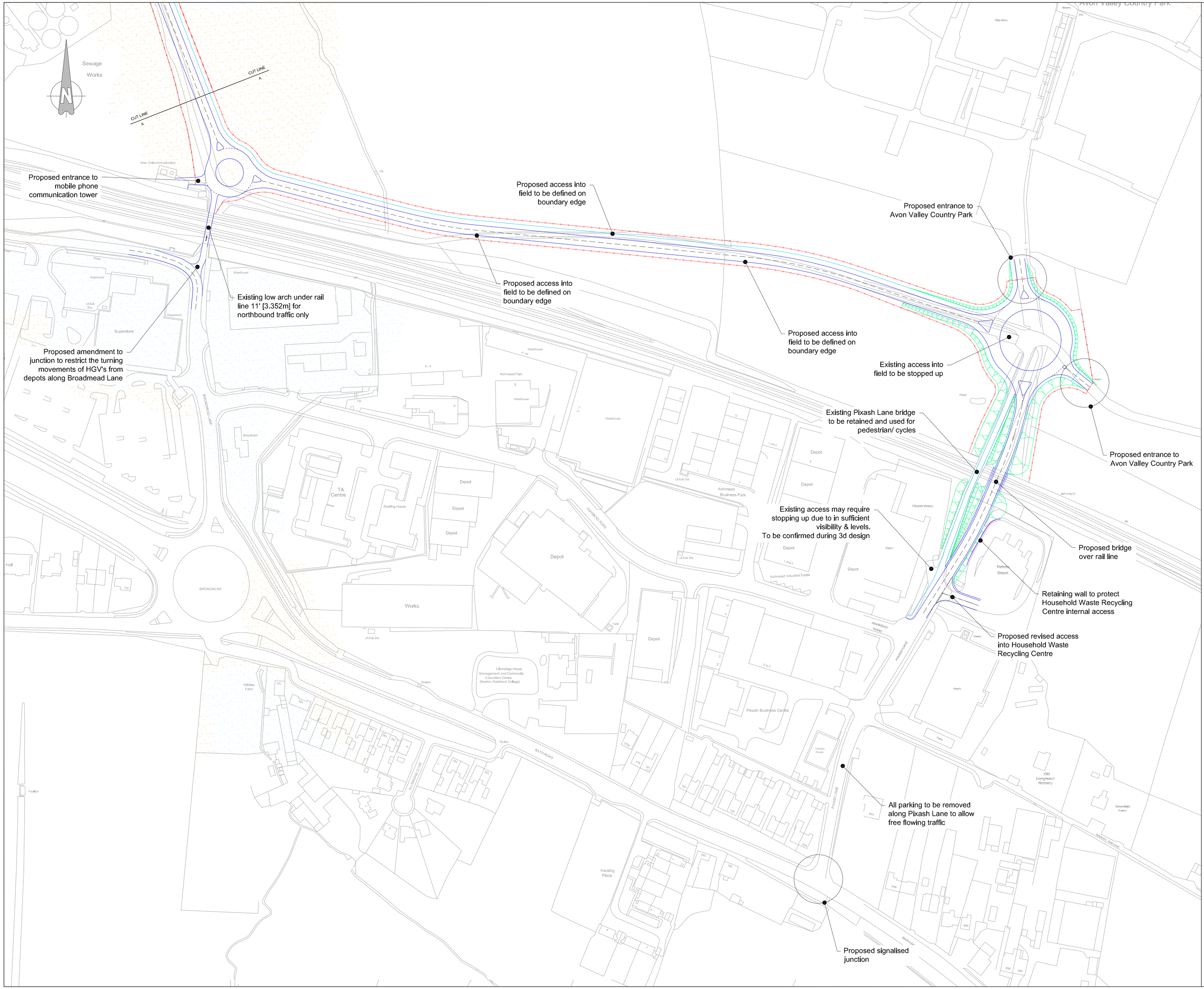

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Drawing Scale: 1:1250 @ A1

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APPENDIX A

Keynsham S-Paramics Modelling: Core Strategy Testing, Network Performance Statistic Comparison.

