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THE CASE FOR DUAL OR SINGLE CARRIAGEWAY IMPROVEMENT BETWEEN M1 JUNCTION 24 AND CLIFTON

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Introduction

For the rural section of the A453 between junction 24 and Clifton, the range of schemes identified in the early stages of the Study has been reduced through the process of scheme sifting and development of Options to two contenders, a maximised single carriageway, or a dual carriageway.
This Working Paper considers and compares the two schemes, examining:

- problems on the existing A453
- safety
- scheme details
- operational performance
- the GOMMMS Appraisal context
- the Options context

Problems with the existing A453 between M1 and Clifton

Analysis of the existing road indicated problems of:

- Poor horizontal alignment - contributing to
- Poor safety record: 70-80% higher than national average for type of road
- Accidents at and between junctions, and at road maintenance works
- Interrupted flow on the uphill sections
- Regular serious congestion in peak hours.

Generation of initial schemes

It was possible to simplify the choices with some basic considerations:

- The existing at-grade junctions at Ratcliffe on Soar, the Power station, Thrumpton north, and Barton in Fabis are of the priority (give way) type, with right turns. They are a source of accidents.
- The only form of at-grade junction capable of substantially improving safety would be a roundabout. An even greater level of safety can normally be achieved with straightforward grade separated junctions.
- The impact of roundabouts can be comparable with simple grade separated junctions.
- On a dual carriageway roundabouts would limit the capacity.
- Roundabouts located on an incline can encounter problems with braking and acceleration.

- There is scope for rationalising the junctions:- combining the junctions at Ratcliffe on Soar, the Power station, and the access to Parkway station , and eliminating the one at Thrumpton north or restricting it to left turns.

- A dual carriageway scheme would not perform well with roundabouts at all the Junctions. It would result in 5 roundabouts in 6 miles.

From this it can be concluded that two schemes can be carried forward:

i) A dual carriageway scheme with preferably fully grade separated junctions.
ii) A single carriageway scheme not restricted to at-grade junctions. This is sub-divided into a 7.3m or a 10m wide design

Development of schemes

Safety

Safety is a major consideration for this section of A453 and has consequently been examined in some detail. Analysis of the accident records follows at the end of this Paper.

There are four strands to the accident problem each with implications for choice of scheme:

i) Junctions

The existing junctions exhibit a variety of safety problems. M1 junction 24 has a tight curve exiting towards Nottingham. The Ratcliffe on Soar, Power Station, Thrumpton north, and Barton in Fabis junctions all allow right turns across heavy traffic. Accidents have also occurred at several of the private accesses along the section.

ii) Horizontal alignment

The long large radius curves between the Power Station and the M1 limit forward visibility. Overtaking nevertheless takes place, with a raised level of risk. Also, in heavy traffic, the limited visibility reduces ability to anticipate conditions ahead, leading to a raised risk of shunt accidents

iii) Vertical alignment

There are two significant inclines of approximately 4% on the route in the Nottingham-bound direction, at Wrights Hill east of the Power Station, and Brands Hill near Barton in Fabis. Both cause heavy vehicles to slow down often by over 20 mph from their level cruising speed. The resulting wave effect sometimes slows following traffic to a stop. The disruption is worsened by the junctions in each case introducing turning traffic on an incline. The Barton junction is particularly bad because of the staggered cross roads layout, bringing A453 traffic to a halt waiting for right turning vehicles.
The hill and junction combinations are a large source of accidents.

iv) Roadworks

The accident records show several injury accidents at roadworks on the A453. Consultation with the maintenance Agent, PlaN consortium, indicate that it difficult to achieve safe working conditions on the single carriageway, and increasingly they try to obtain temporary closures to carry out maintenance and repair. Closures are restricted as far as possible to periods of low traffic flow, but continuing off-peak traffic growth has reduced the availability. Overnight working itself contributes to increased risk of accidents.

The minimum requirement should be a standard of highway that would solve the safety problems:

i) Grade separation of the junctions would be a great improvement over the existing situation. The roundabout proposed as part of the Power Station development would suffice for a single carriageway scheme.
ii) Crawler lanes could resolve the problems on the two Nottingham bound inclines.
iii) Dangerous overtaking could be prevented by regulation: a no-overtaking Order.

