3. Description of Scheme Options

3.1 Description of Options

Do Minimum

3.1.1 The works considered as part of the Do-Minimum scenario are:

- Pavement Resurfacing
- Pavement Reconstruction
- Improvements to traffic signs and road markings within the study area
- Traffic signals at Smithston Bridge

3.1.2 A separate study was carried out to look at the apparent accident cluster at Smithston Bridge (refer to Section 2 above for accident summary). This explored various options to build a new structure and/or separate the northbound and southbound carriageway. However, these were all considered to be stand-alone schemes rather than being part of the Do Minimum for the purposes of this scheme assessment. Possible improvement of traffic signs and road markings was not thought likely to result in a noticeable improvement to safety in the vicinity. Therefore it was decided that the provision of traffic signals at Smithston Bridge should be included within the Do Minimum.

Blue Route

3.1.3 The Blue Route corridor is located to the north-west of Maybole as indicated on Drawing Number 5028091/P/20/01/BLUE, Appendix A and is described in the following paragraphs.

3.1.4 At approximately 5.4km in length, the Blue Route ties into the existing A77 southwest of Maybole by means of a new 60m Inscribed Circle Diameter (ICD) roundabout, Broomknowes Roundabout. From here the route climbs steeply, maximum gradient 6%, up the southwest flank of Gallow Hill where it passes between the summit and the nearby caravan park.

3.1.5 A 720m radius right hand bend swings the route under the B7023 on a gentle uphill grade before it continues in a north easterly direction to the south of the property East Enoch. There is then a 720m radius left hand bend and the route crosses Gardenrose Path and the un-named side road that connects the B7023 and B7024.

3.1.6 The route then passes between St Murray's Plantation and Brockloch Burn in an easterly direction and passes under the B7024 on a downhill gradient of 2% before continuing across agricultural land south of the property 'St Murray'.

3.1.7 A 720m radius left hand curve swings the route to a generally northwards direction where it runs parallel to the Glasgow/Stranraer railway line for a short length before tying in to the existing A77 by means of a 60m ICD roundabout, Smithston Roundabout, approximately 400m north of Smithston Bridge.

Red Route

3.1.8 The Red Route corridor is located to the north-west of Maybole as indicated on Drawing Number 5028091/P/20/01/RED, Appendix A and is described in the following paragraphs.

3.1.9 At approximately 5.3km in length, the Red Route ties into the existing A77 southwest of Maybole by means of a new 60m ICD roundabout, Broomknowes Roundabout. From here the route follows the general line of the Blue Route climbing steeply, maximum gradient 6%, up the southwest flank of Gallow Hill and passing between the summit and the nearby caravan park.

3.1.10 The route then continues on a 720m radius right hand curve, crossing the B7023 and passing to the south of the property 'East Enoch' before crossing Gardenrose Path on a straight approximately 180m north of the developed extent of the town. This straight continues in a generally eastwards direction and the route crosses Kirklandhill Path on a downhill gradient of ~2% approximately 90m south of the access to 'Kirklandhill'.

3.1.11 Continuing on the straight in an eastwardly direction, the route then crosses the B7024 Alloway Road, approximately 30m north of the junction with Lovers Lane and then turns on a 720m radius left-hand curve where it runs north-east parallel to the Glasgow – Stranraer rail line, before tying into the existing A77 by means of a 60m ICD roundabout, Smithston Roundabout, approximately 400m north of Smithston Bridge.

Yellow Route

3.1.12 The Yellow Route corridor is located to the north-west of Maybole as indicated on Drawing Number 5028091/P/20/01/YELLOW, Appendix A and is described in the following paragraphs.

3.1.13 At approximately 5.2km in length, the Yellow Route ties into the existing A77 southwest of Maybole by means of a new 60m ICD roundabout, Broomknowes Roundabout. From here the route climbs steeply, maximum gradient 6 %, up the south flank of Gallow Hill, where it passes to the east of the summit close to the urban fringe of Maybole.

