APPENDIX A3.3

NEED FOR THE SCHEME & ALTERNATIVES

M7 OSBERSTOWN INTERCHANGE & R407 SALLINS BYPASS – INCREMENTAL ANALYSIS REPORT

Kildare County Council

M7 Osberstown Interchange & R407 Sallins Bypass

Incremental Assessment of Cross-section & Interchange

REP/08

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1 Introduction

After selection of the emerging preferred route for the M7 Osberstown Interchange and the R407 Sallins Bypass, the next fundamental decisions are the choice of carriageway cross-section for the R407 Sallins Bypass and the form of the interchange on the M7. This report has been prepared to determine the most appropriate carriageway cross-section for the proposed R407 Sallins Bypass and the form of the interchange on the M7.

Guidance on the approach to the selection of the appropriate cross-section and form of junction is given in TA 30/82 *"Choice between Options for Trunk Road Schemes"* of the UK Design Manual for Roads and Bridges and has been used in this comparison assessment. The method takes a holistic approach to the decision making process and does not rely solely on compliance with design standards. This is to say that the cross-section has not been chosen purely on Road Capacity as defined in TD 9/12 of the NRA Design Manual for Roads and Bridges (DMRB). Economic criteria, as generated by COBA, are also used in the assessment. These economic criteria are included in an assessment framework with other policy and environmental criteria to ensure a more complete assessment.

The R407 Sallins Bypass is approximately 3km in length with one intermediate junction along its length and two junctions at the termini. These junctions have been identified as nodes and three scenarios have been developed with variations in the cross-section between these nodes.

2 Background

2.1 R407 Sallins Bypass

The proposed R407 Sallins Bypass has gone through Phase 1 'Scheme Concept & Feasibility' and Phase 2 'Route Selection' of the 2010 project Management Guidelines. Fehily Timoney Gifford Ltd. (FTG) was responsible for the development of these phases initially in 2008 and 2009 when the R407 Sallins Bypass was considered as a stand-alone project.

At the commencement of Phase 3 'Design' of the combined project M7 Interchange and R407 Sallins Bypass, Arup reviewed the earlier work completed by FTG, which had confirmed a preferred corridor to the west of Sallins for the Bypass. The review undertaken by Arup confirms the recommendations of the original FTG study. Furthermore, Arup reviewed any additional route options which arose as a result of combining the M7 interchange with the Sallins Bypass. Arup prepared a supplemental route options report, REP/04, which examined the route corridor options and developed an emerging preferred route for the combined M7 Interchange and R407 Sallins Bypass scheme.

2.2 M7 Osberstown Interchange

The M7 Osberstown Interchange has gone through Phases 1, 2, 3 and 4 of the 2010 project Management Guidelines as a stand-alone project. Arup was responsible for the development of these four phases between 2008 and 2010.

As part of Phase 4, Arup prepared and lodged an EIS to An Bord Pleanála with the Motorway Order Application in November 2008. In March 2010, An Bord Pleanála refused permission for the M7 Osberstown Interchange scheme indicating that '*in terms of road and transportation planning, there is a very strong connection between the motorway interchange and the R407 Sallins By-pass and the Board has come to the view that both projects should be considered together for the purposes of environmental impact assessment and that it would be premature to determine the instant applications in advance of, or separately from, the determination of a route and design of the R407 Sallins By-pass'*.

Therefore, the direction of ABP in respect of the M7 Osberstown Interchange is that it cannot be considered in isolation but that it should be considered in conjunction with the Sallins Bypass**.**

At the commencement of Phase 3 'Design' of the combined project M7 Interchange and R407 Sallins Bypass, Arup reviewed their earlier work and reviewed any additional interchange location options which arose as a result of combining the M7 interchange with the Sallins Bypass. Arup prepared a supplemental route options report, REP/04, which examined both the original interchange locations and the additional potentially feasible interchange locations in conjunction with the R407 Sallins Bypass. Arup subsequently developed the emerging preferred interchange location in conjunction with the emerging preferred route for the R407 Sallins Bypass.

2.3 Combined M7 Osberstown Interchange and R407 Sallins Bypass Phase 3 & 4

Both the R407 Sallins Bypass and the M7 Osberstown Interchange had been through route corridor option assessment as separate projects independently of each other previously.

