Major Scheme Business Case Norwich Northern Distributor Route

Value for Money Case



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3 Value for Money Case

3.1 Introduction

The Value for Money Case presents the economic evaluation of the Norwich Northern Distributor Route (NDR) Scheme, in accordance with WebTAG appraisal guidance issued by the Department for Transport (DfT). The assessment was carried out using the DfT's Transport Users Benefit Appraisal Software TUBA (v1.7) using vehicle/passenger trips, trip distance and trip time matrices from the SATURN highway and VISUM Public Transport (PT) models developed for the Study.

This section of the Business Case also presents the wider appraisal of the proposed scheme against the DfT's five key objectives (Environment, Safety, Economy, Accessibility and Integration) in the form of an Appraisal Summary Table.

3.1.1 Options Assessed

Four options for the NDR Scheme have been assessed. These are detailed in Section 1, Scheme Description, and are summarised as follows:

• **Preferred Scheme** – a road link of predominantly dual carriageway (9.3m carriageways) connecting the A47 at Postwick to the east of Norwich to the A1067 Norwich-Fakenham Road at Attlebridge, designed to connect with a number of radial roads to the north of Norwich, to distribute traffic making orbital movements and remove traffic from unsuitable roads.

Complementing the scheme would be traffic restrictions on some existing routes including 20mph zones in some northern and north-western suburbs of Norwich and a traffic management system in the city centre to deter through traffic. There will be new facilities suitable for pedestrians and cyclists alongside the NDR route.

- **Next Best Option** this option utilises the same alignment as the Preferred Scheme, but with the westernmost section built as a single rather than dual carriageway and the junction with Drayton lane at-grade. Complementary measures as per the Preferred Scheme would be implemented.
- Low Cost Option a single carriageway route with 40mph speed limit, utilising the alignment of existing roads where practicable, and with complementary measures commensurate with the scale of the new road infrastructure.
- Public Transport Alternative improvements to the frequency of radial services on existing routes; a new bus service on a part of the Outer Ring Road, which would provide service to areas similar to that of the NDR; and a BRT corridor linking Sprowston, City Centre, University, Norfolk and Norwich Hospital and Norwich Research Park.

3.2 Capital Costs

Capital costs for construction, land and design and supervision were estimated for each option based on the outline design and local rates. The rates used in the cost assessment are for the third quarter of 2007; inflation factors are used to take these up to the year of expenditure, broken down into general and local factors, as required by WebTAG and defined as follows:

- the "General Inflation" factor is the Treasury estimate of 2.5% per annum which is applied equally to construction, land and risk mitigation costs;
- the "Local Adjustment" is based on an assessment of rates the County Council's term maintenance contract which shows an average increase in construction prices of 4.5% p.a. (2001-2007), giving an uplift of 2% over general inflation, applied to construction costs only.

The following sections present the outturn scheme costs of each option, which comprise the costs of the scheme for DfT funding. The amount of funding sought from the DfT will be net of developer and other contributions; the assessment of other contributions is set out in Section 3.2.3. Costs are assumed to be incurred over a six year period from 2007 to 2012 taking into account preparation, land acquisition and compensation, construction and supervision costs. It must be noted that Optimism Bias is not included in the scheme cost estimate for funding but is included in the capital cost used for the economic assessment (see Section 3.5.2).

3.2.1 Summary of Outturn Costs

The estimated outturn scheme cost for each of the options is set out in Table 3.1, broken down in line with guidance in WebTAG Unit 3.5.9 (September 2006). The total outturn scheme cost includes General Inflation and Local Adjustments. Further detail of costing is presented in Appendix 3A.

Cost Element	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Construction Costs	£97.8m	£96.0m	£41.8m	£10.0m
Land Costs	£13.1m	£10.5m	£20.2m	£0.2m
Preparation/Supervision	£5.7m	£5.7m	£3.8m	£1.6m
Vehicles	n/a	n/a	n/a	£6.2m
Total Cost	£116.6m	£112.2m	£65.8m	£18.0m
Contributions	£47.6m	£45.8m	£26.9m	£7.3m
Total Cost for DfT Funding	£69.0m	£66.4m	£38.9m	£10.6m
Risk Mitigation	£9.9m	£9.9m	£9.9m	£1.2m

Table 3.1: Summary of Outturn Capital Costs

A full Quantified Risk Assessment (QRA) has been carried out (see Section 3.2.4) and risk mitigation costs for each option are also shown in the table. Within the total cost, the risk mitigation cost is split across construction, land and preparation/supervision; the table shows the total risk mitigation cost across all categories as a discrete item.

3.2.2 Capital Cost Profiles

The tables in Appendix 3A detail the assumed profile of capital expenditure for each option. They also provide a further breakdown of cost elements for each option including the assumed General Inflation and Local Adjustment uplifts.

Key points to note in relation to the capital costs are as follows:

- **Preferred Scheme**: the majority of costs are incurred in 2011/12 (46%) and 2012/13 (42%) although a successful CIF funding application would bring this date forward. Construction costs are incurred over a three-year period starting in 2010/11.Some land costs have already been incurred (£35,000 in 2006/07) and these are excluded from the total.
- **Next Best Option**: a similar overall capital spend profile is assumed as for the Preferred Scheme. Preparation/supervision costs are marginally higher than for the Preferred Scheme because of the greater proportion of the risk mitigation allocated to this element.
- Low Cost Option: a similar spend profile is also assumed for this option. Land costs are higher than for the Preferred and Next Best Options as there

are significant sections of new roads within the urban environment, which will incur higher acquisition costs.

• **Public Transport Alternative**: the majority of spend is incurred between 2011 and 2013. Costs do not begin to be incurred until 2009/10 for this option. All vehicle costs are assumed to be incurred in 2012, the initial year of operation.

3.2.3 Contributions

This business case presents a case for funding application for 60% of the scheme cost, i.e. £69m million for the Preferred Scheme, as shown in Table 3.1. The remaining 40% of the scheme cost (£47.5 million) will be sought from a number of other sources. These comprise:

- **Developer Contributions:** This would primarily be from housing development but could also come from employment development areas. These could also include the Transport Charge.
- Norwich Growth Point (NGP): The first round of bidding yielded lower than anticipated funding. However Norfolk County Council will be utilising future bid opportunities e.g. Community Infrastructure Fund; to obtain funding for schemes facilitating growth targets (such as NDR).
- **Norfolk County Council**: The County Council undertakes to underwrite the outstanding balance of funding.

The breakdown of these contributions for each option is shown in Table 3.2.

Cost Element	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Developer Contributions	£1.7m	£1.7m	£1.0m	£0.3m
Growth Point (Postwick)	£19.0m	£18.3m	£10.7m	£2.9m
Growth Point (NDR)	£19.9m	£19.1m	£11.2m	£3.1m
Norfolk County Council	£7.0m	£6.7m	£3.9m	£1.1m
Total	£47.6m	£45.8m	£26.9m	£7.3m

 Table 3.2: Outturn Capital Cost Contributions

The levels of contributions for the Next Best Option, Low Cost Option and Public Transport Alternative are assumed to be pro-rata to the overall scheme cost. Although there is the possibility that some elements of contributions could be fixed irrespective of the option considered, or that some of the options may not attract

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contributions from some sources due to change of type or scope of scheme, this has not been considered in detail at this stage.

3.2.4 Quantified Risk Assessment

A comprehensive Risk Register has been produced with quantified risk costs and is appended to Section 6, Financial Case. Well-developed Norfolk County Council procedures for risk assessment have been followed and have included thorough consultation with the Strategic Partnership experts. The risk assessment principles are described in Section 4, Delivery Case.

From the QRA, a Monte Carlo simulation has been undertaken to optimise the risk assessment and analyse the sensitivities surrounding the risk allocations used.

The optimised quantified value of risk for each option was presented in Table 3.1.

3.3 Operating Costs

3.3.1 Maintenance Costs

Annual maintenance costs for the road-based options are presented in detail in Appendix 3B, and are summarised in Table 3.3. It is envisaged that only the annual routine maintenance will be required during the 60-year operational period of the economic appraisal, and that therefore no additional refurbishment or rebuild costs would be incurred.

Cost Element	Preferred Scheme	Next Best Option	Low Cost Option
Highways	£90,276	£82,204	£33,584
Landscaping	£37,695	£37,695	£ 4,513
Street Lighting	£27,096	£27,096	£17,734
Structures	£38,480	£36,288	£ 2,055
Total	£193,547	£183,283	£57,887

 Table 3.3: Annual Maintenance Costs for Road Based Options

All costs are in 3rd Quarter 2007 prices

3.3.2 Public Transport Operating Costs

Public transport operating costs apply only to the Public Transport Alternative. There are three elements to the public transport scheme:

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- a new orbital route, utilising six vehicles operating for 12 hours of the day, Monday-Saturday;
- a Bus Rapid Transit (BRT) route, which is assumed to be operated on a de minimis contract with the provision of vehicles forming the subsidy, therefore the operating cost to the local authority is assumed to be nil;
- enhancements to existing services, consisting of increases in frequency on the core bus network such that routes meet minimum frequency standards in the Norwich Bus Strategy.

Revenues have been estimated for each new or enhanced route, based on The County Council criteria for bus service subsidy, which requires a minimum revenue/cost ratio of 30%. New services are not required to meet this indicator in the first 12 months of operation, therefore there is assumed to be a three-year revenue buildup period for the orbital service with revenue meeting the 30% target in year 2. Revenues for the BRT service are assumed to equal operating costs from Year 1 thus no operating subsidy is required.

Public transport operating costs and revenues are summarised in Table 3.4. Note that these are only the costs and revenues associated with operating the new services, and do not take into account revenue loss on other services as a result of these new services. This impact is fully accounted for in the public transport modelling for the economic appraisal. It is assumed that as costs exceed revenues there would be no further enhancements to these services in future years in terms of additional vehicles to provide enhanced frequencies.

Element	Scheme	Year 1	Year 2	Year 3+
Operating Costs	Operating Costs BRT		£3,284,384	£3,284,384
	Orbital bus	£654,024	£654,024	£654,024
	Enhancements	£2,218,651	£2,218,651	£2,218,651
	Total	£2,872,675	£2,872,675	£2,872,675
Revenues BRT		£3,284,384	£3,284,384	£3,284,384
	Orbital bus	£174,428	£196,207	£217,986
	Enhancements	£852,649	£959,230	£1,065,811
	Total	£1,027,077	£1,155,437	£1,283,797
Net Operating Cost		£1,845,598	£1,717,238	£1,588,878

Table 3.4: Annual Operating Costs and Revenues for Public Transport Alternative

All costs are in 3rd Quarter 2007 prices

3.4 Modelling

This section summarises the approach to modelling of the NDR scheme. The modelling provides the necessary inputs to the user benefit appraisal presented in Section 3.5 and is documented in detail in a series of technical reports which are referenced in the text.

3.4.1 General Approach to Modelling the Scheme

In October 2005, new guidance on Variable Demand Modelling was issued by DfT. Following a consultation period, it has replaced the guidance contained within DMRB Volume 12 on Induced Traffic Appraisal and provides advice and recommendations on how to accurately assess changes due to trip reassignment, trip generation, retimed trips, modal switch, and increased trip frequency.

Traffic models were set up to ensure that both the internal and external study areas are suitably detailed to allow re-routing and demand changes to be assessed. These included a minimum number of segmentations based on household/traveller type, value of time, trip purpose, mode and vehicle types. The regeneration and transport study proposals looked to reduce reliance on car trips and promote improved public transport services and enhanced environments for cycling and walking. The modelling undertaken for the Business Case therefore covered the potential for transfer of trips between modes to ensure all the benefits of the improved public transport and slow modes are included.

The 2006 NATS SATURN highway model is based on the existing 2002 NATS SATURN highway model for both the network coding and zone system. Analysis of the local traffic profile from various ATCs throughout the 24 hour daily period, has been undertaken to identify the modelled hours. The AM peak has a single highest hour between 0800 and 0900. The PM peak is spread over two hours between 1600 and 1800.

The AM peak modelled hour has been taken as 0800-0900 and the PM peak modelled as an average between 1600 and 1800. An average interpeak hour between 1000 and 1600 has also been modelled.

The latest traffic signal timings have been obtained and included within the 2006 network for all time periods. In addition the improvement schemes implemented since 2002 have been obtained and included in the model updating process.

The highway model was validated in accordance with the guidelines in the Design Manual for Roads and Bridges (DMRB). Accordingly, the validation acceptability guidelines adopted were as set out in DMRB Volume 12 Section 2 Part 1 Chapter 4. Further details are included in the Assignment Model Validation Report (Appendix 3D).