3.1.14 The route then crosses the B7023 before turning on a 720m radius right hand curve and crosses Gardenrose Path approximately 150 metres from the extents of the developed land.

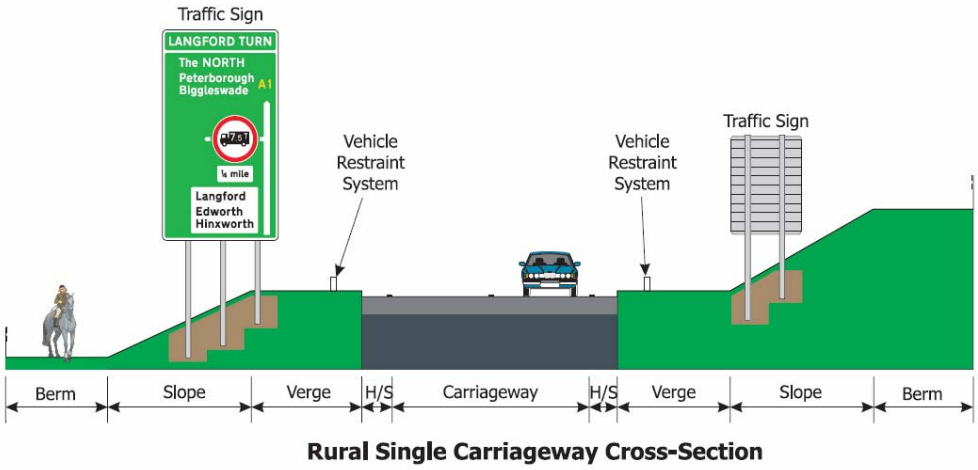
3.1.15 Continuing on a straight, the route passes to the south of the property of Kirklandhill, approximately 130m from the properties on Kilhenzie View and Ashgrove Avenue. From here the route then closely follows that of the Red route to continue to the north of the Stranraer/Glasgow railway line before tying before tying into the existing A77 by means of a 60m ICD roundabout, Smithston Roundabout, approximately 400m north of Smithston Bridge.

3.2 Carriageway Provision

Single Carriageway (S2)

3.2.1 Each of the route corridors has been designed with the carriageway cross-section for a Rural Single Carriageway as set out in TD27 – Carriageway Cross Sections, as shown below in Fig 3.1.

Figure 3.1 – Standard Rural S2 Carriageway Cross-Section



3.2.2 Due to the topography at the proposed tie-ins to the A77, the vertical geometry of the routes is such that each requires additional climbing lanes. This is limited to 1 no climbing lane northbound from the southern tie in for all routes, 1 no climbing lane southbound from the northern tie in for the Blue and Red routes and 2 no southbound climbing lanes for the Yellow route. These climbing lanes are provided where the gradient exceeds 2% for lengths greater than 500m, as prescribed in TD9.

Wide Single Carriageway (WS2)

3.2.3 As part of the Stage 1 Bypass Route Options Assessment, 10m wide, WS2 carriageway was identified as a potential carriageway provision for the routes and was considered within the general scope of the Stage 1 Assessment.

3.2.4 As identified in the Stage 1 Assessment, the topography to the north of Maybole is one of the primary constraints on both route choice and alignment geometry. To provide clearly identifiable Overtaking Sections for either direction of travel as set out in TD9 of the DMRB, desirable minimum values for following criteria must be provided for Overtaking Sections on WS2 roads:

- Full Overtaking Sight Distance (FOSD), Table 3 of TD9
- FOSD Overtaking Crest Value, Table 3 of TD9
- Minimum radius of Straight or nearly Straight sections, Table 5 of TD9

3.2.5 When developing the optimum horizontal and vertical alignments for all routes taken forward to Stage 2 Assessment, it became evident early on that that the above requirements could not be achieved for a design speed of 100A kph over sufficient lengths to provide clear opportunities for overtaking.