Morning Peak Period (7:00-10:00am)

Scenario	Vehicle Type	Mean delay (s)	Total distance travelled (m)	Current No. Vehicles	Journeys Completed	Mean Speed (mph)	Off Network Queue Time (s)	Comments
2022 Baseline	All vehicles	405	72573667	746	24577	16	24	Zero runs out of 30 (0 %) resulting in lock-up.
	Buses	556	338544	5	112	12	-	
2022 Option 1	All vehicles	576	69740704	1569	24161	12	50	Four runs out of 30 (13 %) resulting in lock-up.
	Buses	706	321531	11	111	10		
2022 Option 2	All vehicles	744	66131419	2132	23469	9	99	Eight runs out of 30 (27%) resulting in lock-up.
	Buses	847	304221	15	109	8		
2022 Option 3	All vehicles	753	65166926	2344	23326	9	104	Ten runs out of 30 (33%) resulting in lock-up.
	Buses	869	298471	17	109	7		
2022 Option 4	All vehicles	625	71098322	1728	24465	11	57	Three runs out of 30 (10 %) resulting in lock-up.
	Buses	717	322849	11	111	9		
2022 Option 5	All vehicles	581	70393320	1396	24337	12	66	Two runs out of 30 (6%) resulting in lock-up.
	Buses	713	326305	10	111	10		
2022 Option 6	All vehicles	718	66833139	1989	23568	9	99	Six runs out of 30 (20%) resulting in lock-up.
	Buses	851	307709	15	109	8		
2022 Option 7	All vehicles	709	67727652	1994	23899	9	103	Eight runs out of 30 (27%) resulting in lock-up.
	Buses	825	312319	14	110	8		
2022 Option 8	All vehicles	754	64805298	2326	22981	9	88	Ten runs out of 30 (33%) resulting in lock-up.
	Buses	859	295992	17	108	8		

Notes:

1. Mean delay is the mean delay per vehicle in seconds over the whole simulation period at the end of the simulation
2. Total distance travelled is total distance travelled in metres by all vehicles at the end of the simulation
3. Current No. of vehicles is the number of vehicles completing their journey during the simulation period
4. Mean speed is the culmulative mean speed in miles per hour for all vehicles at the end of the simulation period