The 2006 NATS VISUM public transport (PT) model has been built based on the existing 2005 NATS VISUM public transport model for the network coding and source of movement data.

The 2006 NATS PT model was built with the intention that it would be used in tandem with the NATS SATURN highway model to provide appraisal of modal choice and economic benefits for the transport system as a whole under different Norwich Area Transport Strategy options.

Some features of the 2005 NATS VISUM PT model are:

- A zoning system consistent with the 2002 NATS highway model to make the demand for public transport and private transport between different geographical areas comparable;
- Bus routes and service definitions covering all bus services operating in the Norwich area;
- Rail routes and services covering all rail travel to/from the Norwich area;
- Bus and rail demand matrices built using Electronic Ticketing Machine data obtained from the service operators.

The highway network definition is consistent with the NATS private transport model so that, where appropriate, bus travel speeds are based on the highway assignment model.

3.4.2 Existing Data and Traffic Survey Report

A variety of traffic data sources have been used in development and validation of the NATS traffic model. To ensure that all relevant available roadside interview survey data was incorporated into the matrix building process, both the 2002 and 2006 RSI surveys have been used. The model area has been divided up into eight sectors by creating screenlines of RSI survey sites.

A number of 2006 RSI surveys were carried out at the same location as a number of the 2002 RSIs. To ensure the most recent survey data was used, trips through these locations were removed from the 2002 matrices and replaced with trip matrices built using the 2006 RSI survey information.

The 2006 roadside interview surveys were undertaken on an external cordon of Norwich and in the north-west sector. These provide data for all trips travelling into Norwich from other parts of the county and country as well as trips through Taverham and Drayton on the outskirts of Norwich.

Matrices have been built for each of the outer screenlines from the 2006 RSI survey data. All trips between 0700 and 0900 have been used to build both the AM and AM pre-peak matrices, with appropriate factors applied to get the ratio of trips in each

hour. The appropriate sector to sector movements from these matrices have then been combined with the updated 2002 matrices to complete the observed trip matrix.

Details of the data and traffic surveys used in developing the model can be found in Appendix 3D.

3.4.3 Assignment Model Validation Report

A 2006 NATS model has been developed as described above to include both a highway model, developed using SATURN, and a public transport model, built using VISUM. Validation has been undertaken to illustrate that the traffic model accurately reflects traffic conditions in the 2006 base year. The model contains some 1083 modelled junctions comprising 764 priority (give way) junctions, 199 signal controlled junctions and 75 roundabouts.

An Assignment Model Validation Report is included in Appendix 3D.

3.4.4 Demand Model Report

A Demand Model Report has been completed in support of the Business Case submission. The report considers the demand model structure that was adopted for the NATS model upgrade. DIADEM version 3 has been used to implement the variable demand modelling in accordance with the guidance established in WebTAG Unit 3.10.

The Diadem demand model has a total of 16 demand segments comprising 'car available and 'no car available' trip purpose/vehicle type segments based on the SATURN highway model and the VISUM public transport segments.

Trip distribution and mode choice are both modelled demand responses using 'doubly constrained' trip distribution, with 'origin constrained' trip distribution for 'other' and employers business' trips.

Realism testing was undertaken in accordance with WebTAG Unit 3.10.4 to determine local, scheme specific DIADEM parameters for use in scheme forecasting. Highway fuel cost elasticity testing was completed by determining the effects of increasing the fuel cost by 20%. The results indicated that 'commuting' and 'employers business' user classes have elasticity values within the recommended range. Journey time elasticity testing was also completed. Generally, a trip in the traffic model chooses its routing based on the time and distance between the origin and destination using the PPM (pence per minute) and PPK (pence per kilometre) weightings. The calculation of PPM and PPK takes into account fuel costs and vehicle operating costs and as such, there is a relationship between fuel costs and journey time.

From the above, final DIADEM parameters and elasticity values were established. A full Demand Model Report is included in Appendix 3E.

3.4.5 Forecasting Report

A Forecasting Report has been completed and is included in Appendix 3F. In summary, traffic forecasts have been produced using two distinct sources of information:

- The Norfolk Joint Core Strategy (JCS) identifies 36,000 households to be delivered between 2006 and 2026. Out of this total, 16,000 households are to be delivered by 2016. Of this 16,000 households, 13,000 of these are already shown in existing allocations in the local planning documents and the remaining 3,000 are to be accommodated on new smaller sites in the Broadland and South Norfolk fringes;
- TEMPRO national planning data forecasts.

The Norfolk County Council assumptions were compared to TEMPRO5.3 planning data for the local authority areas and conclusions drawn on how best to incorporate this information into the future year matrix building methodology for the NATS 2006 model. Forecast matrices are required for 2011 and 2026 for the assessment of various schemes with the NATS 2006 updated model. The planning information received has therefore been considered with these two years in mind. Information from the latest Norwich, Broadland and South Norfolk Local Plans will be used to provide numbers and locations for the 13,000 houses. However, the Local Plans continue only as far as 2011 at present so it would be useful to confirm what proportion of the13,000 houses will be built prior to 2011 and which between 2011 and 2016. Areas where housing will be allocated across the entire Joint Core Strategy were identified and applied at a zonal level in the highway model.

Within the Norwich Outer Ring Road, an area represented by 70 model zones (around 25 of which are within the Inner Ring Road) the plan identifies proposals for 5,000 households. There are around 15 main routes used by traffic travelling between the Outer and Inner Ring Roads, and the precise location of the development in relation to these routes will play a important role in determining the routes chosen by the development traffic and consequently those routes that are likely to experience the largest impacts of the planned growth. Furthermore, the proximity of the housing development to the city centre will also affect the number of car-based trips made from the developments.

A comparison of TEMPRO and JCS growth assumptions are shown in Table 3.5.

Local Authority	Norwich	Broadland		South	Norfolk
Year	2021	2028	2032	2030	2042
TEMPRO 5.3	6,592	11,421	14,206	11,845	17,843
Joint Core Strategy (min)	5,000	8,500		9,500	
Joint Core Strategy (max)	5,000		10,500		15,500

Table 3.5: TEMPRO and JCS Growth Assumptions

To conclude, the analysis of the difference between JCS and TEMPRO growth factors have shown a very small differences between them. The JCS factors have been used in forecasting.

3.4.6 Do Minimum Scenario

A number of Do Minimum schemes have been included in the model and are summarised in Table 3.6. The do minimum schemes are based on:

- Committed schemes and schemes in the County Council's second Local Transport Plan (LTP2); and
- Series of measures originally identified for further investigation in the development of NATS and progressed to sufficient detail to enable coding into the highway or public transport model.

Year	Do Minimum Scheme	Description
2012	St Augustines Junct	Provide circulatory one-way system
	ORR/Blackbury Court Jct	Road widening to allow right turn lane
	ORR - Chartwell Ave to Spixworth Rd	Make Oak Lane left turn in/out at junction with ORR. Make 2 lanes from Catton Grove Rd to Spixworth Rd
	ORR/Hall Rd Jct	Widen Hall Road on west side to provide inbound bus lane to ORR
	A140 Ipswich Rd/A11 Newmarket Rd Jct	Widen Ipswich Road on west side to provide inbound bus lane to Newmarket Road
	ORR/Unthank Rd Jct	North side of Unthank Rd widened to provide right turn lane on approach to ORR
	Newmarket Rd/Bluebell Rd Jct	Inbound bus lane from Colney Lane to Bluebell Road
	University Drive	University Drive contra-flow bus lane
	ORR/Dereham Rd Jct	Extension of left turn lane on Grapes hill outbound approach to Dereham Road
2027	ORR/Boundary Road Jct	Modify junction to provide 2 lanes outbound
	ORR/A1067 Jct	Remove traffic signals and replace with Toucan crossing
	A140/B1113 Jct	Pinch point created by bridge and carriageway alignment
	Martineau Lane/Bracondale Rbt	Widen Bracondale arm exit and entry
	ORR/Trowse Bypass Jct	Widen to provide 2 lane approaches
	A47 jct at Postwick	New junction interchange
	ORR/North Walsham Rd Rbt	Provide more regular shape to roundabout

Table 3.6: Do Minimum Schemes

Year	Do Minimum Scheme	Description
	ORR/Weston Rd/Vulcan Rd Jct	Closure of Weston Rd at north end. Widen ORR to provide right turn lane into Vulcan Rd. Form new link from Weston Rd to Mason Rd.
	A47/B1108 Jct	Improve key interchange
	A47/Showground Rbt	Improve key interchange
	Dereham Rd/Belvoir Street	In bound bus lane from Northumberland St
	St Faiths Rd/Fifers Lane	Provide mini roundabout

Note: ORR = Outer Ring Road

3.5 Cost Benefit Analysis

This section sets out the methodology used in the economic cost benefit analysis of the Preferred Scheme, Next Best Option, Low Cost Option and Public Transport Alternative.

3.5.1 TUBA Inputs and Assumptions

The cost benefit analysis was carried out using the DfT's Transport Users Benefit Appraisal Software TUBA (v1.7) using vehicle/passenger trips, trip distance and trip time matrices from the SATURN highway and VISUM Public Transport (PT) models described in Section 3.4.

The PT model was used to calculate bus passenger benefits for all options. Trips were modelled as "vehicles/passengers per hour" for the three time periods for the highway and PT models. Time matrices were in hours for the highway model but in seconds for the PT model. Therefore, a factor (.00028) was used to convert PT time to hours. Distance matrices for both the models were in kilometres.

TUBA was run for the three periods assessed, namely AM peak, Interpeak and PM peak time periods. The following procedure was used to run the TUBA model:

- Review standard economic parameter set;
- Prepare annualisation factors (see Section 3.5.3);
- Define TUBA User Classes (see Section 3.5.4);
- Define run parameters;
- Prepare matrices for input to TUBA;
- Run TUBA; and
- Check output.

TUBA contains a default set of economic parameters. These were verified against the latest WebTAG guidance. A TUBA audit trail comprising the input Economic and Scheme Parameter files, and the output files for all four options can be found in Appendix 3A.

3.5.2 Costs and Optimism Bias

The costs input to TUBA comprise the Base Year capital costs detailed in Appendix 3A, less the General Inflation element. An Optimism Bias uplift is applied to these costs, and the revised cost is then input to TUBA in accordance with the expenditure profiles in Appendix 3A.

Optimism Bias is also applied to Operating Costs and to contributions. As stated in the Financial Case, the County Council will underwrite 50% of cost overruns up to the relevant Optimism Bias threshold and 100% above this. For the purposes of appraisal, therefore, 50% of the cost added in for Optimism Bias is assumed to be recouped as a Developer Contribution, in addition to the contributions identified in Section 3.2.3.

In accordance with the Green Book Guidance, the base level of Optimism Bias during the construction stage was set initially at 44%, i.e. the level for a standard construction contract. However, the level of optimism bias is based on a set of contributory factors from the robustness of the Business Case through to the level of confidence in the risk. Norfolk County Council have analysed the contributory factors and the work they have done in developing the project to date as well as the mitigation factors and consider appropriate to reduce the level of Optimism Bias for the Preferred Scheme and Next Best Option to 25% applied to the Quantified Cost Estimate at this Programme Entry Application.

At this stage the Preferred and Next Best Options (being essentially similar) are designed and developed to a greater degree than the other options and as such the level of certainty on costs is greater. Accordingly, an Optimism Bias level of 44% for the Low Cost Option and Public Transport Alternative has been used in the appraisal.

3.5.3 Annualisation Factors

In TUBA there is a distinction between time periods and time slices. Time periods have standard definitions supplied in the TUBA economic file, whereas the assignment model uses a separately defined time slice to represent the time period for assignment purposes. Thus the annualisation factor used will be based on the relationship between the demand in the modelled time slices and that of the non-modelled part of the TUBA time periods. This is detailed in Table 3.7.

Period	TUBA Time Period	Model Time Slice	Time Period Factor
AM Peak	0700-1000	0800-0900	253
Interpeak	1000-1600	1100-1200*	1518
PM Peak	1600-1900	1700-1800*	506
Off-Peak	1900-0700	Not modelled	n/a
Weekend	All day (Sat/Sun)	Not modelled	n/a

Table 3.7: Time Period Factors

*one hour representing an average of the time period

Furthermore the modelled periods apply to all working days in the year and hence all the matrices (with the exception of the Saturday and Sunday factors) were also annualised using a factor of 253. Saturdays and Sundays had a factor of 52 applied to represent the number of weekends in a year. Off-peak, other times during the weekends except those specified above, the first hour of the AM peak period (07:00-08:00) and the last hour of the PM peak period (18:00-19:00) were not considered for any of the analyses.

