FRAMEWORK: TRANSPORT SCOTLAND TRANSPORT RESEARCH – REPORT

SRRB – An Assessment of the Geometric Layout of Type A Lay-bys

Prepared for

Transport Scotland

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Document History

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SECTION 1

Introduction and Background

The requirement for this study is rooted within the development of the A9 Dualling Scheme from Perth to Inverness. This important infrastructure project includes a proposal for the provision of 'enhanced lay-bys' which aim to take advantage of key views and connections along the route. The proposal for the 'enhanced lay-bys' expands on the existing Type A lay-by design specified within TD 69/07[1] by incorporating a wider 4 metre segregation island to increase separation from traffic and thereby provide a safe and more comfortable environment for all road users.

Transport Scotland appointed CH2M (now part of Jacobs) in June 2017 to undertake a study for the Scottish Road Research Board (SRRB) with the project title 'An Assessment of the Geometric Layout of Type A Lay-bys'. The purpose of this study is to investigate the implications related to changing the geometry, in particular the layout on both the merge and diverge tapers as a result of increasing the segregation island width.

This report sets out the individual elements of work undertaken. It identifies and summarises design options available to achieve the desired increase in width of the segregation island in order to provide an 'enhanced lay-by'.

The findings should provide benefit not just for the A9 Dualling project, but for lay-by designs on the whole trunk road network.

SECTION 2

Scope of Work

Further to the initial inception meeting and proposal, this report, in line with the identified scope, covers the following key areas.

- A review of selected standards from the Design Manual for Roads and Bridges (DMRB) to identify reasoning and basis of the current Type A lay-by layout
- A literature review of selected international standards to assess any direct comparison between DMRB Type A lay-by design and lay-bys outwith the UK
- Collision data and analysis to identify any potential safety issues with existing lay-by design which may inform geometric assessment of lay-by options
- An assessment of the geometric layout of Type A 'enhanced lay-bys' with differing options for diverge and merge tapers and nose layouts
- Findings, conclusions and recommendations

SECTION 3

A review of DMRB standards

To identify the reasoning and basis behind the current Type A lay-by design parameters, the following standards have been assessed in this study:

- TD 69/07 'The Location and Layout of Lay-bys and Rest Areas'[1]
- TD 22/06 'Layout of Grade Separated Junctions'[2]
- TD 41/95 'Vehicular Access to All-Purpose Trunk Roads'[3]
- TD 42/95 'Geometric Design of Major/Minor Priority Junctions'[4]
- TD 9/93 'Highway Link Design'[5]
- Roads for All: Good Practice Guide for Roads[6]

3.1 TD 69 - The Location and Layout of Lay-bys and Rest Areas – Overview

The DMRB standard for the geometric layout of lay-bys is detailed within TD 69[1]. A Type A lay-by is defined by the incorporation of a segregation island. A Type A with merge taper is required on dual carriageways with speed limit greater than 40mph. For this study, a dual carriageway of design speed 120kph is assumed (in keeping with the A9 situation), and therefore a merge taper, has been incorporated into the design options. The standard segregation island is raised and kerbed, and is 1.8 metres, in accordance with TD 69. It is identified as a safety feature to separate the mainline from the lay-by.

The individual elements of the existing Type A lay-by have been assessed. These are broken down into the following headings.

- Diverge taper and nose
- Central parking area
- Merge taper and nose

The three distinct areas are identified using the current geometric layout as per Figure 3-1.

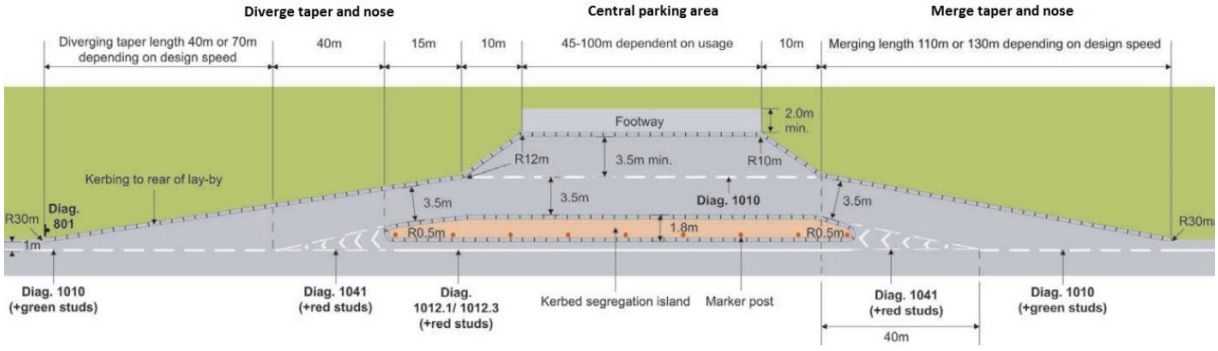


Figure 3-1: ***Extract of Figure 4/2: Geometric Layout of Type A with Merge Taper Lay-by***

3.2 Diverge Taper and Nose

The diverging taper length dimension within TD 69 is 70 metres for a design speed of 120kph. The overall length of diverge to the back of the nose is dimensioned as 110 metres. An additional 15 metres allows the segregation island to become full width prior to the start of the central parking

area. There is no clear explanation within TD 69 as to the reason for the dimensions set out within Figure 3-2 overleaf.