As Arup is currently preparing Phase 3 'Design' and Phase 4 'EIA/EAR & the Statutory Processes' of the combined M7 Osberstown Interchange and R407 Sallins Bypass, the first task completed by Arup was a review of the route corridors of the stand-alone projects together with any new additional route options which arose as a result of the combination of the projects. Arup then developed an emerging preferred route for the overall combined project, which was subsequently approved by Steering Committee.

The next task is to determine the cross-section of the Sallins Bypass and the form of the M7 interchange.

3 Cost Benefit Appraisal

3.1 Cross-section Assessment

A cost-benefit assessment was carried out using the COBA 11 Program (Release 15, Republic of Ireland, TRL) to assess the economic benefits of each Do-Something scenario (that is, with Sallins Bypass) in terms of travel and accident benefits, when compared to the Do-Minimum scenario (that is, the existing road network with committed schemes).

The Do-Minimum scenario for the M7 Osberstown Interchange and R407 Sallins Bypass Scheme includes the following committed development:

- M7 Widening;
- Newhall Interchange upgrade, and
- Sallins Road Roundabout upgrade at the junction of the existing R407 and the Western Distributor Road.

Testing was carried out to establish the effect of the upgrade of the Sallins Road Roundabout on the traffic volumes on the Sallins Bypass. The results showed that traffic volumes will increase by 3% on the Sallins Bypass if the upgrade is not implemented due to the resultant delay at the Sallins Road Roundabout. However, a sensitivity test on the COBA analysis does not detect any significant change as a result of a 3% projected change in traffic volumes on the Sallins Bypass. Therefore, it will not affect the cross-section decision framework and it is not considered further in this report.

The COBA analysis has been undertaken in accordance with the NRA Project Appraisal Guidelines (July 2011, Unit 6.1: Guidance on Conducting COBA).

Particular aspects of the COBA analysis approach are outlined below:

- The benefits incorporated in the cost benefit analysis include travel time savings to road based transport, as well as changes in vehicle operating costs and accidents.
- The costs take account of the capital cost of providing the infrastructure.
- An appraisal period of 30 years was adopted with the costs and benefits discounted to 2009 prices within the COBA program based on a discount rate of 4%.
- On the basis of infrastructure having a long life, the residual value calculation for infrastructure is based on further 30 years beyond 30 year appraisal period.
- The COBA model considers two sets of demand flows i.e. the opening year (2015) and the interim year 2030 as obtained from the strategic model. The inclusion of 2030 demand flows gives a more realistic representation of the actual situation as it addressed the fact that there is a significant amount of reassignment of traffic in the years from 2015 to 2030.

3.2 Junction Option Assessment

A cost-benefit type assessment was also carried out using the COBA 11 Program (Release 15, Republic of Ireland, TRL) to assess the economic benefits of the different forms of junction available. However, the COBA programme had limitations, and the differences between the junction choices were too fine to be distinguishable in terms of COBA user benefits. The results were not reliable and did not inform the choice of junction and therefore the COBA assessment was not used for the choice of junction.

Therefore, a micro simulation model is developed using VISSUM to access the preferred junction options and modelling results as obtained from VISSUM for journey time and mean max queue are included in the assessment framework.

4 Cross-section Assessment

4.1 Cross-section Scenarios

Three potential junctions have been identified on the proposed Sallins Bypass as follows:

- M7 Osberstown Interchange at the southern terminus;
- Sallins Link Road at-grade roundabout; and,
- R407 Clane Road at-grade roundabout at the northern terminus.

Using these three junctions as nodes, two links have been identified on the proposed Sallins Bypass for the cross-section assessment as follows:

- Link 1 – M7 Osberstown Interchange to Sallins Link Road at-grade roundabout; and,
- Link 2 – Sallins Link Road at-grade roundabout to R407 Clane Road at-grade roundabout.

The links and junctions are shown on Figure 1 in Appendix A. Three scenarios are assessed as part of the cross-section assessment. Each scenario has a different combination of cross-section types for Links 1 and 2 identified above.