3.5.4 Definition of User Classes

The definition of user classes is a combination of:

- Mode;
- Vehicle type/submode;
- Purpose; and
- Person type.

These categories served two purposes. Firstly, they enable the TUBA cost/benefit inputs and outputs to be disaggregated by category. Secondly, some of the economic parameters vary by category; for example, value of time depends on person type, vehicle type and purpose.

Trips in the highway model have been divided into eight segments. Trips have been divided into two vehicle types, namely light vehicles (comprising cars and light goods vehicles (LGVs)) and heavy vehicles (HGVs). The light vehicles have been further divided by trip purpose and by income band. Three trip purposes have been used, namely Commuting, Employer's Business and Other trips. Three income bands have also been used, annual household incomes less than £17,500, incomes between £17,500 and £35,000, and finally incomes over £35,000. For the Employer's

Business purpose no income segmentation has been carried out. The final eight segments form the user classes input to TUBA and are listed in Table 3.8.

Vehicle Type	Trip Purpose	Income Band	User Class
		< £17,500	1
	Commuting	£17,500 to £35,000	2
		> £35,000	3
Cars and LGVs	Employer's Business	All	4
		< £17,500	5
	Other	£17,500 to £35,000	6
		> £35,000	7
HGVs	All	All	8

Table 3.8: TUBA User Class Definition

3.5.5 Other Inputs to the Cost Benefit Analysis

Some elements of the cost benefit appraisal (operating costs, delay costs and developer contributions) were not included in the TUBA assessment and have been assessed separately, therefore the NPV and BCR values shown in the TUBA output files in Appendix 3G differ from the final figures presented.

Of the elements of the cost benefit appraisal not assessed within TUBA, operating costs and developer contributions were detailed in Sections 3.3 and 3.2.3 respectively. The following section discusses delay costs, which are those experienced by users of the network that are related to the planned construction and maintenance of the scheme infrastructure.

(i) Disruption During Construction

The disruption to existing traffic movements caused by the construction of the NDR scheme is likely to be minimal. It will be limited to the construction of roundabout junctions on seven radial roads plus the provision of new overbridges for three roads. Roads permanently closed by the construction of the scheme are not included within this calculation as the impact of those road closures will be reflected in the Do Something highway network assignments.

(ii) Maintenance Delay Costs

There is a reduction in traffic using minor roads in northern suburbs due to the presence of the NDR. The NDR itself is designed to 40 years design life, so the maintenance requirements causing significant delays would be expected to be minimal, provided that good routine maintenance is carried out. Therefore, the possible delays related to maintenance of the NDR over the assessment period would be also be minimal and most likely to be offset by the delay savings made in northern suburbs. To conclude, the impact of the NDR is likely to be neutral if not slightly positive. No benefits from potential maintenance savings were claimed in the cost benefit assessment.

3.5.6 Cost Benefit Analysis Results

Detailed results of the economic assessment are contained in Appendix 3H, which presents the Transport Economic Efficiency (TEE), Public Accounts and Analysis of Monetised Costs and Benefits (AMCB) tables for the Preferred Scheme, Next Best Option, Low Cost Option and Public Transport Alternative.

- The Preferred Scheme has a positive Cost Benefit Ratio (BCR) of in the order of 2.6 which categorises the scheme as "High Value for Money" according to the DfT's Value for Money guidance. This BCR figure does not incorporate any benefits and from noise, air quality or COBA, which are likely to increase the final BCR to over 3.0, as shown in the AMCB table.
- The Next Best Option has a very similar result to the Preferred Scheme, with slightly lower capital costs and the same level of benefits, leading to a marginally higher BCR.
- The Low Cost Option performs poorly, failing to deliver journey time savings, due to the impacts of additional traffic using existing road links.
- The Public Transport Alternative provides a low cost benefit ratio, mainly as a result of the high level of operating subsidy to bus operators.

3.5.7 Optimism Bias Sensitivity Tests

The appraisal is based on the Optimism Bias levels described in Section 3.5.2. Further runs of TUBA have been undertaken testing the Preferred Scheme and Next Best Option at 44% Optimism Bias, to test the sensitivity of the scheme to higher levels of cost uncertainty. The results of this analysis are contained in the relevant TEE, Public Accounts and AMCB tables included in Appendix 3H.

The main case with Optimism Bias of 25% produces a "High Value for Money" BCR of 2.6. See notes in Section 3.5.6.

3.5.8 Before and After Implementation Comparisons

The Before and After Implementation Comparison table is designed to track the changes to the key appraisal statistics at various stages of the development and implementation processes of a scheme. Specifically it requires information at Programme Entry, Conditional Approval and Full Approval stages, and post-implementation. presents the key statistics for the Programme Entry stage for each option. Note that the operating costs for the road-based options essentially comprise highway maintenance and thus these costs are included in the table under Maintenance Costs. Congestion benefits comprise time and vehicle operating cost savings for consumers and business users.

Statistic	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Capital Cost (£000)	102,890	98,913	66,589	11,060
Annual Operating Cost (£000)				1,302
Annual Maintenance Cost (£000)	206	195	71	
Annual Revenue (£000)	-2,226	-2,226	-2,418	-102
Annual Passenger/Vehicle Trips (m)	131	131	131	131
Annual Passenger/Vehicle Km (m)	1,942	1,942	1,862	1,856
Congestion Benefits (£000)	254,724	254,724	-54,752	23,990
Mode Shift (%)	0.03%	0.03%	0.03%	0.04%

Table 3.9: Before and After Implementation: Programme Entry Statistics

Note: Values are in £m in 2002 prices, discounted to 2002. Annual figures are for opening year 2012

3.6 New Approach to Appraisal Assessment

This section presents the appraisal of the scheme against the Government's five key transport objectives within the New Approach to Appraisal (NATA), and as summarised in the Appraisal Summary Tables (AST), which are presented for all options in Appendix 3K. The commentary on the NATA assessment for each option and summarises the assessment score for the Preferred Scheme have been included in this section; assessment scores for the other options are provided in the relevant ASTs.

Where detailed information is provided either in other Sections of the Business Case, or in other supporting documentation, this is indicated within the text.

Summary tables are provided throughout this section for most sub-objectives. For ease of presentation a seven-point scale is used in some tables to represent the impacts as follows:

Large	Moderate	Slight	Neutral	Slight	Moderate	Large
Beneficial	Beneficial	Beneficial		Adverse	Adverse	Adverse
+++	++	+	0	-		

3.6.1 Environment

Detailed worksheets for the assessment of the Environment objective are included in Appendix 3I. A series of Environmental Constraints Maps which show the locations of key environmental features affected by the NDR route are provided as part of the Distribution and Equity supporting analysis in Appendix 3I. The following sections summarise the methodologies involved, and key issues within each of the subobjectives.

(i) Noise

Two levels of assessment are described in WebTAG: a simplified level for initial broad strategies involving various route options, and a more detailed methodology for plans. At plan level it is anticipated that a spatially detailed transport model is available. In the case of the NDR a detailed transport model is available. The Noise Sub-Objective was amended in November 2006 to include an assessment of the effects on property values, and this methodology is incorporated into this assessment.

WebTAG Unit 3.9.1 states that "if the change in traffic brought about by a proposal is less the 20% (for a decrease in traffic) or 25% (for an increase in traffic), traffic noise can usually be scoped out. Where traffic noise changes by more than this amount on any part of the network, the change in noise may be noticeable and should be quantified." This change of -20%/+25% corresponds to a change of +/-1dB.

WebTAG Unit 3.3.2 states "for freely flowing traffic, a difference of about 3dB in noise level is required before there is a statistically significant change in the average assessment of nuisance. The assessment of nuisance however could still be affected even if there is only a 1dB change in the noise level if the change is associated with changes in the view of traffic, or if the change occurs suddenly. When options of this nature are being appraised, particularly strategies, the analyst will need to exercise judgement about whether the impact on noise should be ignored."

In order to undertake both monetary evaluation and annoyance, calculations of L_{Aeq} _{18hour} are required for all properties in opening year and design year with and without scheme. A spreadsheet is provided of DM vs DS for each opening and design years, and calculation results for each property are required in the appropriate cell. DM and DS values are divided into 3dB bands. The spreadsheet provided also relates noise changes to monetary changes and sums the results.

Calculation methodology is based on the DoT memorandum Calculation of Road Traffic Noise 1988 (CRTN), and the 'annoyance with noise' relationship is based on

the Design Manual for Roads and Bridges Vol 11 Section 3 Part 7 steady state relationship between noise level and percentage of people bothered very much or quite a lot by noise.

The traffic predictions cover approximately 2000 links across Norwich and in the surrounding area. Clearly a strict interpretation of the methodology for plans would be impractical across the entire network as, owing to the spatial extent of the scheme and the complex urban network involved, the potential number of individual calculations would become prohibitive. Accordingly a number of assumptions were made. The procedure was as follows:

- The basic noise level, and change in basic noise levels was calculated for each link using CRTN in order to establish where changes of 1dB would be likely to occur across the network.
- A house count was made using Ordnance Survey Address-Point data adjacent to each link within distance bands of 0-20m, 20-50m, 50-100m, 100-150m, 150-200, 200-250m, 250-300m.
- Basic noise levels were adjusted using CRTN to an average distance within each distance band e.g. between 200-250m it was assumed all houses were located at 225m.
- Properties and noise levels were summed for each scenario and entered into the WebTag worksheet accordingly.

The results are summarised in Table 3.10. Results are presented for the three roadbased options only. The Public Transport Alternative is considered to have no significant impact on noise as the traffic flows, and changes in traffic flows are outside the scope of the noise assessment; the detailed justification for this is presented in Appendix 3I.

Statistic	Preferred Scheme	Next Best Option	Low Cost Option
Estimated Population Annoyed			
- Do Minimum	7,171	8,225	5,808
- Do Something	5,708	6,822	5,000
Net Noise Annoyance Change in Year 15	-1,463	-1,402	-807
NPV of Noise of Proposal	£47.0m	£47.4m	£25.5m

Table 3.10: Summary of Noise Impacts

(ii) Local Air Quality

The WebTAG methodology was used to assess the local air quality impacts of the various Scheme options to assess the overall impact on local air quality across Norwich as a whole.

A comprehensive traffic model was developed for this Scheme. For the air quality assessment, roads within the traffic model study area were divided into a series of links with each link modelled with its own vehicle flow and vehicle split (i.e. light vehicles, heavy vehicles).

The detailed traffic model was used to estimate the traffic flows for each of the options, which are compared to the Do-Minimum. This is used as a basis of comparison to quantify the relative effects on air quality of the different route options. The relative impacts of each route depend on the traffic flows as well as the number of receptors affected. Each option was assessed for the assumed opening year (2012) and the design year (2027).

For the purposes of this assessment, an Addresspoint database was used which calculates the number of properties within the various boundaries as defined by the WebTAG methodology (see below). This was then used to calculate the number of properties which experience changes in air quality (both positive and negative) between the Do-Minimum scenario and the options.

The Public Transport Option was assessed at a Strategic Level (in accordance with the WebTAG guidelines) to identify if it had potential to have a positive impact on air quality in Norwich.

The outline methodology for the quantitative assessment of the options can be summarised as:

- Counting of receptors sensitive to air quality within the vicinity of the affected routes, by distance band (at 50m increments up to 200m distance) using GIS tools;
- Collation of baseline air quality data including background data for the entire area baseline monitoring has been undertaken to inform this assessment;
- Calculation of road traffic emissions for each option using the DMRB spreadsheet v1.03;
- Quantitative assessment of the change in people's exposure to PM₁₀ and NO₂ and assessment of the number of properties likely to experience improvement or deterioration in air quality;
- For each year considered, calculation of roadside PM₁₀ and NO₂ concentrations with the Do-Minimum and Do-Something options using the DMRB spreadsheet. Concentrations are calculated at 20m, 70m, 115m and 175m from the centreline of the road, based on AADT flows, average speed and average percentage Heavy Duty Vehicles (HDVs). These concentrations represent the average concentration within respectively 50m, 100m, 150m and 200m of the centreline of the road;
- Calculation of the WebTAG units for both options, for each road link and distance band:

Average concentration	PM ₁₀	Х	number of properties within the band
Average concentration	NO _x	Х	number of properties within the band

- Aggregation of the WebTAG units for each option and comparison of the assessment results for each option;
- Comparison of the different options and their relative impacts.

The results of this analysis are summarised in Table 3.11.