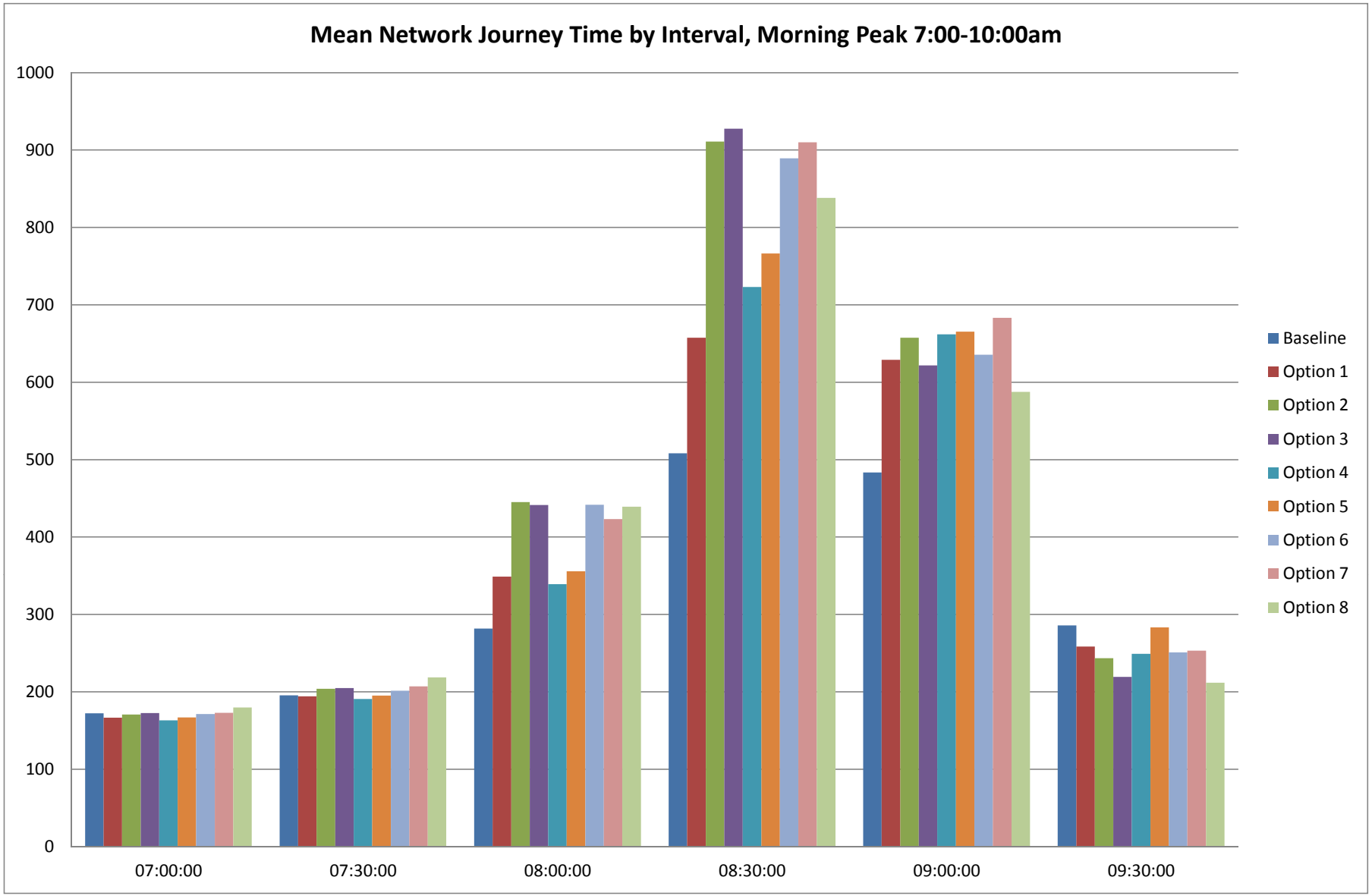
Keynsham S-Paramics Modelling: Core Strategy Testing, Network Performance Statistic Comparison.