The two cross-section types being used are Type 1 Single Carriageway (S2) and Type 2 Dual Carriageway (D2AP). These cross-sections were initially selected as the traffic volumes were estimated to lie in the capacity range of these cross-sections, as detailed in Table 6/1 of TD 9/12 of the NRA DMRB.

The cross-sections are indicated in figure 4.1 and 4.2 below.

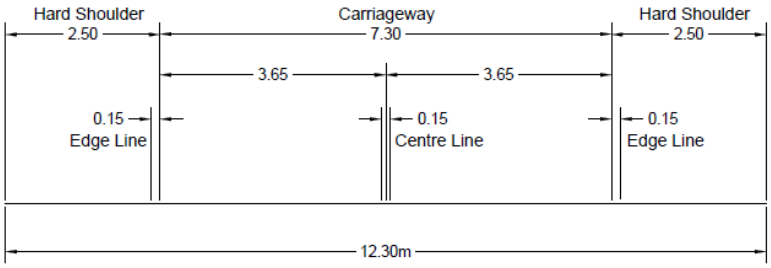

Figure 4.1 Type 1 Single Carriageway (S2) Cross-section

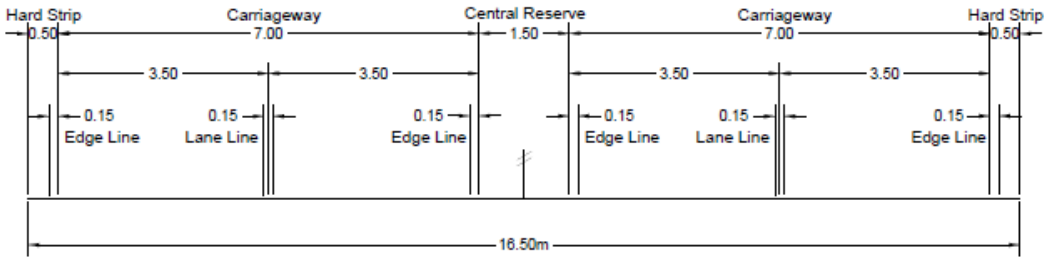

Figure 4.2 Type 2 Dual Carriageway (D2AP) Cross-section

The 3 scenarios are as shown in Table 4.1 below. Traffic models have been built for all 3 scenarios which have been interrogated to produce traffic flows for input into the COBA software. The speed limit has been taken as 80km/h and all classes of traffic are catered for in the three scenarios.

	Link 1	Link 2
Scenario 1	S2	S2
Scenario 2	D2AP	S2
Scenario 3	D2AP	D2AP

Table 4.1 Cross-section Assessment Scenarios

4.2 Cross-section Scenario Costs

Preliminary construction costs have been calculated for each scenario as shown in Table 4.2, which includes the construction of Clane Road at-grade roundabout, Sallins Link Road, Sallins Link Road at-grade roundabout, and the proposed M7 Osberstown Interchange as a rotary interchange.

Scenario	Length of S2	Length of D2AP	Total Construction Cost (€M incl. VAT)
Scenario 1	3.64	0	28.62
Scenario 2	1.9	1.74	29.72
Scenario 3	0	3.64	31.42

Table 4.2 Construction Costs for Each Scenario

The construction costs were then expanded to estimate the Preliminary Scheme Cost for each scenario to include planning and design, archaeology, land and property costs and contract supervision as shown in Table 4.3. These Preliminary Scheme Costs, inclusive of VAT but excluding inflation and programme risk, were used for the COBA assessment.

Scenario	Total Cost incl. Archaeology, Land, Planning & Design, Contract Supervision (€M incl. VAT)
Scenario 1	43.36
Scenario 2	45.03
Scenario 3	47.60

Table 4.3 Preliminary Scheme Costs for Each Scenario

4.3 Impact of Scenarios on Occupiers

Another criterion of the assessment framework is the impact on occupiers. The differentiating factor in the three scenarios is the carriageway width only as all three scenarios have the same vertical and horizontal alignment and the same

junction form and location. Therefore, the major differentiating impact on occupiers relates to landtake.

The total amount of land to be acquired for Scenario 3, i.e. D2AP throughout, has been calculated at 49.67ha using a draft preliminary design for the proposed Sallins Bypass and associated works. There are no extra properties demolished in any particular scenario; therefore, only the landtake is used in the assessment of the impact on the occupiers.