Statistic	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
NO ₂ , 2012				
Net Properties Improved	22,494	22,494	15,357	-17,408
Net Impact (All Routes)	-7,444	-7,444	-4,454	5
PM10, 2012				
Net Properties Improved	23,552	23,552	16,369	-14,584
Net Impact (All Routes)	-2,131	-2,131	-1,420	0
NO ₂ , 2027				
Net Properties Improved	23,051	23,051	14,575	-4,946
Net Impact (All Routes)	-7,282	-7,282	-4,110	-60
PM10, 2027				
Net Properties Improved	23,547	23,547	16,947	-1,426
Net Impact (All Routes)	-2,127	-2,127	-1,273	-16

Table 3.11: Summary of Local Air Quality Impacts

(iii) Greenhouse Gases

The total emissions from each option were compared to estimate the relative impacts on regional air pollution. Regional air pollution includes issues such as acid and nitrogen deposition.

In accordance with the WebTAG guidance, the emissions for each of the options were calculated using the DMRB spreadsheet. Each of the options was assessed based on the traffic flows predicted along with the average vehicle speeds and the ratio of light duty vehicles to heavy duty vehicles.

The results from each option were then compared to those of the Do-Minimum scenario in order to compare the relative impacts of each option.

This analysis (shown in detail in Appendix 3I) showed that without the NDR Scheme, $C0_2$ emissions would increase by 7% from 2007 to 2012 and by a further 11% to

2027. The NDR (Preferred Scheme and Next Best Option) would increase $C0_2$ emissions relative to the Do-Minimum scenario, by 6% in 2012 and 8% in 2027, whereas the Low Cost Option and Public Transport Alternative would result in minimal change in $C0_2$ emissions.

By comparison, NO_x emissions are forecast to decrease by 27% by 2012 and a further 9% by 2027 without the NDR Scheme. The Preferred Scheme and Next Best Option increase NO_x emissions by 5% in 2012 and 8% in 2027, whereas the Low Cost and Public Transport alternatives result in minimal change in NO_x emissions. In all cases future year NO_x levels remain below present levels.

The overall assessment for this sub-objective relates to the forecast change in total carbon emissions over the appraisal period, which is calculated by TUBA. The quantitative assessment is the change in total tonnes of carbon in the scheme opening year and across the 60-year period. The latter has been extrapolated based on totals forecast for the model years 2012 and 2027. The indicators input to the AST are summarised in Table 3.12.

Statistic	Preferred Next Best Scheme Option		Low Cost Option	Public Transport Alternative	
Change in tonnes of carbon emitted					
- Opening Year	24,631	24,631	820	17	
- Appraisal Period	1,182,592	1,182,592	112,915	46,436	
PVB Carbon Benefits	-£2.2m	-£2.2m	-£0.3m	£0.0m	

Table 3.12: Summary of Carbon Emissions

(iv) Landscape

The environment sub objective for landscape was assessed in accordance with WebTAG Unit 3.3.7; the information is included in the worksheets in Appendix 3I. The level of assessment for all options was at plan level, although the assessment of the Public Transport Alternative is at a preliminary level of detail. WebTAG does not provide worksheets for strategic level assessments for landscape, since assessment at this level is of transport strategies only, with no proposed route options available.

The landscape character of the NDR (Preferred Scheme and Next Best Option) is mainly open arable farmland, with pockets of more enclosed well wooded farmland resulting from the presence of former estates, particularly Beeston Park and Rackheath Hall. These give rise to areas of good landscape quality that would be adversely affected by the road, although the areas of highest parkland quality are avoided by the route and elsewhere a combination of earthshaping and planting would mitigate the impacts. Isolated properties and residents on the edge of Horsham St Faith, Thorpe End and Rackheath would experience visual intrusion; Thorpe End and Rackheath would be particularly affected where the route crosses over the Norwich to Sheringham railway line. The road could be accommodated into the landscape for the most part, although some adverse effects would arise. The Low Cost Option varies in landscape character along the route but lies close to the northern edge of Norwich and is characterised by open arable farmland for the most part, but with large coniferous plantations at the western and eastern ends. Much of the western part of the route follows existing roads and impact would be relatively slight, but severance of woodland blocks at the eastern end would be harder to mitigate. The historic parkland associated with Sprowston Hall would be adversely affected along its southern boundary, but as its value has been reduced by conversion to a golf course this effect is regarded as only slight. Visual intrusion would be experienced by properties on the northern edge of Norwich and isolated properties close to the road elsewhere. The route could be accommodated into the landscape for the most part, although some adverse effects would arise.

Assessment of the Public Transport Alternative was based largely on the Bus Rapid Transit Corridor, since it is assumed the Orbital Bus Route will use existing (i.e. unmodified) roads. There are limited areas of landscape proposed, since the option is mostly urban in character. Impacts on parkland around Earlham and Sprowston, with river valley landscape around UEA and the Research Park would be slight, due to the option mostly using existing roads, although the river valley landscape would be affected.

The scores given to various features of landscape in the worksheets are summarised in Table 3.13.

Feature	Preferred Next Best Lo Scheme Option C		Low Cost Option	Public Transport Alternative
Pattern				-
Tranquility	-	-	-	-
Cultural				-
Landcover				-
Summary of Character				-
Overall Assessment	Moderate adverse	Moderate adverse	Moderate adverse	Slight adverse

 Table 3.13: Summary of Landscape Impacts

(v) Townscape

The environment sub objective for townscape was assessed in accordance with WebTAG Unit 3.3.8; the information is included in the worksheets in Appendix 3I. The level of assessment for all options is at plan level, although the assessment of the public transport option is at a preliminary level of detail and is based largely on the Bus Rapid Transit Corridor, since it is assumed the Orbital Bus Route will use existing (i.e. unmodified) roads and therefore have limited townscape impacts. WebTAG does not provide worksheets for strategic level assessments for townscape, since assessment at this level is of transport strategies only, with no proposed route options available.

The centre of Norwich consists of a thriving commercial environment centred on a unique and irreplaceable historic medieval core. On the edges of the city are extensive urban fringes typically consisting of relatively modern residential suburbs of rather uniform visual character. All options would result in the removal of some of the traffic which currently passes through the city centre, though to varying degrees as identified in the economic assessment. New bus lanes for the Public Transport Alternative could potentially require the removal of street trees along Earlham Road and impact on the boundary of Chapelfield Gardens.

The scores given to various features of townscape in the worksheets are summarised in **Table 3.14**.

Feature	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Layout	+	+	+	0
Density and Mix	+	+	+	0
Scale	+	+	+	0
Appearance	+	+	+	-
Human Interaction	+	+	+	+
Cultural	+		+	+
Land Use	0	0	0	-
Summary of Character	+	+	+	-
Overall Assessment	Slight beneficial	Slight beneficial	Slight beneficial	Slight adverse

Table 3.14: Summary of Townscape Impacts

(vi) Heritage of Historic Resources

The cultural heritage worksheets have been produced with reference to WebTAG guidance (Department of Transport 2008- *WebTAG Unit 3.3.9 The Heritage of Historic Resources Sub-Objective* - http://www.webtag.org.uk/) and the Department for Transport's Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 2.

Reference was made to the findings of the Stage 2 assessment, along with limited additional desktop research. This has included map regression analysis, examination of the Norfolk Historic Environment Record and reference to available published local history sources.

In respect of historic buildings and landscapes, the above was supplemented by limited field survey, generally from publicly available viewpoints.

The Preferred and Next Best Options would be likely to have only minor adverse impact on listed buildings related to visual and aural impacts of road building and operation. The historic parklands would suffer a greater degree of adverse impact caused by severance and road operation. Archaeological sites on the alignment of the Low Cost Option are mainly found on ploughed land and therefore many probably do not survive in particularly good condition. This would vary and some sites may be less denuded through ploughing than others. A direct impact on the putative Roman marching camp is here deemed to be potentially a major adverse impact, although the veracity of the crop-mark's interpretation of this has not been tested and survival of interior features not investigated.

The Low Cost Option would impact on relatively few historic buildings. Three appear to be in close proximity and are likely to experience some impact from road operations. Most significant is likely to be the potential effect on the setting of the Grade I listed Sprowston Parish Church.

In terms of historic landscapes, the route crosses to the south of Sprowston Park. This park is one of a group of historic parks in this area which are of varying size and condition. None of the parks are registered but as a group they do form an important part of the wider historic landscape. The potential affected area is however much altered and in poor condition as historic parkland.

The Public Transport Alternative would use predominantly existing roads. Changes in bus use along these roads are likely to have very minimal impact on cultural heritage assets. This assessment is therefore focused on the area around the proposed new crossing of the river Yare in Earlham. As there is a group of high status heritage assets in this area, the impact of the scheme is considered to be moderate. The overall significance of impact on historic buildings and landscape is therefore considered to be slight. In terms of the archaeological remains known currently to be present within the area there is a moderate adverse impact.

The key Heritage impacts of each option are summarised in Table 3.15.

Impact Area	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Listed Buildings	Minor relating to impacts of road building	Minor relating to impacts of road building	Minor relating to impacts of road building	Minimal
Unlisted BuildingsSome demolitionSome demolitionof poor quality stockof poor quality		Minimal	Minimal	
Historic Landscapes	Adverse impacts on Beeston St Andrew and Rackheath through severance and road operation	Adverse impacts on Beeston St Andrew and Rackheath through severance and road operation	Potential impact on Sprowston Manor Park in terms of land take, road construction and operaiton	The route may clip the south- western edge of the Earlham Conservation Area
Archaeological Sites	Two sites (WW2 airplane crash site and round barrow) have	Two sites (WW2 airplane crash site and round barrow) have	Minor adverse, although the putative Roman marching camp	There is a direct impact on one known flint production site.

Table 3.15: Summary of Heritage Impacts



Impact Area	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
	potential major adverse impacts, otherwise moderate or neutral	potential major adverse impacts, otherwise moderate or neutral	could be affected to a major adverse degree.	
Overall Assessment	Moderate Adverse	Moderate Adverse	Moderate Adverse	Slight/ Moderate Adverse

(vii) Biodiversity

The environment sub objective for biodiversity was assessed in accordance with WebTAG Unit 3.3.10, the information is included in the worksheets in Appendix 3I. The level of assessment for the Preferred Scheme, Low Cost and Next Best Options is at plan level, although the level of baseline date used to inform the assessment varies between options. The assessment level for the Public Transport Alternative is strategic, using the information currently available.

The assessment methodology for the road based options (Preferred Scheme, Low cost and Next Best Options) has followed a four stage approach:

- Describe the characteristic biodiversity and earth heritage features
- Assess the importance of the features, why they are important and their interrelationships
- Describe the impacts including the effects of its distinctive quality and local diversity
- Produce an overall assessment score

The Preferred and Next Best Options are not expected to have any adverse impacts on the River Wensum SAC. With mitigation measures in place including improvements to the exiting road drainage, impacts on Church Wood, Ladies Carr and Springs County Wildlife Site (CWS) would be beneficial. The majority of habitat loss would result from arable land; however a number of hedgerows would be severed. Overall the scheme is likely to have a slight adverse impact with the successful implication of adequate mitigation measures including substantial habitat creation. However, the impacts are predicted to be greater on barn owls, and bats due to loss of foraging and commuting roots and potential mortality, as these impacts are more difficult to effectively mitigate. Further work is ongoing to establish if the impacts on bats can be reduced. The impacts on bats and barn owls raise the summary assessment score to large adverse.

The Low Cost Option would sever the Racecourse Plantation CWS but this could be mitigated to some extent with new blocks of woodland. There are potential impacts

on breeding birds and bats, and to a lesser extent badgers and great crested newts, the effectiveness of mitigation would affect the overall impact on these species.

The Public Transport Alternative identifies potential impacts on biodiversity features and gives an overall assessment score. The assessment of this option is at strategic level only.

Where the orbital bus route operates within the existing transport corridor and no works are required to facilitate the long term operation of this public transport service then the biodiversity impact is considered at this strategic stage of the assessment to be neutral.

However, where works are required in the River Yare corridor (land take etc) to support this transport option that would result in a loss or disturbance to the Heronry and Violet Grove and UEA Marsh local County Wildlife Sites, Biodiversity Action Plan (BAP) habitats (River Yare) or European protected species adverse biodiversity impacts are likely.

Under regulation 48 of the Conservation (Natural Habitats) Regulations 1994, Natural England require an Appropriate Assessment to be undertaken in respect of the River Wensum SAC as part of this scheme

Having concluded this it is considered that the proposals for the NDR are not considered likely to adversely affect the integrity of the European designated site, namely the River Wensum SAC.

The key Biodiversity impacts for each option are summarised in Table 3.16.