The remaining problems are associated with roadworks in particular, but also random shunts due to unstable traffic flow with poor forward visibility. These are very difficult to solve for a single carriageway.
A wide single carriageway (10m + 1m wide hardstrips on each side) would, once built, make the subsequent job of maintenance less hazardous. Its initial construction would involve protracted on-carriageway working. The major structures between the Power Station and River Soar would have to be widened.
Construction of a standard 2 lane carriageway with 1m hardstrips on each side would need extended periods of closure leading to diversion and rat-running through the minor road network.

Scheme details

A Single 2 lane improvement would widen the existing carriageway by removing the kerbs and adding 1m continuous paved edge strips on each side behind a white edge line, resulting in modest gains in safety and flow. Junctions, crossings, and accesses envisaged are:

i) A roundabout at the proposed Parkway Station access, also connecting the roads to Ratcliffe on Soar, the two adjacent accesses to the Ratcliffe on Soar Power Station, and the Power Station – Thrumpton – West Leake Road, via a new link south of the A453
ii) Retention of the existing grade separated Power Station – Thrumpton – W. Leake junction
iii) Thrumpton north at grade restricted to left-in, left-out movements
iv) Grade separated minimum standard junction at New Lane Barton in Fabis cross roads.

v) Other existing bridged crossings retained and at-grade accesses linked to local roads.

A Wide Single carriageway would have the same junction, access and crossing arrangements, but would widen the existing road mostly or entirely on the south side. The 10m wide carriageway would be marked to 2 lanes, with further 1m hard strips on each side.
The dual carriageway scheme would basically follow the Highways Agency scheme published in 1993. It would in principle add a second carriageway on the south side of the existing. Junction, access, and crossings would be as for the single carriageway schemes, adapted for the extra width, except for the Parkway station access, which would be grade separated.
Crawler lanes would be included in a Wide Single carriageway scheme, and an option to be resolved with later design stages for dualling.

Operational characteristics

The strategies identified in the Study ranged from one based on expansion of highway capacity to one involving minimum highway construction. These strategies are reflected in the consultation Options B, and C respectively, with Option A representing an intermediate level of highway construction within its package of schemes.

The tests on Option packages in the Transport Model indicate a range of future traffic flows. With the exception of Option C all flows are higher than the limit for a Wide Single 2 lane scheme within the 20 year Study horizon. Existing traffic flows exceed the capacity of the A453 in peak hours resulting in incidences of serious delay. They also exceed the WS2 lane capacity.

Road lighting

This was one of the suggestions received for improvement of the existing single carriageway A453, but it has varying applications to each of the schemes.
DTLR standards require roundabouts on major roads to be lit, and that is expected to apply to the Parkway Station access junction. Minor grade separated junctions, such as the one referred to for the Barton junction, do not have to be lit.
Lighting of the main length of the A453 would depend on the night time accident record, which is a matter for more detailed examination subsequent to this Study.

M1 junction 24

A free flow provision with southbound flyover for the A50 – M1 southbound and an additional through lane on the west side of the existing roundabout for the opposite movement.

The GOMMMS Appraisal context

GOMMMS appraisal has been carried out for the single carriageway scheme with grade separation and crawler lanes, and for the dual 2 lane scheme as part of the Option packages. The effects are included at the end of this Working Paper.

Congestion

Congestion is only one of the considerations in GOMMMS (assessed as part of the transport economic efficiency and reliability sub objectives). Treating its elimination as a priority could introduce bias towards the principle of predict and provide. Congestion alone does not constitute a case for rejection of a single carriageway scheme.
It does however, have serious consequences. Apart from the disruption to many aspects of day to day business and living it threatens the ability of the Emergency Services, and results transfer and rat running to other often minor and more vulnerable roads, with environmental and safety consequences. An A453 highway scheme designed to retain present levels of congestion would be an unsatisfactory strategic approach. Constraint of traffic growth is addressed by other schemes in the option packages.