The average cross-section width of Scenarios 1 and 2 is less than Scenario 3; therefore, the amount of land to be acquired for Scenarios 1 and 2 should be proportionally smaller based on the proportionality of the cross-section width. The areas of land to be acquired for each scenario are shown in Table 4.4 below.

Scenario	Cross-section Width (m)	Difference in Width (m)	Length of Varied Section (km)	Reduction in Area (Ha)	Total Area to be Acquired (Ha)
Scenario 1	12.3	4.2	3.64	1.53	48.14
Scenario 2	12.3 16.5	4.2 0.0	1.9 0.0	0.80 0.00	48.87
Scenario 3	16.5	0.0	0.0	0.00	49.67

Table 4.4 Total Landtake for Each Scenario

4.4 Cross-section Assessment Framework

The scenarios are assessed against each other as set out in Table 4.5.

	Scenario 1			Scenario 2			Scenario 3		
	Low Growth	**Medium Growth**	**High Growth**	**Low Growth**	**Medium Growth**	**High Growth**	**Low Growth**	**Medium Growth**	**High Growth**
User Cost Savings (€M) (summation of Link Costs, VOT and VOC)	443.4	484.7	627.2	449.4	491.1	635.7	449.6	491.3	636.2
Accident Savings (€M)	1.31	1.38	1.57	4.99	5.17	5.88	8.52	8.81	10.01
Conditions experienced by Drivers	Sparse overtaking opportunities, particularly in peak periods, along full length of bypass.			Sparse overtaking opportunities, particularly in peak periods, along 1.9km of single carriageway.			High standard at all times.		
Route Consistency	Significant change in cross-section once depart motorway and enter a single carriageway on the proposed Sallins Bypass.			Gradual change in cross-section to reflect changing traffic volumes with step down from dual to single carriageway at tie-in to Sallins Link Road.			Significant change at tie-in to existing R407 as dual carriageway meets single carriageway with 60km/h posted speed limit at northern tie-in.		
Number of accidents saved on network over 30 years	151	156	176.0	182	188	213	212	220	249
- Fatal	-	-	-	3	4	4	7	7	8
- Serious	5	6	5	18	19	21	31	32	37
- Minor	313	323	358	428	443	499	539	559	635
Total	**318**	**329**	**363**	**449**	**466**	**524**	**577**	**598**	**680**
Residential number of properties within 300m subject to increased visual impact	The road centreline location remains constant for each scenario. The road cross-section varies by a maximum of 4.2m between scenarios for the different links. The additional 4.2m width does not impact additional new landowners or additional dwellings. Therefore, the number of properties within 300m subject to increased visual impact is the same for each scenario.								
Number of properties requiring acquisition	1			1			1		
Agricultural land acquisition necessary (ha)	48.14			48.87			49.67		
Local Area Plan Compliance	All scenarios are equally compliant with Sallins Local Area Plan which has an objective to develop the bypass of Sallins Town.								
PVC: Total Discounted Scheme Budget Cost	42.65			44.75			47.75		
PVB: Quantified Monetary Benefits (including Residual Value Benefits)	528.58	582.71	764.81	539.58	594.28	779.43	545.03	599.95	786.47
NPV (Net Present Value	**485.93**	**540.06**	**722.15**	**494.82**	**549.53**	**734.68**	**497.28**	**552.20**	**738.7**
CBR (Cost Benefit Ratio)	**12.39**	**13.66**	**17.93**	**12.06**	**13.28**	**17.42**	**11.41**	**12.56**	**16.47**

Table 4.5 Scenario Assessment

4.5 Incremental Assessment of Cross-section

The scenarios are compared in pairs starting with Scenario 1 which comprises the single carriageway cross-section over the full length of the Sallins Bypass and the comparison moves ahead then to the subsequent scenarios in incremental steps.

All the scenarios are equal in terms of user cost savings as this is linked to the speed of vehicles on the proposed carriageway. As the design speed for both the single and dual carriageway is 85 with a posted speed limit of 80km/h, the user cost savings does not become a differentiating factor across the scenarios.