3.2.6 The influence of physical constraints, including topography and properties, prohibited developing horizontal geometry sufficient to provide minimum radius of straight or nearly straight sections of road. In addition, verge widening and vertical crest requirements compliant with TD9 were identified as generating extremely high earthworks requirements with cuttings potentially in excess of 20m in some locations.

3.2.7 Stage 1 cost estimates were prepared based solely on the length of route and carriageway width. The added cost of construction, in particular earthworks elements, required to satisfy the criteria for WS2 carriageway for each of the routes would be significantly increased from those provided in the Stage1 Assessment. There may also have been significant environmental impacts associated with such extensive earthworks.

3.2.8 As a result of this, WS2 roads were not progressed further as part of the Stage 2 Assessment.

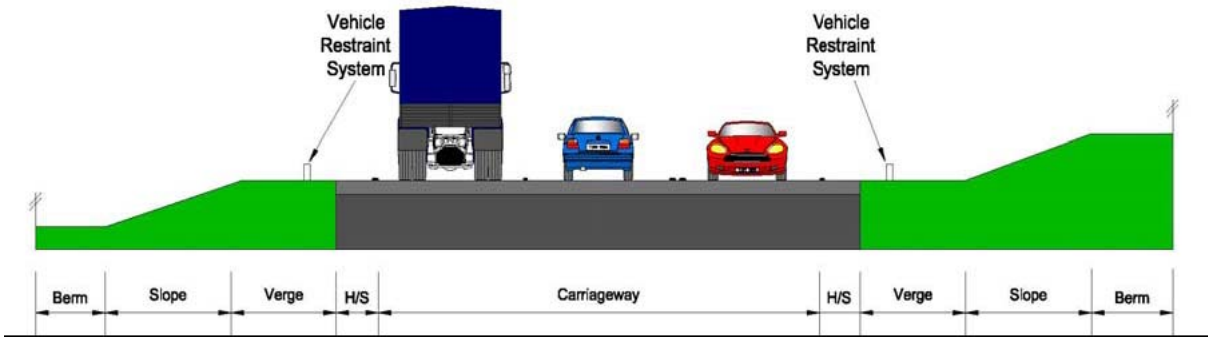
Wide Single Carriageway with Overtaking (WS2+1)

3.2.9 On S2 carriageways significant platoons of traffic can form behind slower moving vehicles. This can lead to driver frustration and attempts at unsafe overtaking. WS2+1 roads provide the opportunity for drivers to overtake safely in designated areas, allowing the platoons of vehicles to disperse over the two lane section.

3.2.10 The length of overtaking opportunity in either direction varies between the routes but has been provided to maximise overtaking opportunity where slower moving vehicles are also negotiating an uphill grade.

3.2.11 Figure 3.2 below shows the typical cross section adopted for WS2+1 carriageway.

Figure 3.2 – Standard WS2+1 Carriageway Cross-Section



Dual Carriageway (D2AP)

3.2.12 As part of the Stage 1 Bypass Route Options Assessment, dual carriageway (D2AP) was identified as a potential carriageway provision for the routes and was considered within the general scope of the Stage 1 Assessment.

3.2.13 The opening year traffic flows indicated that a dual carriageway was a viable option in terms of carriageway provision (refer to DMRB TA 46/97)

3.2.14 An assessment was then carried out which looked at the benefits arising from dual carriageway schemes. The outputs from the Stage 1 traffic modelling were used for this, and they showed that the benefits were slightly greater for D2AP due to the additional guaranteed overtaking opportunities. However, the additional capital cost associated with constructing a dual carriageway rather than a WS2+1 is considerable and resulted in the benefit to cost ratio (BCR) being slightly reduced.

3.2.15 A Value for Money exercise was also carried out to assess how well each option contributes to achieving the scheme objectives. As the journey time benefits were not considerably greater than for the other carriageway options, and again due to the considerable capital cost, this further indicated that the dual carriageway would not provide value for money.