Feature	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Designated Sites	Slight adverse impact on Church Wood, Ladies Carr and Springs CWS	Slight adverse impact on Church Wood, Ladies Carr and Springs CWS	Slight adverse impact on Racecourse Plantation CWS and TPO on frontage of Sprowston Manor	Probable negative impact on Heronry Violet Grove and UEA Marsh CWS
Habitats	Slight adverse impacts on late mature trees, hedgerows, woodland and semi improved grasslands	Slight adverse impacts on late mature trees, hedgerows, woodland and semi improved grasslands	Slight adverse impacts on hedgerows and woodland	Probable negative impact on Heronry Violet Grove and UEA Marsh CWS
Species	Moderate to major adverse impact on badgers and barn owls, minor	Moderate to major adverse impact on badgers and barn owls, minor	Slight adverse impact on bats and breeding birds, possible slight	Probable negative impact on Heronry Violet Grove and UEA Marsh

Table 3.16: Summary o	f Biodiversity Impacts
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Feature	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
	adverse impact on some other species	adverse impact on some other species	improvement for great crested newts	CWS
Overall Assessment	Large adverse	Large adverse	Slight adverse	Insignificant/ Probably Negative

(viii) Water Environment

The Water Environment Sub-objective methodology (WebTAG Unit 3.3.11) has been used in analysing the key features and their associated attributes/services of relevance to the water environment. The completed worksheets are provided in Appendix 3I. The Preferred, Next Best and Low Cost Options have been assessed at plan level, which reviews the proposal activities and the potential impacts on specific features and attributes of the water environment, and identifies the potential impacts of the proposal on the important attributes.

The baseline information available for the Low Cost Option allowed it to be assed up to Stage 2 level. Stage 2 enables the significance of impact assessment of individual features but not against specific attributes as these are not clearly defined at this stage.

The Public Transport Alternative has been assessed at strategy level using the information currently available. Impact significance has been assessed as supporting or contradicting objectives under national and regional policy objectives.

Overall Assessment: Slight adverse (Preferred and Next Best Options), Neutral (Low Cost Option), Insignificant (PT Alternative)

(ix) Physical Fitness

The effect on physical fitness is assessed by considering the impact of the preferred scheme and its alternative options on the likelihood of pedestrians and cyclists on achieving more than 30 minutes physical exercise a day. For all scheme options reference is made to guidance found in the Department of Transport; The Physical Sub-Objective WebTAG Unit 3.3.12 (March 08), the Design Manual for Roads and Bridges Volume 11, Section 3 Part 8, Pedestrians, Cyclists, Equestrians and Community Facilities. WebTAG recognises that it is not appropriate to assess physical fitness at a strategy level.

Information from the Norfolk County Council Map Browser showing Ordnance Survey digital mapping, which incorporates information from the county's definitive Rights of Way mapping, has been used in all cases to identify public rights of way. Survey information, which was obtained from public rights of way user surveys (September 2006) supports the assessment for the Preferred Scheme and the Next Best Option.

In addition in some cases, estimates of cycle usage have been given following discussions with the Norfolk County Council's cycling officer.

The four options are generally expected to not to lead to any more pedestrians or cyclists making journeys of greater than 30 minutes per day, other than in residential areas and on new walking/cycling facilities. New pedestrian and cycling facilities only apply to the Preferred Scheme and Next Best Option, which would provide 11 and 8 kms respectively of new or improved pedestrian/cycle links. However, as no baseline usage data exists then it is not possible to calculate the number of people likely to be encouraged to make additional journeys.

Overall Assessment: Slight Beneficial (Preferred and Next Best Options), Neutral (Low Cost Option), Insignificant (PT Alternative)

(x) Journey Ambience

This section of the Stage 3 Environmental Assessment covers the impacts on vehicle travellers which are not included in the cost-benefit economic analysis as quantifiable effects. The two impacts considered in the assessment were:

- 'view from the road'
- 'driver stress'

View from the Road was assessed taking into assessment wide differences between route options, landscape character and quality and especially good or bad potential views along the route. It is defined as "the extent to which travellers, including drivers, are exposed to the different types of scenery through which a route passes. Aspects to be considered are: -

- Types of scenery or the landscape character as described and assessed in Section 8.
- The extent to which travellers may be able to view the scene;
- The quality of the landscape as assessed for the baseline studies;
- Features of particular interest or prominence in the view."

There were four categories which used in assessing traveller's abilities to see the surrounding landscape:

- No view road in deep cutting or contained by bunds, environmental barriers or structures;
- Restricted view frequent cuttings or structures;
- Intermittent view road generally at ground level but with barriers at intervals;
- Open view view extending over many miles, or only restricted by existing landscape features".

Driver stress was defined for the purposes of the environmental assessment as the adverse mental and physiological effects experienced by a driver traversing a road network. Factors influencing the level of stress include road layout and geometry, junction frequency, and speed and flow per lane. Taken together, these factors can induce in drivers the feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the value and safety of a journey.

DMRB considers that driver stress has three components; frustration, fear of potential accidents, and uncertainty relating to the route being followed. This stress can be graded as Low, Moderate or high. Available research evidence does not permit the use of finely graded assessment of driver stress. A three point descriptive scale – Low, Moderate or High were, therefore, used.

For the NDR (Preferred Scheme and Next Best Options), landscape quality ranges from 'ordinary' (for most of the route) to 'very attractive'. Views from the road are mostly 'restricted', limited by the use of landscape mitigation and earthwork cuttings to reduce the visual impact of the route. However, the NDR affords improved views for vehicle travellers over the baseline conditions. Even sections of road passing through wooded or newly landscaped areas would be more attractive than the baseline urban environment. Driver stress would be improved from the existing high adverse situation to low/moderate beneficial.

Landscape quality on the route of the Low Cost Option is mostly 'ordinary' for most of the route. Views from the road are mostly 'intermittent' or 'restricted', limited by the use of landscape mitigation and earthwork cuttings to reduce the visual impact of the route. However, the NDR affords improved views for vehicle travellers over the baseline conditions. Even sections of road passing through wooded or newly landscaped areas would be more attractive than the baseline urban environment. Driver stress would not change from the existing high adverse situation, mainly due to relatively high traffic flows on single carriageway.

Landscape quality for the PT option would be largely unchanged as most routes are either identical or of a similar nature. The proposals include a capital allowance for vehicles on the new BRT route, new shelters and mini-interchanges which will offer significant improvement to facilities as well as information screens for updated travel advice. Traveller frustration would be reduced due to improved frequency of services and easier access for the elderly and people travelling with young children.

Overall Assessment: Large beneficial (Preferred Scheme and Next Best Options), Neutral (Low Cost Option), Moderate Beneficial (PT Alternative)

3.6.2 Safety

(i) Accident Trends for the Norwich Area

Analysis of 5 years' data (1 Nov 2002 to 31 Oct 2007) revealed a total of 4,607 Personal Injury accidents and 6,007 casualties, 75% of these occurring north of the

Dereham Rd–Prince of Wales Rd–Plumstead Rd network link. Figure 3.1 shows the breakdown of accidents by road user group.





Trends in Norwich indicate that accidents and casualties are falling in line with Government casualty targets. This may be one possible factor of the success of current Norfolk County Council Transport Strategies and Casualty Reduction Initiatives. However, to the north beyond the urban boundary of Greater Norwich, in the rural area where the NDR is proposed, the accident trend has flattened out and casualties are rising. Here the car is the dominant vehicle for daily needs and the general perception is that it is too hazardous to walk or cycle.

The dominant contributory factor for accidents in the rural area is drivers "failing to give way". This may be caused by "flow breakdown" i.e. drivers failing to deal with differing circumstances at various junction layouts along the route. Accident reduction in these circumstances may benefit from a whole route improvement rather than piecemeal junction modifications.

(ii) Assessment of Accident Impacts

An assessment of the accident impacts of the scheme is being undertaken for each option, in accordance with WebTAG 3.4.1. The assessment is being carried out using DfT's software COBA11 using Annual Average Daily Traffic (AADT) flows from the SATURN highway model developed for these options.

For the COBA assessment it was assumed that all components of the scheme will be open at the same time in year 2012. The assessment period was 60 years from the year of opening with 2071 the last year of assessment. Scheme Data (node link data, flow data, link lengths etc) were input using the SATCOBA output from the highway model. Accident rates were based on COBA defaults. Accident calculations were performed for links and junctions combined. AADT volumes from the highway model were input for the modelled year of 2012 for the Do Minimum (DM) and Do Something (DS) scenarios. Beyond this year, compound growth rates for each vehicle category were applied until 2027; a zero growth rate was assumed thereafter.

The results of the COBA assessment are currently being reviewed.

(iii) Security

Assessment of the scheme against the Security sub-objective was made in consultation with the County Council, who have provided information regarding different design issues affecting the security throughout the project.

The assessment follows the guidance provided in the Department for Transport's Transport Analysis Guidance, WebTAG Unit 3.4.2. Six different indicators were considered where both the relative importance and the individual performance were assessed. These indicators evaluate the provision of different features which can reduce the exposure of road users to crime.

Separate Security assessment worksheets were produced for each of the four options. Within each worksheet the 'Do Minimum' and 'Do Something' scenarios were evaluated and compared to determine the overall assessment of the proposed strategy. Additionally, a qualitative comment section at the end of each worksheet describes other issues affecting the security of the proposals.

For the road-based options (Preferred, Next Best and Low Cost), traffic management complimentary measures throughout the city centre would be likely to have a positive impact on pedestrian and cyclist facilities and stimulate greater pedestrian and cycle movements, increasing general security through higher activity. The whole route, including the existing network, would benefit from high quality lighting and open visible footpaths and cycle routes. Lighting for the Preferred Scheme would only be required at junctions and slip roads to grade separated junctions along the routes. The change from an urban (Do minimum) to a rural environment (Do something) means that road users will have to stop less on the road; therefore, they would be less exposed to crime.

Taking into account the character of the Do Minimum and Do Something options, both of them count with appropriate security features and an adequate provision of CCTV and lighting. The difference between the three road-based options is limited only to the alignment and the security provisions are regarded to be the same.

For the Public Transport Alternative, by creating a bus link between the UEA and Hospital sites there is scope to improve the facilities for cyclists and walkers who currently cross the path identified for development in to a bus only road. The improved visibility created by the busway would be likely to improve safety and offer significant time savings for those travelling between the two sites as existing buses must travel to Earlham Road to gain access, encountering considerable congestion. Mobility issues are improved considerably by both routes. Links to supermarkets, doctor's surgeries and schools are maximised on both routes. Bus Shelters design

would seek to follow best practice guidance on layout of bus stops, aiming to improve security and people's confidence.

The proposed Public Transport Alternative includes the upgrade of the existing security features throughout the network such as new bus shelters, adequate lighting and CCTV provision and improvements in the pedestrian cyclist facilities. It is considered that this option will have a positive impact in terms of security.

The results of the assessment are presented in Appendix 3J and summarised in Table 3.17. As the impacts of the three road-based options are considered to be the same, the assessment is not repeated in the table for each option. The scoring system in the Table differs from the standard scoring system outlined at the beginning of Section 3.6 and a separate key is provided.

Security	Road	Based Op	otions	Public Transport Alternative			
Indicator	Relative Importance	Do Minimum	Do Something	Relative Importance	Do Minimum	Do Something	
Site perimeters, entrances and exits	++	+++	++/+++	+++	++	+++	
Formal surveillance	+	++/+++	++	+++	+	+++	
Informal surveillance	++	++	+++	++	++	+++	
Landscaping	+++	++/+++	++/+++	+++	++	++	
Lighting and visibility	+++	+/++	+	+	++	++	
Emergency call	++	++/+++	++	+++	++	+++	
Pedestrian & Cyclist facilities	++	+++	++/+++	+++	++	+++	
Overall Assessment	Neutral			Mod	lerate Pos	itive	
Kev: + Relative	Kev: + Relative Importance Low/Assessment Poor						

Table 3.17: Summary of Security Impacts

Relative Importance Low/Assessment Poor

Relative Importance Medium/Assessment Moderate ++

Relative Importance High/Assessment High +++

3.6.3 Economy

(i) **Public Accounts**

The Public Accounts sub-objective deals with the economic impact of the proposed scheme on local and central government, and comprises the Present Value of Costs (PVC) which forms the denominator of the Benefit Cost Ratio calculation.

The impact of the proposed scheme options on public sector providers is detailed in the Public Accounts tables in Appendix 3H, and summarised in Table 3.18. The table shows that the Preferred Scheme and Next Best Options have a similar public sector cost burden, with the Preferred Scheme marginally higher given the greater investment costs. There is no difference in parking or indirect tax revenues between these options, reflecting the lack of variation in vehicle operating costs.