4.5.1 Scenario 1 compared with Scenario 2

- Scenario 2 is preferable to Scenario 1 in terms of accidents saved and casualties saved.
- Scenario 2 is preferable to Scenario 1 in terms of the driver experience as the dual carriageway section on Link 1 offers a smoother drive without restrictions due to slow vehicles. The dual carriageway leading into the M7 Interchange also facilitates the heavier traffic movements in the vicinity of the interchange by utilising the dual lanes for traffic going/coming from opposite directions.
- Scenario 1 is preferable to Scenario 2 as involves a lesser landtake.
- Scenario 1 is cheaper than Scenario 2. However, Scenario 2 is preferable to Scenario 1 in terms of the greater increase in the net present value. Therefore, for the additional spend of €2M approx. in construction costs, there is an increase in the net present value of €9M for the low and medium growths.
- There is a significant improvement in the net present value between Scenario 1 and Scenario 2.
- In consideration of all of the above, Scenario 2 is carried forward.

4.5.2 Scenario 2 compared with Scenario 3

- Scenario 3 is preferable to Scenario 2 in terms of accidents saved and casualties saved.
- Scenario 3 is preferable to Scenario 2 in terms of the driver experience as the dual carriageway section over the entire bypass offers a smoother drive without restrictions due to slow vehicles. However, there will be a very significant change for drivers once they leave the bypass and re-join the R407, which is a single carriageway north to Clane with a posted speed limit of 60km/h.
- Scenario 2 is preferable to Scenario 3 as involves a lesser landtake.
- Scenario 2 is cheaper than Scenario 3 by €3M approx. Whilst Scenario 3 shows an increase in the net present value over Scenario 2, the increase is slightly less than the increase in construction costs in both the low and medium growth scenarios.
- As the increase in construction costs exceeds the increase in net present value when moving from Scenario 2 to Scenario 3 in both the low and

medium growth scenarios, the justification for spending the additional money to deliver Scenario 3 would have to rely on other factors.

- Looking across the range of criterion considered, there is not another overwhelming factor which would justify the additional spend to advance to Scenario 3.
- In consideration of all of the above, Scenario 2 is carried forward.

4.6 Conclusions

- The present value of costs (PVC) increases as you move from Scenario 1 (all single carriageway) to Scenario 3 (all dual carriageway), with a €5.5M increase in costs for Scenario 3 over Scenario 1.
- The present value of benefits (PVB) also increases as you move from Scenario 1 to Scenario 3. However, the increase when moving from Scenario 1 to Scenario 2 is very significant, five-fold, when compared with the increase in the value of costs when moving from Scenario 1 to Scenario 2, whereas the increase in value of benefits is of the same order of magnitude as the increase in value of costs when moving from Scenario 2 to Scenario 3.
- There is strong justification for moving from Scenario 1 (all single carriageway) to Scenario 2 (dual carriageway to Sallins Link Road with single carriageway to the northern tie-in).
- There is not as strong a justification to incur further spend and move to Scenario 3 and therefore, the additional spend is not recommended.

4.7 Recommendations

Scenario 2 (dual carriageway to Sallins Link Road with single carriageway to the northern tie-in) is recommended.

5 Junction Assessment

5.1 Junction Options

Three potential junction options have been identified for the proposed junction of the M7 and the R407 Sallins Bypass as follows:

- Option 1: Dumbbell Interchange;
- Option 2: Rotary Interchange, and
- Option 3: Dumbbell Interchange with Partial Signalisation

The options considered have also taken cognisance of the proposed M7 Widening Scheme and the proposed upgrading of the M7 Newhall Interchange in terms of traffic demand and impacts.

5.2 Junction Option Costs

Preliminary construction costs have been calculated for a dumbbell interchange in place of a rotary interchange.

The Preliminary Scheme Cost for each junction option, including the cost of the Sallins Bypass as per Scenario 2, to include planning and design, archaeology, land and property costs and contract supervision as shown in Table 5.1. These Preliminary Scheme Costs are inclusive of VAT but excluding inflation and programme risk.