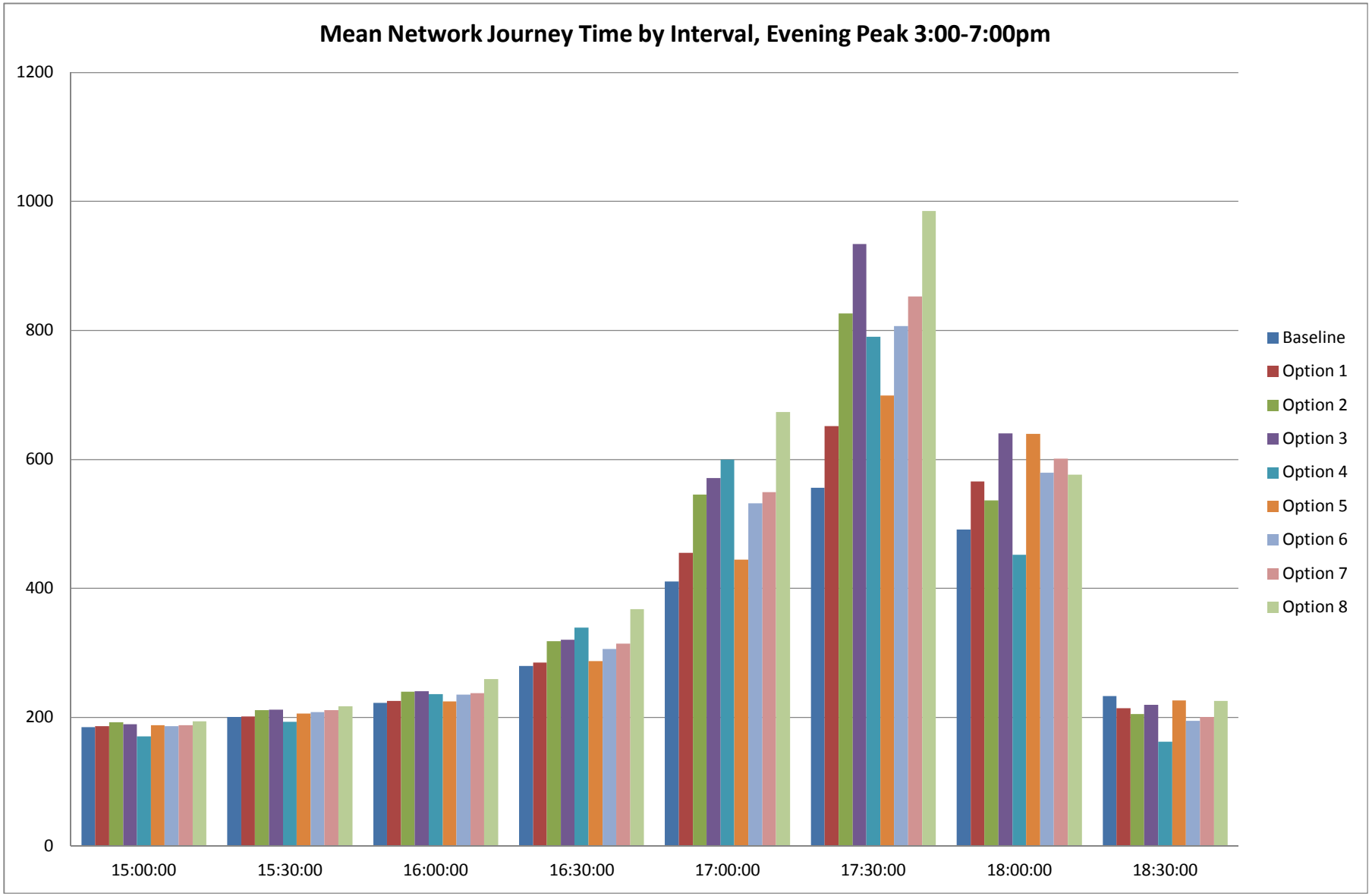
Evening Peak Period (3:00-7:00pm)

Scenario	Vehicle Type	Mean delay (s)	Total distance travelled (m)	Current No. Vehicles	Journeys Completed	Mean Speed (mph)	Off Network Queue Time (s)	Comments
2022 Baseline	All vehicles	562	107486461	1239	36659	12	137	One run out of 30 (3 %) resulting in lock-up.
	Buses	511	457132	6	152	13	-	
2022 Option 1	All vehicles	663	106374365	1759	36677	10	171	Two runs out of 30 (6%) resulting in lock-up.
	Buses	590	448619	9	151	12		
2022 Option 2	All vehicles	801	101882505	2347	35698	8	211	Seven runs out of 30 (23%) resulting in lock-up.
	Buses	707	426894	15	149	10		
2022 Option 3	All vehicles	787	104692014	2159	36507	8	230	Four runs out of 30 (13 %) resulting in lock-up.
	Buses	664	441590	12	151	10		
2022 Option 4	All vehicles	875	98965049	2725	34644	7	217	Nine runs outof 30 (30%) resulting in lock-up.
	Buses	741	418843	16	148	9		
2022 Option 5	All vehicles	685	105851336	1971	36674	10	171	Two runs out of 30 (6%) resulting in lock-up.
	Buses	609	444577	10	151	11		
2022 Option 6	All vehicles	771	102465735	2266	35854	8	194	Seven runs out of 30 (23%) resulting in lock-up.
	Buses	692	430251	13	149	10		
2022 Option 7	All vehicles	768	103716349	2261	36236	9	198	Six runs out of 30 (20%) resulting in lock-up.
	Buses	688	432000	13	149	10		
2022 Option 8	All vehicles	890	98890655	2468	34669	7	257	Seven runs out of 30 (23%) resulting in lock-up.
	Buses	745	426445	14	149	9		