The Low Cost Option has lower figures commensurate with the scale of scheme; it is notable however that indirect tax revenues are much lower, which reflects the low level of additional vehicle kilometres generated by the route. The Public Transport Alternative has low levels of local government costs, however a large operating subsidy is required to support the new bus services. Indirect tax revenues are lower than in the do minimum, as a result of a small reduction in fuel consumption through mode shift from car to bus.

Statistic	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Local Government:				
- Revenue	8.6	8.6	8.4	0.1
- Operating Costs	4.0	3.8	1.4	0.0
- Investment Costs	8.6	8.5	4.3	0.9
- Developer Contributions	-1.2	-1.2	-0.7	-0.2
- Grant/Subsidy Payment	0.0	0.0	0.0	31.9
Net Local Impact	20.1	19.8	13.4	32.8
Central Government				
- Investment Costs	94.2	90.4	62.3	10.1
- Indirect tax Revenues	-13.2	-13.2	-0.4	0.6
Net Central Impact	81.1	77.3	61.9	10.7
Present Value of Costs	101.2	97.0	75.3	43.5

Table 3.18: Public Accounts Summary

Note: Values are in £m in 2002 prices, discounted to 2002. Negative figures denote incomes

(ii) Transport Economic Efficiency

The Transport Economic Efficiency (TEE) table demonstrates the impact of the proposed scheme on both transport users and private sector providers, and comprises the Present Value of Benefits (PVB) which forms the numerator of the Benefit Cost Ratio calculation.

The impact of the proposed scheme options on users and private providers is detailed in the TEE tables in Appendix 3H, and summarised in Table 3.19. The Preferred and Next Best Options provide similar PVBs, with the Next Best being marginally higher due to lower developer contributions.

The Low Cost Option has negative impacts on user travel time even though operating costs are slightly reduced (the NDR options saw greater time savings in spite of increased operating costs). The Public Transport Alternative has some positive benefits in terms of travel time benefits (mainly for consumer users). Impacts on private bus operators are neutral as any revenue shortfall on operation of the new services is met through subsidy from the local authority; the residual disbenefit to private operators relates to loss in private parking revenue.

Statistic	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Consumers:				
- Travel Time Benefits	129.1	129.1	-43.8	21.5
- Vehicle Operating Costs	-26.7	-26.7	0.7	0.4
- User Charges	35.0	35.0	34.4	2.6
- Construction/Maintenance	0.0	0.0	0.0	0.0
Net Consumer Impact	137.4	137.4	-8.6	24.4
Business Users:				
- Travel Time Benefits	150.9	150.9	-15.8	2.1
- Vehicle Operating Costs	1.4	1.4	4.2	0.1
- User Charges	4.4	4.4	2.9	-2.9
- Construction/Maintenance	0.0	0.0	0.0	0.0
Net Business User Impact	156.7	156.7	-8.8	-0.7
Private Operators:				
- Revenues	-16.7	-16.7	-15.9	2.1
- Operating Costs	0.0	0.0	0.0	-34.5
- Grant/Subsidy	0.0	0.0	0.0	31.9
Net Operator Impact	-16.7	-16.7	-15.9	-0.5
Developer Contributions	-1.2	-1.2	-0.7	-0.2
Net Business Impact	138.8	138.9	-25.4	-1.4
Present Value of Benefits	276.2	276.3	-34.0	23.0

Table 3.19: Transport Economic Efficiency Summary

Note: Values are in £m in 2002 prices, discounted to 2002. Negative figures denote disbenefits

(iii) Reliability

Changes in reliability brought about by the NDR and associated measures have been calculated using the stress-based method described in WebTAG 3.5.7, using congestion reference flows as defined in DMRB 5.1.3 Annex D. In this case the changes in stress across the whole modelled network have been calculated; links which fall outside the range of 75% to 125% stress have been set to these values, and where this results in no change in stress these links have been scoped out of the analysis. The full worksheets for each option are contained in Appendix 3H.

In line with WebTAG guidance, it is not appropriate to provide a definitive numerical quantification of reliability benefits calculated in this way. Guidance states that an overall value of between 200,000 and 1 million is considered slight. This typically reflects high and moderate flow routes with small differences in stress, and low flow routes with moderate differences in stress. In the Norwich model, three-quarters of links are single carriageway, yet only a third of links with changes in stress are single carriageway, hence the reliability impacts are mostly concentrated on dual

carriageway routes. Also, four-fifths of affected links have a change in stress within the range 0% to +10%, which can overall be considered a slight impact.

The impact of the Public Transport Alternative on reliability has been assessed on the same basis as the road-based alternatives. It has not been possible to undertake an assessment of public transport reliability impacts resulting from changes in average lateness as no information on existing commercial bus journey time reliability is available upon which to base the assessment. The PT alternative is driven mainly by improved frequencies, which will not inherently improve reliability, and new routes, for which baseline reliability information does not exist. While there are some localised measures to assist buses through problem locations, the impact of these on whole route bus reliability is not likely to be significant.

Overall Assessment: Slight Beneficial (Preferred and Next Best Options), Neutral (Low Cost Option), Slight Adverse (Public Transport Alternative)

(iv) Wider Economic Impacts

Among the objectives for the NDR Scheme stated in the Norfolk Local Transport Plan 2006-2011 are two objectives specifically related to the wider economy of the Norwich area:

- Provide direct access to growth locations, helping to deliver significant housing and employment growth;
- Support the continued success of the Norwich economy as the driver to growth across the north of the region.

A study was undertaken for the County Council by Roger Tym & Partners in 2005 to assess the economic impacts of the NDR. Their report (The Economic Impacts of the NDR, June 2005) assessed what is now the Preferred Scheme:

- A "full route" which included the link across the Wensum Valley to the A47, which is no longer part of the proposed scheme;
- A "three-quarters route", which is equivalent to the Preferred Scheme, terminating at the A1067;
- A "half route", terminating at the A140 west of Norwich Airport.

It should be noted that this assessment was based on the NDR in isolation, therefore it does not take account of the impact of complementary measures in the current scheme package. Also some of the analyses were performed on the full route alone, as data was not available (e.g. from transport model runs) for the other options.

The NDR is likely to have particularly positive effects on the following:

• The development of the airport, where it releases the airport from planning restrictions imposed due to poor surface access. This was estimated to

generate 350 jobs by 2015, on the assumption that expected growth in passenger numbers materialises. The full route would be of most benefit for attracting longer distance customers, but the half route would be sufficient for the local catchment.

- The Airport Industrial Estate proposed in the RSS.
- The development of employment sites near the route of the NDR, such as Broadland Business Park, where a wider labour catchment would prove particularly valuable to new businesses. However, many sites have constraints which would not be overcome by the NDR, depressing the positive effect of the NDR in some locations. After deadweight is taken into account, the NDR might stimulate site development that would accommodate 1,300 jobs (full route) or 1,100 jobs (three-quarter and half route options).
- Existing businesses located to the north and north-east of Norwich, further from the NDR in areas which will have access to major markets improved by the NDR. However, these effects are likely to be relatively modest.

Areas where the NDR was identified as having no clear positive effect were:

- Retail trade and office employment in central Norwich access improvements from most areas of the city by 2025 were considered to be very small.
- Tourism impacts were not quantified but were expected to be slight. The new road would not be expected to generate additional tourism trips to the Norfolk area, and any benefits accruing to particular tourist locations are most likely to be displaced from other destinations.
- Alleviating labour market constraints to company growth broadly, the NDR improves links between areas with similarly tight labour markets, meaning benefits to businesses are likely to be small.
- Unemployment given the current levels of transport access in the economy, it is unlikely that accessibility is forming a significant barrier to accessing the jobs market, suggesting in turn that labour constraints to company growth are unlikely to be significantly affected by the NDR.
- Economic activity rates improvements would require the NDR to be responsible for persuading the currently inactive to return to the labour market. The local economy already performs relatively well on these measures, meaning that any effects of the NDR in this respect are likely to be slight.
- Deprivation impacts are only likely to be found in Norwich itself; other deprived areas are too distant to be plausibly affected. There is very little evidence that deprivation exists in Norwich due to a deficient demand for labour, or from poor accessibility. Deprivation is likely to exist for a series of more complex social reasons, and the NDR is unlikely to have a significant effect in this regard.

• Peripherality – research has indicated that the effects of infrastructure investment on existing businesses in areas considered peripheral might be low. However, perceptions of peripherality might be reduced by the NDR.

The study concluded that whether the NDR is considered a helpful project depends on what the policy objectives are. If the policy objectives are to grow the city centre, then the NDR was not considered particularly helpful on its own. Growth in the city centre would depend on a package of measures involving skills development, public transport development and site development. The NDR could help push forward this agenda, but it should not be regarded as a main plank of this programme.

If, however, the policy objectives are to go for growth sub regionally, the NDR was seen as a more helpful project. Broadland is the area set to benefit most from the project (although obviously, parts of Broadland are within the Norwich urban area, even though they are at the fringe). The NDR was seen as likely to boost growth on the periphery of the city, and would have particularly positive effects on already developing sites such as the Broadland Business Park.

Given that the original EIR was not specifically focused on assessing the route as currently proposed, and did not include the impacts of other parts of the package of measures under consideration here, a revised EIR is currently being commissioned. In the meantime it is considered that the impacts of the NDR are considered to be moderate – while some specific growth areas will be significantly aided by the route, the wider geographical benefits are more limited. The Low Cost Option, being predominantly on existing road alignments, would be expected to have minimal impact. While public transport improvements may help to support the economy of Norwich city centre, it would not be adequate to address significant economic growth.

Overall Assessment: Moderate Beneficial (Preferred and Next Best Options), Neutral (Low Cost Option), Slight Beneficial (Public Transport Alternative)

3.6.4 Accessibility

(i) Option Values

The provision of the NDR will provide increased travel options for residents in the wards through which the route runs, by improving linkages between areas to the north of Norwich and access to radial routes into Norwich including Park and Ride sites at Sprowston and Postwick. The road increases the options for residents to choose between alternative destinations for various services (shopping, leisure etc). As the adjacent wards contain a total resident population of 30,000, it is considered that the new road will have a large beneficial impact, given that many residents of Norwich (who are not counted among the neighbouring ward populations) will also benefit from having a wider range of destinations more easily accessible. The Low Cost Option predominantly uses existing road alignments and as such the option values will be more limited than for the NDR.

The Public Transport Alternative involves two new bus services – the orbital route and the Bus Rapid Transit route. Both provide new opportunities for movement and the orbital route in particular provides improved route options avoiding the city centre. As this service potentially benefits all residents of Norwich the impact of this option on option values is considered to be significant.

Overall Assessment: Large beneficial (Preferred and Next Best Options and PT Alternative), Slight beneficial (Low Cost Option)

(ii) Severance

The effect on severance has been assessed by considering the impact of the Preferred Scheme and its alternative options on the relative ease or difficulty of pedestrians making journeys to local facilities. For all scheme options reference has been made to guidance found in the Department of Transport; The Severance Sub-Objective WebTAG Unit 3.6.2 (March 08), the Design Manual for Roads and Bridges Volume 11, Section 3 Part 8, Pedestrians, Cyclists, Equestrians and Community Facilities (March 08).

Information from the Norfolk County Council Map Browser showing Ordnance Survey digital mapping, which incorporates information from the county's definitive Rights of Way mapping, has been used in all cases to identify public rights of way. Survey information, which was obtained from public rights of way user surveys (September 2006) supports the assessment for the Preferred Route and the Next Best Option. In addition in some cases, estimates of cycle usage have been given following discussions with the Norfolk County Council's cycling officer.

Additional information which shows the location of community facilities has been used to support the assessments for the Preferred Scheme and the Next Best Option. A worksheet has not been prepared for the Public Transport Alternative as this option largely comprises changes to the existing level of service. A qualitative comment only has been made in respect of this option.

The NDR runs through rural areas and as such the severance impacts in relation to existing pedestrian, cyclist or equestrian movements will be limited to locations where existing rights of way are amended. Currently it is proposed that roundabout junctions would be constructed along the route to give direct access to the following radial routes:

- C262 Fir Covert Road
- C261 Reepham Road
- B1150 North Walsham Road
- A1151 Wroxham Road
- C283 Salhouse Road
- C874 Norwich Road

In addition a grade separated junction would be provided at the crossing with the A140 Cromer Road, which would also give access to the B1149 Holt Road. The new junctions would be designed to meet the joint objectives of minimising delay for vehicles passing through the junction whilst maintaining a safe passage of all road users.

For the Preferred Scheme, approximately 11km of new or improved links suitable for use by pedestrians, cyclists and equestrians would be provided along the route within the landscape strip, linked to existing facilities. In addition, two purpose built cycleways would be carried over the NDR on bridges. The Marriott's Way long distance path and a further 2 public rights of way would also cross the road on new bridges and one would be diverted to maintain its connectivity together with providing a safer crossing of the existing A47.