3.2.16 As a result of this, D2AP roads were not progressed further as part of the Stage 2 Assessment.

3.2.17 Whilst it is recognised that there would be no engineering constraints ruling out provision of a D2AP, the recommendation from the Carriageway Provision for DMRB Stage 2 Assessment Report[7] was not to progress with this option through Stage 2.

3.3 Junction Arrangements & Tie-Ins with Existing

Broomknowes & Smithston Roundabouts

3.3.1 New, 60m ICD roundabouts provide the tie-ins to the existing S2 standard A77 at the extents of the bypass.

3.3.2 Due to the steep nature of the existing topography, it is necessary for each of the bypass S2 route options to have additional climbing lane provision at both the southern and northern extents. To simplify this change in carriageway provision, and maximise the overtaking opportunities provided by the climbing lanes, it is considered that roundabouts are the most suitable junction arrangement.

3.3.3 Additional benefits are gained by providing the bypass tie-in to the north of Smithston Bridge, as this removes the majority of through traffic from this accident cluster site and, via the new alignment of the link road to the roundabout, provides improved visibility through the bridge itself.

3.3.4 During initial consultations with South Ayrshire Council, they indicated their desire for a junction with the B7023 Culzean Road. An at-grade, major/minor T-junction solution was submitted to the Standards, Traffic and Environment (STE) section of Transport Scotland at a meeting in November 2006. STE advised that due to the potential safety concerns associated with the conflicting movements at junctions providing right-turn opportunities, Atkins were to eliminate this option and progress designs incorporating a roundabout at this location.

B7023 Roundabout

3.3.5 Options have also been developed for each of the coloured routes which follow the same geometry as described above but which also provide a 70m ICD, 4-arm, at-grade roundabout with the B7023 Culzean Road.

[7] Carriageway Provision Report, Atkins, 2007

3.4 Options Summary

3.4.1 The following table summarises the options that were assessed at this DMRB Stage 2 level, and which are therefore included in this report:

Table 3.1 – Options Summary

Reference Number	Route	Carriageway Provision	Roundabout with B7023
1.1	Blue	S2	No
1.2	Blue	S2	Yes
1.3	Blue	WS2+1	No
1.4	Blue	WS2+1	Yes
2.1	Red	S2	No
2.2	Red	S2	Yes
2.3	Red	WS2+1	No
2.4	Red	WS2+1	Yes
3.1	Yellow	S2	No
3.2	Yellow	S2	Yes
3.3	Yellow	WS2+1	No
3.4	Yellow	WS2+1	Yes

3.5 Cost Estimates

3.5.1 Cost estimates for all route options were prepared using comparable price data. Summary tables for each option are provided below; the full cost estimates are contained in Appendix B.

3.5.2 The main assumptions made when compiling the estimates are listed below:

Table 3.2 – Cost Estimate Assumptions

Category	Description
Safety Fencing	Safety fencing to be provided where embankment height ≥ 6m, where crossing structures/watercourses and on 50m approaches to roundabouts.
Drainage	Filter drains to be provided along full length of scheme. Gullies to be provided at 10m intervals on 50m approaches to roundabouts and around both perimeter and central island.
Earthworks	All excavated material to be available for re-use on site following processing.
Pavements	Pavement construction to be minimum depth required by Transport Scotland (450mm). To be made up of 150mm sub-base, 200mm road base, 60mm binder course and 40mm surface course.
Kerbs	To be provided on 50m approaches to roundabouts and around roundabout perimeter and central island.
Road lighting	Road lighting columns to be provided on 160m approaches to roundabouts at 20m centres.
Structures	Structures costs are based on a rate of £1200 per m^2 of deck area.

3.5.3 The cost estimates do include for a number of mitigation measures as follows:

- An assumed number of accommodation underpasses for each scheme
- Traffic calming through Maybole town centre in order to further discourage through traffic from passing through the town

3.5.4 The cost estimates do not include for any environmental mitigation measures detailed in Section 5 of this report as it felt that these would be incorporated in the construction costs for the particular element, or that they are standard methods of working and would not incur significant costs.