Junction Option	Junction Form	Total Cost incl. Archaeology, Land, Planning & Design, Contract Supervision (€M incl. VAT)
Option 1	Dumbbell Interchange	42.65
Option 2	Rotary Interchange	45.03

Table 5.1 Preliminary Scheme Costs for Each Junction Option

5.3 Impact of Junction Options on Road Users

One of the main differences between the junction options which will be obvious to drivers will be average journey time and speeds and the traffic model was used to assess these issues. The VISSIM modelling of Dumbbell Interchange demonstrates that the Dumbbell design (northern roundabout) will have operational capacity issues (with 2030 AM peak flows) corresponding to 'High' growth scenario.

For comparison of the interchange design options, three sections are evaluated for journey time and mean max queues (in vehicles every 5 min) for AM peak hour. In addition, an interim option is also tested with Dumbbell design and signalising the M7 Off –slip and Sallins Bypass approach to the dumbbell interchange.

For the purpose of this assessment, the comparison between the average journey times for the different junction options for 2030 AM peak flows corresponding to 'High' growth scenario are outlined in Table 5.2 below.

AM Peak Hour		**Option 1 (Dumbbell)**		**Option 2 (Rotary)**		**Option 3 (Dumbbell - partially signalised)**	
Journey Time sections	Distance (km)	Average Journey Time (min)	Speed (km/h)	Average Journey Time (min)	Speed (km/h)	Average Journey Time (min)	Speed (km/h)
Sallins Bypass to Millennium Park Roundabout	0.98	4.32	13.67	1.51	39.0	1.65	34.57
Sallins Bypass to M7 (towards Cork)	1.77	5.76	18.37	1.91	55.44	2.22	48.21
M7 from Cork to Millennium Park Roundabout	1.48	1.94	45.76	1.48	42.12	2.17	41.87

Table 5.2 Average Journey Times for Each Junction Option

The differences between the mean max queues (in vehicles) for 2030 AM peak flows experienced on the approaches for the different junction options are outlined in Table 5.3 below.

AM Peak Hour	**Mean Max Queue (in vehicles)**		
Journey Time sections	Option 1 (Dumbbell)	Option 2 (Rotary)	Option 3 (Dumbbell - partially signalised)
Sallins Bypass	48	6	10
M7 Northbound Off Ramp	4	10	5
Bridge from Millennium Park	1	0	8

Table 5.3 Mean Max Queue (in vehicles) for Each Junction Option

There is very little difference in terms of landtake for the different junction layouts and this will not be a deciding factor in the assessment framework.

5.4 Comparison of Junction Design Options

The junction options are assessed against each other and compared below.

- Option 2 (Rotary) is preferable to Option 1(Dumbbell) in terms of Journey Time Savings and Queues on the Sallins Bypass approach at northern roundabout.
- Option 2 is costlier than Option 1 by over €2M and involves spending of entire cost upfront in the opening year.
- With improvement of Option 1 (i.e. Option 3 with partial signalisation of northern roundabout), there is no significant worsening of Speeds (decrease by around 4kph), Journey Time (loss of around 8 sec) and increase in Mean Max Queue (by around 4 vehicles) at Sallins Bypass approach.
- Option 3 is preferable to Option 2, as signals will facilitate a more equal priority to the traffic coming from Sallins Bypass, M7 Off-Slip and Millennium Park.
- Option 3 gives the flexibility to implement signals beyond 2020 depending upon the future traffic demand. For the purpose of this assessment, the VISSIM modelling is based on the 'High' growth scenario, whereby forecasted traffic demand on Sallins Bypass might not be achieved.
- In consideration of all of the above, Option 1 is carried forward in the short term and Option 3 in the long term.

5.5 Conclusions

- Option 2 is preferable to Option 1 in terms of Journey Time Savings and Queues on the Sallins Bypass approach at northern roundabout. However, with introduction of signals at northern roundabout in future (i.e. Option 3), it significantly improves the operational capacity of the roundabout.
- There is not a strong a justification to incur additional spend to provide Option 2 in the opening year, when there is a reasonable solution to address operational capacity issues if they occur in the future due to an increase in traffic demand. If the high grow does not materialise, then Option 1 as provided at year of opening will meet traffic demand up to design year.

5.6 Recommendations

Option 1 (Dumbbell) is recommended as the preferred interchange option. Further, with increase in forecasted traffic demand; it is proposed to introduce partial signals at the northern roundabout (i.e. Option 3) as and when required.