These links will reduce the severance effect of poor or non-existent pedestrian links between settlements adjacent to the route. In addition the complementary traffic management measures within the city centre will reduce the severance effect of vehicular traffic within the city centre, allowing freer pedestrian movement.

No communities are severed by the NDR, although six minor roads would be severed.

The single carriageway section would intersect with one public right of way, while the dual carriageway section would intersect with 4 public rights of way and meet a third at the roundabout with Reepham Road.

The Next Best Option severs fewer public rights of way, while the Low Cost Option, being a lower grade of road, has more interaction with pedestrians and cyclists who would be provided with at-grade crossing rather than dedicated overbridges. Also the Low Cost Option involves more roundabout junctions with existing roads (11 in total) than the other options.

Full details of the severance impacts of each option are presented in Appendix 3K. The impacts are summarised in Table 3.20, which shows the number of sites affected by severance impacts, categorised by the scale of impact. Note that the number of impacts in some cases exceeds the number of sites as there are sites where the impact on pedestrians is categorised differently to the impact on cyclists.

Scale of Impact	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Large Positive				Not
Moderate Positive				individually
Slight Positive	3	3	3	assesseu
Neutral	10	9	16	
Slight Negative	10	11	3	

 Table 3.20: Summary of Severance Impacts

Scale of Impact	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Moderate Negative				
Large Negative	1	1		
Total Sites Affected	23	23	22	
Overall Assessment	Slight adverse	Slight adverse	Slight adverse	Slight Beneficial

(iii) Access to the Transport System

Access to the transport system is measured in terms of:

- The availability of a vehicle for private use;
- Distance from the nearest public transport service, for those without access to a car.

The NDR scheme does not involve any significant change in these indicators. Neither does the scheme provide new access points onto the highway network for local residents. The function of the road in linking existing radial roads together is reflected in the Transport Economic Efficiency sub-objective, in terms of the changes in travel time predicted by the assignment models. The Distribution and Equity sub-objective assesses the location of the route in relation to the distribution of households without access to a car.

Where individual or joint access to properties will be severed by the new road, arrangements will be made to link these to existing roads. Some road links will be severed (see Severance sub-objective), although alternative routes will be provided as part of the scheme design to maintain access.

The Public Transport Alternative will provide enhanced stops on the public transport network, through the provision of 10 mini-interchanges on the new orbital bus route and 60 stops on the BRT route. Most of these are enhancements of existing stops, and as such will provide additional accessibility through improved boarding facilities. Three new stop locations will be provided as part of the orbital route, at:

- Falcon Road East (Sprowston), between Linacre Avenue and Salhouse Road;
- Barkers Lane (Sprowston), between North Walsham Road and Church Lane;
- Sweetbriar Road (west Norwich), between Drayton Road and Dereham Road.

Overall Assessment: Neutral (Preferred, Next Best and Low Cost Options), Slight beneficial (PT Alternative)

3.6.5 Integration

(i) Transport Interchange – Passenger

The scope of the passenger interchange assessment includes intermodal interchange. This covers both interchange between public transport modes and between public and private modes, such as Park and Ride.

The road based options (Preferred, Next Best and Low Cost) do not include the provision of any new passenger interchange facilities. However, an assessment has been made of:

- Standards of interchange quality at the existing formal interchanges within the NATS area including Norwich Bus Station, Norwich Railway Station, on-street interchanges in Norwich City Centre and the six Norwich Park and Ride sites.
- The impact of the NNDR on current standards of interchange quality as defined by WebTAG.

Assessment of the public transport alternative option includes:

- Provision of new or improved passenger interchange facilities at ten key locations where there is significant potential for interchange between the orbital bus route and existing radial bus services.
- Improvements to passenger facilities and information at 60 bus stops on the bus rapid transit corridor, including provision of high quality bus shelters, real time passenger information, ticket vending machines and a passenger help point.
- The impact of the public transport alternative option on current standards of interchange quality as defined by TAG.

A single worksheet is provided for all three road based options. This is set out in Appendix 3L.

It is estimated that approximately 600 Park and Ride passengers per day will benefit from improved access to Park and Ride sites as a result of the NDR being built. By improving car access to the existing Airport, Sprowston and Postwick Park & Ride sites the NDR will facilitate interchange between car and public transport on key radial routes into the city from the north.

The improved interchange facilities provided as part of the Public Transport Alternative will benefit between 500 and 10,000 passengers per day. The provision of high quality waiting facilities and information at key locations where there is significant potential for interchange between the orbital bus route and existing radial bus routes will improve physical linkage and facilitate interchange between bus services in the northern fringe of Norwich.

(ii) Transport Interchange – Freight

None of the scheme options include the provision of any new freight interchange facilities. However, rail freight reliability is a particular concern for this assessment. The existing rail freight terminal facilities in Norwich at Riverside and Trowse are located to the south east of the city centre. The NDR will have no impact on freight interchange quality indicators for these facilities.

As part of the Norwich Area Transportation Strategy an urban freight consolidation centre has been developed for deliveries to businesses in Norwich city centre, but the consolidation centre itself is located outside the NATS area at Snetterton. The NDR will have no impact on freight interchange quality indicators for this facility.

Assessments have been made against the freight interchange quality indicators where this is possible from existing reference sources. These are set out in Appendix 3L.

Overall Assessment for Transport Interchange: Slight Beneficial (Preferred, Next Best and Low Cost Options), Moderate Positive (Public Transport Alternative)

(iii) Land Use Policy

The land-use assessment was completed in accordance to the Transport Analysis Guidance and with reference also to DMRB Volume 11 Section 3 Part 12.

For each of the four options, the national, regional and local policy context was analysed to assess the impact of the option on the policies both thematic and site specific. The analysis was based on judgements about the impacts on these policies and proposals in terms as follows, from impacts that facilitate and support the particular policy to those that are neutral in their effects to those which hinder policies adversely.

The assessment took into account the relevant policies at local, regional and national level. There were considered the following policies:

- Local Broadland District Local Plan (May 2006), Second Local Transport Plan (March 2006), Joint Core Strategy for Broadland, Norwich and South Norfolk – Issues and Options, Environmental Assessment Report (21 October 2004)
- **Regional** East of England Plan (May 2008),
- National Transport White Paper, PPG1, PPG3, PPG4, PPG 6, PPS 7, PPS9, PPG 13, PPS 15, PPG16, PPG 17, PPG24

Local Policy is generally supported by the NDR, notably the Local Transport Plan, Broadland Local Plan and emerging Joint Core Strategy for Greater Norwich. The Joint Core Strategy Issues and Option Stage proposes development in several key locations on the route of the NDR at Rackheath, Postwick and Airport. Additional growth will remain to be determined. Potential adverse effects include severance of possible Green infrastructure.

At a regional level, the route is broadly supportive of policies in East of England Plan including environmental policies and Norwich's role as a growth centre. Adverse effects include weakening of cultural heritage plans and impact on rural landscapes.

In terms of national policy, the area is subjected to congestion, poor air quality and the growth plans would accentuate this without NDR being in place. However, car journeys will not be reduced significantly and other development will be encouraged to fill the gaps on the north and east side of the city. Habitat creation will offset impacts along the route. Other effects include potential reduction of traffic noise in Norwich City which will be a benefit. Cultural heritage could be adversely affected.

The Low Cost Option is not considered adequate to promote and sustain growth over the long term. Similar impacts as the NDR would be felt but to a lesser degree, and this option is less able to support growth plans, particularly for the Airport.

The Public Transport Alternative is supportive of some local policies but will not support the growth agenda. Contribution to the Joint Core Strategy would be limited to the Growth Area. Growth areas proposed near Postwick, Sprowston, Rackheath would benefit from improvement in provision including BRT. This is in line with PPG 13 objectives on accessibility and sustainability. The majority of the services for the city will not benefit without significant reduction in car usage which will remain high as through traffic continues to use city centre and ring round for access.

Table 3.21 Table 3.21 summarises the overall impacts on land-use policy at local, regional and national level, which are described in detail in Appendix 3L.

Policy Level	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Local	Beneficial	Beneficial	Beneficial	Neutral
Regional	Beneficial	Beneficial	Neutral/ Adverse	Neutral
National	Neutral	Neutral	Neutral/ Adverse	Neutral
Overall Assessment	Beneficial	Beneficial	Neutral	Neutral

Table 3.21: Summary of Land Use	Policy Impacts
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Further discussion of the contribution of the NDR scheme to policies and strategies at local, regional and national level can be found in Section 2, Strategic Case.

(iv) Other Government Policies

The strategic fit of the NDR with local, regional and national transport and other policy objectives is discussed in detail in Section 2, Strategic Case. The impact of

each option on government policies in areas other than transport is detailed in Appendix 3L and summarised in Table 3.22. The schemes are expected to contribute positively towards government policy in the areas of:

- Social Inclusion (Cabinet Office);
- Business success, regional economic performance and enterprise economy (Department for Business, Enterprise and Regulatory Reform);
- Employment opportunity (Department for Work and Pensions);
- Promoting health and access to healthcare (Department of Health).

The road options could hinder environmental and heritage policies and may impact negatively on health of children and young people. The public transport alternative is considered to have more beneficial impacts in these respects, although this option is less effective in promoting business and enterprise.

Government Department	Policy Areas	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Cabinet Office	Social inclusion	+	+	+	+
Business, Enterprise and Regulatory Reform	Business development, regional competitiveness	++	++	+	+
Children, Schools and Families	Child health	-	-	0	+
Culture, Media and Sport	Local heritage		/-		-/
Environment, Food and Rural Affairs	Environment and rural communities			-	++
Work and Pensions	Employment opportunity	++	++	+	+
Health	Health	0	0	-	+
HM Treasury	Economy and employment	++	++	+	+
Overall Assessment		Moderate Beneficial	Moderate Beneficial	Slight Beneficial	Slight Beneficial

 Table 3.22: Summary of Other Government Policy Impacts

3.6.6 Appraisal Summary Tables

The Appraisal Summary Tables for each option are included in Appendix 3M. A summary of the NATA appraisal contained in the ASTs is provided in Table 3.23Table 3.23.

Objective	Sub-Objective	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Environment	Noise (NPV)	£46.9m	£47.4m	£25.5m	£0m
	Local Air Quality (2012)	NO ₂ -7,444 PM10 -2,131	NO ₂ -7,444 PM10 -2,131	NO ₂ -4,454 PM10 -1,420	NO ₂ +5 PM10 0
	Greenhouse Gases (PVB)	-£2.2m	-£2.2m	-£0.3m	£0.04m
	Landscape				-
	Townscape	+	+	+	-
	Heritage of Historic resources		/-		-/
	Biodiversity			-	o/-
	Water	-	-	0	0
	Physical Fitness	+	+	0	0
	Journey Ambience	+++	+++	0	++
Safety	Accidents (PVB)	COBA results currently being reviewed.			
	Security	0	0	0	++
Economy	Public Accounts (PVC)	£101.2m	£97.0m	£75.3m	£43.5m
	TEE: Business Users and Providers (PVB)	£138.8m	£138.9m	-£25.4m	-£1.4m
	TEE: Consumers (PVB)	£137.4m	£137.4m	-£8.6m	£24.4m
	Reliability	+	+	0	-
	Wider Economic Impacts	++	++	0	+
Accessibility	Option Values	+++	+++	+	+++
	Severance	-	-	-	+
	Access to the Transport System	0	0	0	+
Integration	Transport Interchange	+	+	+	++
	Land-Use Policy	++	++	0	0
	Other Government Policies	+	+	0	++

Table 3.23: Summary of NATA Appraisal	Table 3	3.23:	Summary	of NATA	Appraisal
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3.7 NATA Supporting Analyses

In addition to the NATA assessment of the five key transport objectives presented in Section 3.6, there are three groups of issues of relevance to the overall case for the scheme, but which are not covered within the Appraisal Summary Tables. These groups of issues are more locally focused on specific groups of users, providers and affected parties. These are:

- Distribution and Equity;
- Affordability and Financial Sustainability;
- Practicality and Public Acceptability.

In addition, supporting analysis is required to assess the impacts of the proposed scheme on the Ten Year Plan for Transport.

3.7.1 Distribution and Equity

The supporting analysis of Distribution and Equality demonstrates the social and geographic distribution of the impacts of the NDR scheme. This analysis enables an assessment to be made as to whether the overall scheme impacts, demonstrated within the Appraisal Summary Table, are felt equally among the affected population, or whether certain groups are disproportionately affected. This may therefore highlight specific mitigation measures required to assist these groups.