3.5.5 The costs presented below are quoted in 2007 Q1 prices and have been derived from historical tender information. It should be noted that the following tables present figures to the nearest one thousand pounds. The calculations have been carried out separately, on a more accurate basis, and therefore the numbers quoted here may not add accurately to give the total presented.

Do Minimum

Table 3.3 – Do Minimum Cost Estimate Summary

Do Minimum	
Component (£)	**Do Minimum (£)**
Preparation	108,000
Construction	995,000
Contingency	149,000
Land	0
Optimism Bias	551,000
Sub-Total	**1,804,000**
VAT	316,000
Total (incl. VAT)	**2,120,000**

Blue Route Options

Table 3.4 – Blue Route Options Cost Estimate Summary

Blue				
Component (£'000s)	**S2**	**S2+1**	**S2R (with r'bout at B7023)**	**S2+1R (with r'bout at B7023)**
Preparation	1,779	1,900	1,810	2,042
Construction	17,025	18,190	17,322	19,561
Contingency	2,554	2,728	2,598	2,934
Land	137	138	138	144
Optimism Bias (44%)	9,397	10,040	9,562	10,797
Sub-Total	**30,892**	**32,996**	**31,430**	**35,478**
VAT	5,406	5,774	5,500	6,209
Total (incl. VAT)	**36,298**	**38,770**	**36,930**	**41,686**

Red Route Options

Table 3.5 – Red Route Options Cost Estimate Summary

Red				
Component (£'000s)	**S2**	**S2+1**	**S2R (with r'bout at B7023)**	**S2+1R (with r'bout at B7023)**
Preparation	2,008	2,135	1,796	1,925
Construction	19,244	20,462	17,197	18,434
Contingency	2,887	3,069	2,580	2,765
Land	127	133	128	134
Optimism Bias (44%)	10,621	11,293	9,492	10,175
Sub-Total	**34,887**	**37,092**	**31,193**	**33,433**
VAT	6,105	6,491	5,459	5,851
Total (incl. VAT)	**40, 992**	**43,583**	**36,652**	**39,284**

Yellow Route Options

Table 3.6 – Yellow Route Options Cost Estimate Summary

Yellow				
Component (£'000s)	**S2**	**S2+1**	**S2R (with r'bout at B7023)**	**S2+1R (with r'bout at B7023)**
Preparation	1,333	1,412	1,309	1,390
Construction	12,732	13,494	12,500	13,272
Contingency	1,910	2,024	1,875	1,991
Land	113	116	119	122
Optimism Bias (44%)	7,029	7,449	6,901	7,327
Sub-Total	**23,118**	**24,495**	**22,705**	**24,103**
VAT	4,045	4,287	3,973	4,218
Total (incl. VAT)	**27,163**	**28,781**	**26,678**	**28,321**

3.5.6 In order to reflect recent Transport Scotland guidance in the application of Optimism Bias and risk for projects at feasibility stage, it is necessary to report a range of figures to incorporate an allowance for presently unquantified risk. Table 3.6 below shows the range of anticipated out turn costs based on a review of other similar schemes in the Transport Scotland portfolio.

Table 3.6 – Range of Out Turn Costs (excl. VAT)

Route Option	Low End Out Turn Cost (£'000s) (-5%)	Anticipated Out Turn Cost (£'000s) (with OB @ 44%)	High End Out Turn Cost (£'000s) (+25%)
Blue S2	29,347	30,892	38,615
Blue S2+1	31,346	32,996	41,245
Blue S2R	29,859	31,430	39,288
Blue S2+1R	33,704	35,478	44,348
Red S2	33,143	34,887	43,609
Red S2+1	35,237	37,092	46,365
Red S2R	29,633	31,193	38,991
Red S2+1R	31,761	33,433	41,791
Yellow S2	21,962	23,118	28,898
Yellow S2+1	23,270	24,495	30,619
Yellow S2R	21,570	22,705	28,381
Yellow S2+1R	22,898	24,103	30,129
Do Minimum	1,714	1,804	2,255