At the strategic assessment level used in GOMMMS the differences between dual and single carriageway, excluding economic performance, are minor. The static impacts of landscape, heritage, etc. vary in correlation to the scale of the road construction, but because the schemes follow the existing alignment, impacts are less significant than a new route.
The differences in the impacts of the road in use: noise, air quality, etc. are mainly dependent on traffic flow and speeds. Differences in more detail are compared at the end of this Working Paper, taking the single 7.3m scheme as the base case.

The Options context

A Wide Single carriageway scheme would be appropriate for the minimum highway strategy Option C. All the other Options would require dual 2 lanes.

The Study is obliged to make firm recommendations covering at least the 20 period to 2021. However, a particular aspect of the minimum highway strategy that has been raised is the role of plan monitor and manage approach. The main aim would be that if major changes in transport trends could take place over the next few years, a flexible approach is needed, and commitments to heavy and long term infrastructure works should not be made too early.

The 7.3m carriageway scheme would be the natural choice to form one half of an ultimate dualling. As a single carriageway it has overwhelming disadvantages as already noted. The Wide Single carriageway scheme also has a disadvantage in that it would be an excessive provision for one half of a dualling, but more significantly it requires widening of the existing bridges in the River Soar area.

The widening could sensibly only be to dual carriageway width, and whilst this would not fully commit to ultimate dualling, the cost and extent of construction of wider road and bridges would tend to compromise future choice.

The dual carriageway scheme has a broad range of capacity, appropriate to all the other Option packages except Option C.

There is a pressing case for solving the safety problems at the earliest opportunity. Most can be dealt with by junction improvement schemes that could be implemented in advance of more major schemes and would be consistent with all the Option packages.

Conclusions

1. A standard 2 lane single carriageway scheme is inadequate for any of the Options under consideration.

2. The Wide single and the dual carriageway schemes each have possible roles in Options.

The main points of the two schemes are summarised as follows:

TABLE 3.1 COMPARISON OF WIDE SINGLE & DUAL 2LANE SCHEMES		
	Wide Single carriageway	**Dual 2 lane carriageway**
Environment	Slight impacts due to limited scale of on line works	Slight to Moderate impacts mainly from increased scale of road
Safety in operation	Would retain some overtaking accidents	All accident causes treated, but overall savings not much better than S2 scheme
Safety in construction and maintenance	Single way working with traffic lights. Occasional closures	Facilitated with lane closures and contraflow. Additional restrictions confined to isolated locations.
Cost	Construction £15 - 18m	Construction £45m
Reliability	Likely to incur large delay costs in construction. Delays also normal in operation except with Option C	Delay costs restricted to construction and maintenance
Options	Appropriate for Option C	Appropriate with Options A, B, D, and E

It is concluded that the single carriageway scheme should be eliminated from further consideration.
Options should include for early implementation of safety schemes.

Assessment of accidents

1. Basic injury accident records from Notts and Leics CC
2. Extracted for links and junctions for primary analysis.
3. Notts: 5 year period 1996 – 2000
4. Leics: 6 year period 1996-2001. 5 year equivalent in brackets
5. Severity: Slight except where shown

TABLE 3.2 A453 M1 – CLIFTON ACCIDENTS				
LOCATION	LINK OR JUNCTION	ACCIDENT NUMBERS	SEVERITY	PED/CYCLE CASUALTIES
J24	J	25 (20.8)	4 SERIOUS	
M1 – County Boundary	L	22 (18.33)	2 SERIOUS 1 FATAL	
County Boundary – Ratcliffe jnct	L	6	1 SERIOUS	
Ratcliffe junction	J	9	1 SERIOUS	
Ratcliffe jn. To Power Stn. Access	L	5	1 SERIOUS	
Power Station access	J	1	1 FATAL	
Power Stn. To Thrumpton-Gotham GSJ	L	2		
Thrumpton-Gotham GSJ	J	2		
Thrumpton-Gotham GSJ to Thrumpton north turn	L	3		
Thrumpton north turn	J	3		
Thrumpton north turn to Barton cross roads	L	8	1 SERIOUS	
Barton cross roads	J	23	3 SERIOUS I FATAL	
Barton cross roads to Crusader	L	16	7 SERIOUS	
Crusader Rbt.	J	9		
Crusader to Green Lane	L	7		
Green Lane	J	4	2 SERIOUS	1 PED SE
Green Lane to NTUsouth	L	7	2 SERIOUS	2 PED SE
NTU south	J	2		
NTU south to NTU north	L	5	3 SERIOUS 1 FATAL	1 PED SE 1 PED FA
NTU north	J	3	1 SERIOUS	1 PED SE
NTU north to Farnb./Fabis Dr.	L	13	3 SERIOUS	
F/F Dr junction	J	20	6 SERIOUS	
F/F Dr. to Silverdale Rbt	L	6	3 SERIOUS	1 PED SE
Silverdale Rbt.	J	5	3 SERIOUS	