(i) Distribution and Equity Assessment of NATA Objectives

A full analysis of distribution and equity impacts in terms of the Environment, Safety, Economy and Accessibility objectives can be found in Appendix 3N. The key findings of this analysis are as follows:

- Noise and Air Quality there are negative impacts in the NDR corridor and connecting roads, and in the western rural area, although the number of residences affected is small compared to the number benefiting from reduced noise and improved air quality within the city of Norwich. The majority of the study area has no significant noise and air quality impacts.
- Landscape, Townscape, Biodiversity, Heritage, Water a series of Environmental Constraints Maps which show the locations of key environmental features affected by the NDR route are provided in Appendix 3N.
- Transport Economic Efficiency overall the greatest time saving benefits are for journeys from areas around the NDR route, specifically Thorpe Marriott, Horsford, Spixworth and Rackheath, while the greatest increases in journey time are felt in some areas beyond the north-west end of the route, and across the southern part of Norwich. The PM peak has the greatest extremes positive and negative impacts.

For commuters, the main time saving benefits are felt in areas to the north of the NDR. Business travellers located on the urban fringes of Norwich derive significant time savings, whereas further out into the rural area, especially to the south of Norwich, journey times are longer. For other purposes the changes are generally moderate, being negative within Norwich but positive in the surrounding rural areas.

There are generally fewer areas of major disbenefit for people on low incomes; there are a number of areas on the urban fringe where time savings are reduced for these travellers. Medium and high income travellers exhibit similar patterns with large disbenefits to the south and west of the city.

• Access to the Transport System – the NDR runs predominantly through areas with low proportions (under 20%) of households without access to a car. Higher levels of non car ownership occur towards the centre of Norwich, and these households would benefit from the improved conditions for public transport access resulting from the complementary traffic management measures.

(ii) Demographic Indicators

The 2001 Census Key Statistics contain a number of indicators which can be analysed to assess the demographic profile of the areas affected by the NDR route. These are presented in Appendix 3N. These indicators identify the wards immediately adjacent to the NDR as having the following characteristics:

- A higher level of economically active residents than surrounding areas, especially Norwich which has high levels of unemployment especially among the young, and a significant student population;
- A well-educated population, with high levels of secondary achievement;
- Low numbers of people living alone and single-parent households, but high levels of households with school-age children;
- Mostly owner-occupied housing, compared to Norwich which has significant proportions of council tenants;
- High levels of car ownership, whereas Norwich has on average less than one car per household;
- High levels of car use for travel to work, average levels of bus use and low use of non-motorised modes;
- Use of public transport for work trips mostly restricted to those without a car available;
- Generally low levels of deprivation.

Other demographic indicators relating to specific social groups are discussed in the following section.

(iii) Equality Impact Assessment

The purpose of an Equality Impact Assessment (EqIA) is to measure and record the likely positive and negative impacts of a strategy, policy or project on specific target equality groups, in the areas of gender, race, disability, age, faith/religion and sexuality.

Investigating the impacts on equality groups is now a statutory responsibility. Since the introduction of the Race Relations (Amendment) Act 2000, the equalities agenda

has continued to rise in prominence and more responsibilities have been placed on public sector bodies.

An EqIA is usually conducted in two stages:

- **Stage 1** is a scoping exercise, which prompts thoughts about the potential impacts on equality groups. Potential positive and negative impacts are analysed, together with some consideration of possible mitigation actions where adverse consequences have been identified. This stage is a relatively brief exercise which can draw upon a variety of evidence sources such as: personal knowledge and experience; relevant research, reports and literature; consultation results, and demographic data and other statistics. The screening process also questions whether there are any gaps in the data that is required for a robust assessment.
- **Stage 2** involves a far more rigorous examination of the project/policy, with indepth consultation with affected groups to establish the extent of the impact and develop an action plan to mitigate any negative differential outcomes.

A preliminary Stage 1 assessment has been undertaken for the NDR Scheme and is included in Appendix 3O. In summary, the analysis of demographic data for the areas affected by the NDR demonstrates that the wards immediately adjacent to the route are characterised by:

- A higher average household size than other areas of Norfolk;
- A slightly higher proportionate male population than other areas of Norfolk;
- A predominantly white, Christian population, in line with the rest of the county and with significantly lower representation of other ethnic/religious groups compared to regional and national trends;
- An age profile in line with national and regional trends, compared to Norwich which has an older population;
- Lower than average proportions of people with health problems.

Thus the area within which the NDR will be constructed does not contain significant populations of target groups. The wider areas of Broadland and Norwich, who may also be expected to experience impacts of the route, have generally similar or lower proportions of populations in the target groups than exists regionally or nationally.

It is proposed to undertake a full Stage 1 assessment upon the scheme gaining Programme Entry. The Stage 1 scoping exercise did not flag up any immediate adverse consequences for any of the equality strands, and at this stage it is considered unlikely that a Stage 2 assessment will be required. However, there are some areas which may warrant further investigation to provide a more detailed Stage 1 assessment. The full Stage 1 assessment is intended to focus on four equality strands of young people, old people, women and people with disabilities. Whilst additional or substantial adverse consequences are not expected to be found, the process will help to unearth any mitigating actions or improvement suggestions,

which could serve to maximise equality of outcomes for all groups. It is also likely that a further list of positive consequences of the scheme will be borne out of this more indepth process.

3.7.2 Affordability and Financial Sustainability

Based on the current estimate, and the various contributions from Government taken together with the adjustment to the Council's current Formula Spending Shares to cover the cost of future maintenance of an the increased length of infrastructure, the Council has assessed the affordability of the project, not only for the construction but during the maintenance and operation during future years and has concluded that the project is indeed affordable not only now but in the future.

The Councils during the Initial Project Appraisal have also investigated the potential for third party revenue from opportunities such as advertising, leasing of land for mobile communication facilities etc. At this stage the Councils have concluded that none of these third party opportunities are deliverable but will commit to continue to investigate any opportunities for lowering the Project cost further.

Further details relating to the financing and ongoing revenue funding for the scheme can be found in Section 6, Financial Case. The Affordability and Financial Sustainability Tables for each option are presented in Appendix 3P and summarised in Table 3.24Table 3.24. Note that the net cost to central government is the cost of RFA grant less the flow of indirect tax revenues over 60 years.

Indicator	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Net Investment Cost (Local)	7,000	6,734	3,946	1,079
Net Investment Cost (Central)	39,498	36,878	39,212	12,181
Local Government Operations:				
- Net Impact Year 1	-995	-984	-763	-2,798
- Net Impact Year 8	-775	-761	-561	-2,125
- Net Impact Year 15	-556	-540	-355	-2,507
Central Government Operations:				
- Net Impact Year 1	877	877	227	-8
- Net Impact Year 8	656	656	83	-20
- Net Impact Year 15	483	483	-42	-31
Private Sector Operations:				
- Net Impact Year 1	-2,983	-2,983	-2,662	-123
- Net Impact Year 8	-1,511	-1,511	-1,511	-57
- Net Impact Year 15	-48	-48	-101	7

Table 3.24: Summary of Affordability and Financial Sustainability

All costs are £000, outturn

The analysis indicates that the net revenue burden to local government would decrease over time for the three road based schemes - although maintenance costs increase with inflation, the reduction in parking revenue loss over time (as forecast by TUBA) outweighs it. Local government costs for the Public Transport Alternative increase over time, mostly as a result of increasing bus operating subsidy, as parking revenue loss decreases.

For Central Government, the net cost impact is positive as Government receives additional revenue from indirect taxes resulting from additional fuel consumption generated by the new roads. This falls gradually over time, as a result of general traffic growth in the Do-Minimum, which makes the additional traffic (and fuel consumption), generated by the road more marginal in each successive year. Only the Public Transport Alternative has a loss of central revenue, due to mode shift from car to bus.

Private sector parking operators lose more in revenue than local government, but have a similar reduction in that loss over time. Revenue to private bus operators varies little between the road-based options. The net impact on private bus operators is nil in the Public Transport Alternative, as the shortfall in revenue is made up with local government subsidy; the figures in Table 3.24 thus reflect the changes in private parking revenue.

3.7.3 Practicality and Public Acceptability

A number of the key issues in relation to the assessment of the practicality and public acceptability of the proposed NDR scheme are dealt with in other sections of the Business Case as follows:

- Studies have identified that there are a number of route options for the NDR that are practical in engineering terms, and the scheme design has been progressively improved through a number of staged assessments as detailed in Section 2, Strategic Case.
- A funding package has been identified for the scheme and is detailed in Section 6, Financial Case.
- A preferred procurement route and contract type have been identified, and soft market testing involving five leading national civil engineering contractors undertaken to identify and address potential procurement and contractual issues (see Section 5, Commercial Case).
- A detailed project programme, including dates for submission of planning applications, public inquiry and confirmation of orders, has been produced and is shown in Section 4, Delivery Case, which also details the governance, project management and risk management strategy for the scheme.

- A comprehensive list of key stakeholders has been produced along with a communications strategy to manage interaction with stakeholders; this is detailed in Section 4, Delivery Case.
- An extensive number of public consultations have already been carried out, and further consultations are scheduled at key points in the project programme. These are scheduled in Section 4, Delivery Case. There is a high level of public support for the NDR Scheme, with 77.6% supporting or strongly supporting, and only 13.9% opposed or strongly opposed to the proposals.
- Early public consultation concluded in termination of the NDR prior to impacting on The River Wensum SAC hence improving public perception.
- Written support for the NDR scheme has been received from a number of key stakeholders, copies of letters to be found in Appendix 4.E Evidence of this support is provided as part of Section 2, Strategic Case.
- Details of how the NDR integrates with other local, regional and national transport policies and programme are provided in Section 2, Strategic Case.
- Consultation with Statutory Environmental Bodies has taken place during the scheme development process; this is scheduled in Section 4, Delivery Case. A number of these bodies have objected to the principle and detail of an NDR Scheme.

Other issues relating to the practicality and public acceptability of the scheme are as follows:

- Robustness of project programme and procurement route is covered in section 4 Delivery Case
- Partitioning the Economic Impact Report suggests that in some cases, the economic regeneration impacts of the NDR Scheme could be delivered by implementing the "half-route" which satisfies the requirement for improved access to Norwich International Airport to enable its expansion. However, in other cases the full route as currently proposed would be required. It is unlikely that the western part of the route would be built in isolation as a separate scheme as the benefits would be limited. The connection to the A47 at Postwick is particularly critical to the scheme, although this is anticipated to be progressed through Growth Point funding.

3.7.4 Contribution to 10 Year Plan Targets

The 10 Year Plan for Transport, published in July 2000, set down eight Public Service Agreement targets. The outcomes of the multi-modal studies (including road based studies) are a key contribution to meeting many of these targets. Therefore an assessment of the contribution that proposed schemes make to achieving these targets is important in assessing their overall value. Appendix 3Q presents the contribution of each of the NDR options to the targets, which is summarised in Table 3.25Table 3.25. Note that targets relating to light rail and London Underground are not relevant to this analysis and are omitted from the table.

Target	Preferred Scheme	Next Best Option	Low Cost Option	Public Transport Alternative
Reducing congestion on	1.3sec or	1.3sec or	1.0sec or	-1.5sec or
the inter-urban network and	1,343hrs	1,343hrs	261.2hrs	-0.3hrs
in large urban areas.				
Increase rail use (kms)	-0.1%	-0.1%	-2.4%	-0.2%
Increase bus use (jnys)	0.3%	0.3%	-0.1%	0.3%
Improve Air Quality	Net benefit	Net benefit	Net benefit	No change
	to 1 AQMA	to 1 AQMA	to 1 AQMA	to AQMAs
Reduce Greenhouse gases	6%	6%	0.2%	No change
	increase in	increase in	increase in	in CO ₂
	CO ₂	CO ₂	CO ₂	tonnes
	tonnes	tonnes	tonnes	
Reduce Accidents	COBA result	s currently be	ing reviewed.	

Table 3.25: Contribution to 10 Year Plan Targets

Schedule of Appendices to Section 3

- 3.A Capital Costs
- 3.B Operating Costs
- 3.C Existing Data and Traffic Survey Report
- 3.D Local Model Validation Report
- 3.E Demand Report
- 3.F Forecasting Report
- 3.G TUBA Audit Trail
- 3.H Economy Worksheets
- 3.I Environment Worksheets
- 3.J Safety Worksheets
- 3.K Accessibility Worksheets
- 3.L Integration Worksheets
- 3.M Appraisal Summary Tables
- 3.N Distribution and Equity Supporting Analysis
- 3.0 Equality Impact Analysis
- 3.P Affordability and Financial Sustainability Tables
- 3.Q Contribution to 10 Year Plan Targets