Notes:

1. Mean delay is the mean delay per vehicle in seconds over the whole simulation period at the end of the simulation
2. Total distance travelled is total distance travelled in metres by all vehicles at the end of the simulation
3. Current No. of vehicles is the number of vehicles completing their journey during the simulation period
4. Mean speed is the culmulative mean speed in miles per hour for all vehicles at the end of the simulation period


Mean Network Journey Time by Interval, Morning Peak 7:00-10:00am
1000
900
800
700
600
500
400
300
200
100
0
07:00:00
07:30:00
08:00:00
08:30:00
09:00:00
09:30:00
Baseline
Option 1
Option 2
Option 3
Option 4
Option 5
Option 6
Option 7
Option 8


Mean Network Journey Time by Interval, Evening Peak 3:00-7:00pm
1200
1000
800
600
400
200
0
15:00:00
15:30:00
16:00:00
16:30:00
17:00:00
17:30:00
18:00:00
18:30:00
Baseline
Option 1
Option 2
Option 3
Option 4
Option 5
Option 6
Option 7
Option 8

Appendix D

Keynsham S-Paramics Modelling - Core Strategy Testing, Route Journey Time Summary

Morning Peak Period (8:00-9:00am)

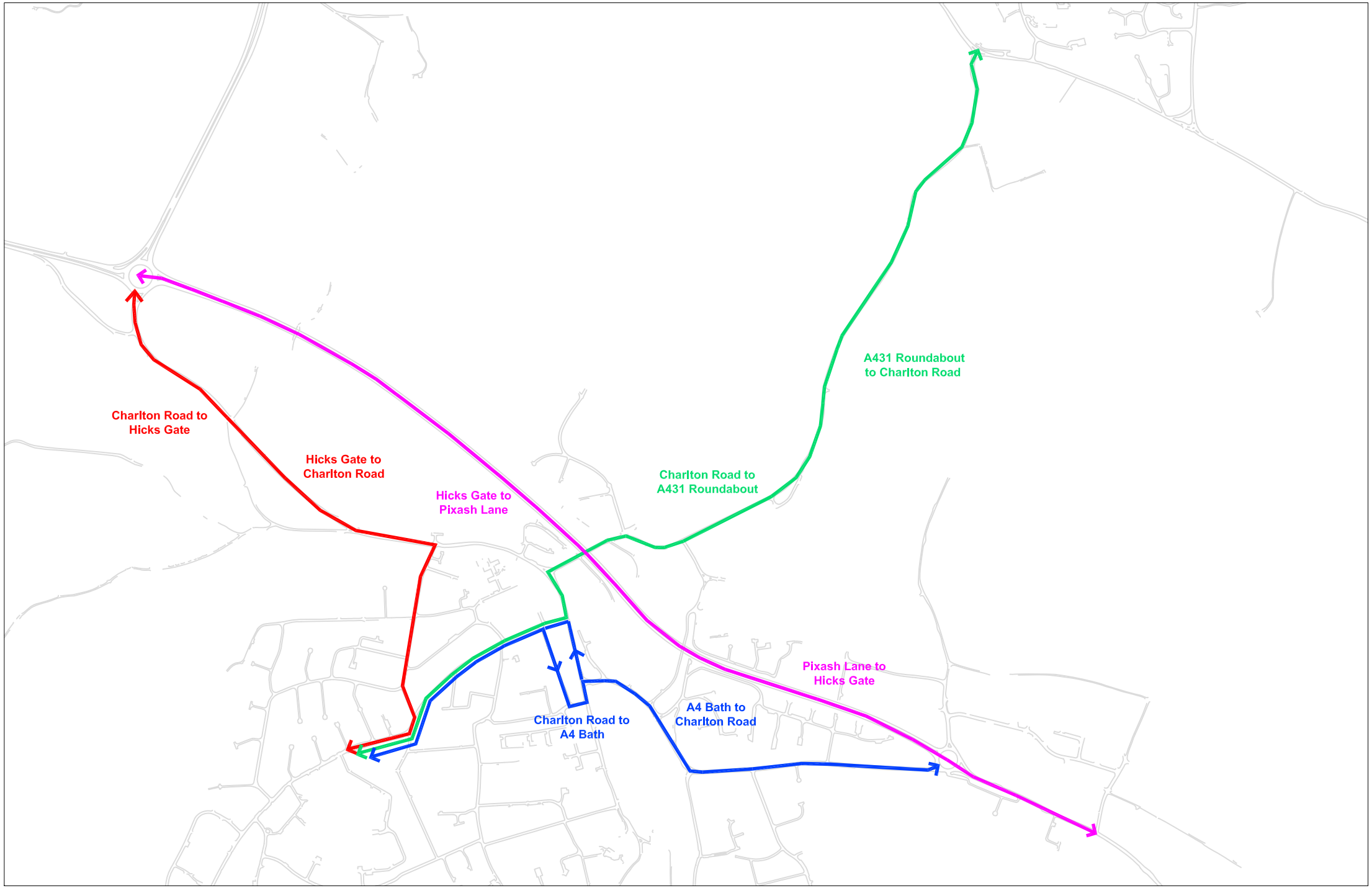
Route	Baseline	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
1. Charlton Road to Hicks Gate	398	577	765	708	604	538	622	625	754
2. Hicks Gate to Charlton Road	228	402	623	599	348	436	495	521	533
3. Charlton Road to A4175/A431 Mini-Roundabout	518	698	982	1027	661	753	872	874	943