Consideration of accident records

Notable features:

M1 Junction 24

- 9 accidents, 4 of them involving serious injury, were all of the same type: loss of control exiting the roundabout towards Nottingham.

- 10 accidents were shunts in queuing on approach to the roundabout mostly from Nottingham.

M1 to Notts. County Boundary

- 6 accidents were shunts, miscellaneous or resulting from turns into minor side accesses.

- 3 accidents were at roadworks, one of which was fatal (none involved site staff).

Barton Cross Roads

- 23 accidents of which one was fatal and 3 serious.

Barton Cross Roads to South of Crusader Roundabout

- 16 miscellaneous accidents of which 7 were serious.

All of the above except for miscellaneous shunts and accidents at roadworks and could be resolved by improvements equally applicable to single or dual carriageway schemes.

The miscellaneous shunts and accidents at roadworks are most likely caused by very heavy traffic conditions, poor forward visibility mainly due to queuing, but possibly aggravated by the horizontal alignment on the Leicestershire section, and driver frustration. A dual scheme should be superior to single carriageway schemes, but the differences are not as great as might be expected.

An estimate of the difference in forecast future accidents can be made based on:

- Statistical rates for the A453 improvement schemes
- Accident rates for traffic prevented by the limited capacity of the single carriageway scheme from using the A453 uses either A52 (west of Nottingham), displaced onto A60, A606, or the minor roads along the A453 corridor.

(The Transport Model indicates that traffic displaced from the A453 does indeed use these roads)

The Urban section from Crusader Roundabout through Clifton is not included here, as it is not part of the case for a single or dual carriageway scheme between M1 and Clifton.

TABLE 3.3: COMPARISON OF SINGLE AND DUAL C'WAY SCHEMES FOR A453 M1 – CLIFTON (APPRAISAL SUMMARY TABLE BASED)		
GOMMMS Sub objective	**Single C'way scheme 10m + 1m strips with some grade separated junctions and crawler lanes**	**Dual 2 lane c'way scheme with grade separated junctions**
Noise	The main appraisals have been for whole Options. The differences between these two schemes are minor	
Local Air quality		
Greenhouse gases		
Landscape	Slight Adverse	Slight Adverse
Townscape	N/A	N/A
Heritage of historic resources	Negligible impact	Negligible impact
Biodiversity	Negligible impact	Slight Adverse
Water Environment	Slight Adverse	Slight Adverse
Journey Ambience	Moderate benefit	Moderate benefit
Accidents	See separate safety analysis	
Transport Economic Efficiency	See following paragraphs	
Reliability		
Severance	Differences between the schemes are minor	
Land use policy	Negligible effect	Minor Adverse
Other Government Policies	Neutral effect	Neutral effect

Note: the table is based on the GOMMMS Appraisal Summary table, excluding headings where the effects are minor or negligible and would be rated the same for each scheme.

TABLE 3.4 NOISE AND EXHAUST EMISSIONS COMPARISONS (Summarised data extracted from DMRB) taking 75kph as a baseline.

Scheme	Average Speed cars + 10% Heavy Vehs. (kph)	Noise dB(A)	NOx	PM10	CO2
Single 7.3m +HSs	75	0	0	0	0
Single 10m + HSs	80	+0.4	+9%	+1%	+2%
Dual 2 lane +HSs	95	+1.7	+20%	+3%	+12%