4. A431/A4175 Mini-Roundabout to Charlton Road	1038	1492	1801	1928	1642	1549	1871	1860	1883
5. Charlton Road to A4 Broadmead Rbt: via Ashton Way	569	788	1124	1067	801	786	1001	950	1088
6. A4 Broadmead Rbt to Charlton Road: via High Street	631	900	1133	1185	928	932	1072	1042	1111
7. A4: Pixash Lane to Hicks Gate Rbt - via Bypass	525	700	859	805	869	766	754	822	763
8. A4: Hick Gate Rbt to Pixash Lane - via Bypass	193	213	262	277	199	259	265	245	190

Evening Peak Period (5:00-6:00pm)

Route	Baseline	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
1. Charlton Road to Hicks Gate	269	289	337	318	325	295	333	319	397
2. Hicks Gate to Charlton Road	297	422	628	622	580	464	547	565	844
3. Charlton Road to A4175/A431 Mini-Roundabout	439	510	619	610	649	552	629	665	696
4. A431/A4175 Mini-Roundabout to Charlton Road	861	1309	1811	1684	1860	1597	1645	1621	1910
5. Charlton Road to A4 Broadmead Rbt: via Ashton Way	416	548	665	719	678	585	687	688	761
6. A4 Broadmead Rbt to Charlton Road: via High Street	513	621	760	775	891	689	749	748	917
7. A4: Pixash Lane to Hicks Gate Rbt - via Bypass	364	444	549	616	600	490	566	533	715
8. A4: Hick Gate Rbt to Pixash Lane - via Bypass	138	157	183	188	194	163	198	194	225

Notes

1. Refer to Figure 1 which shows the routes evaluated.



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Keynsham Core Strategy S-Paramics Testing

Figure 1: Model Journey Time Routes