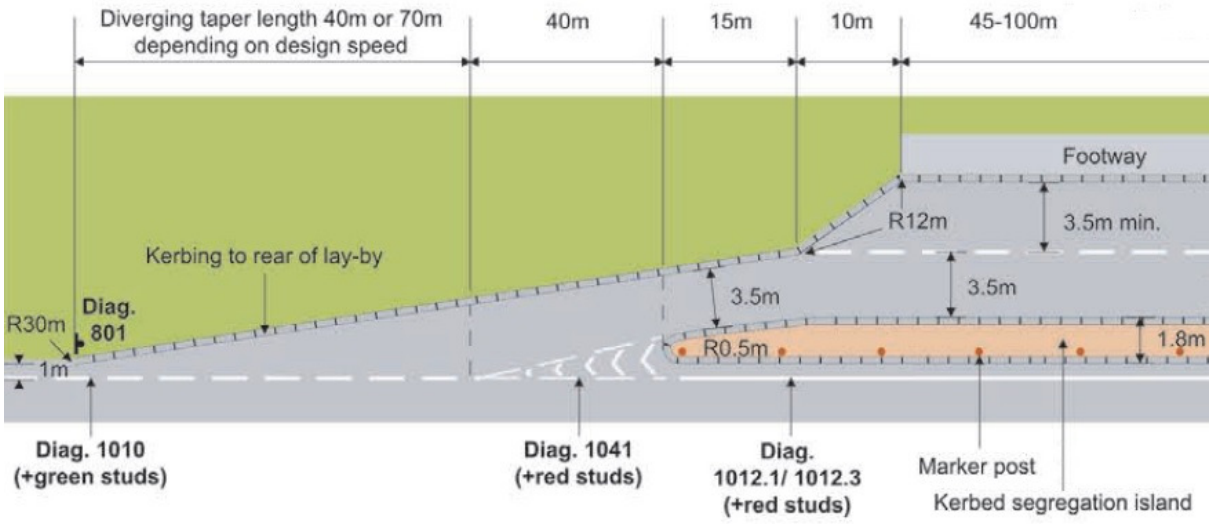
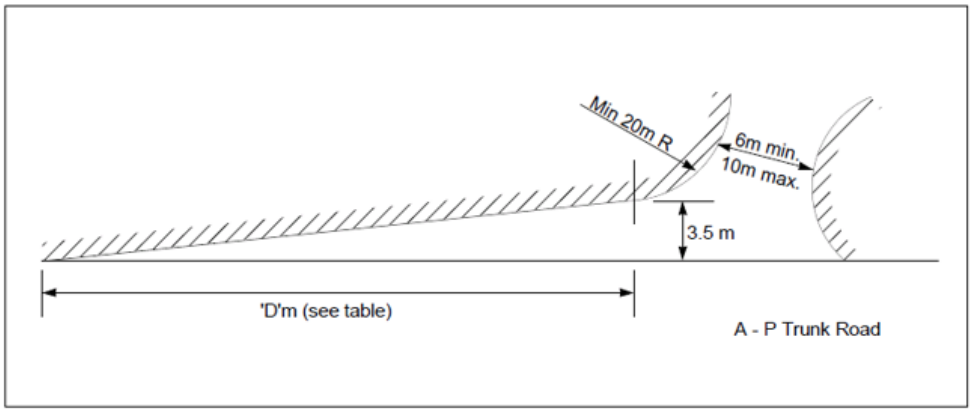


Figure 3-2: Standard TD 69 diverge taper and nose length.

A review of various DMRB standards has sought to explain rationale behind the dimensions above.



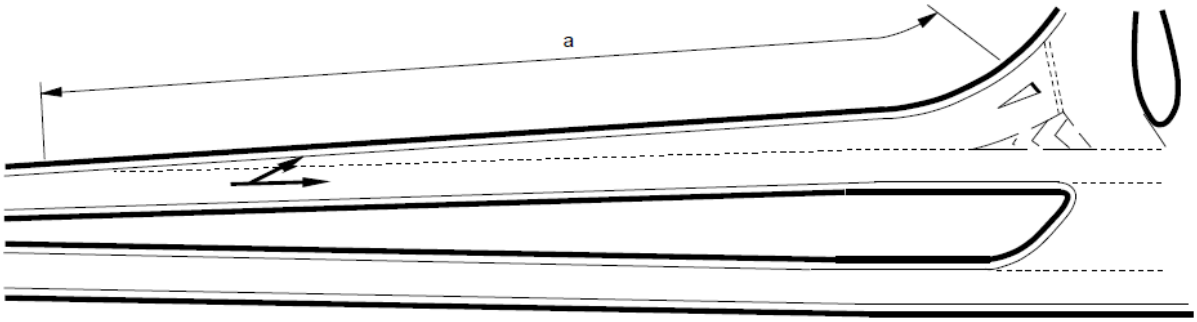
Design Speed (kph)	On Up Gradient		On Down Gradient	
	0 - 4 %	Over 4 %	0 - 4%	Over 4%
120	110	80	110	150 (110)
100	80	55	80	110 (80)
85	55	40	55	80 (55)
70	40	25	40	55 (40)
60	25	25	25	40 (25)
50	25	25	25	25

Figure 3-3: Layout 9 from TD 41

TD 41[3] sets out the dimensions for nearside diverge tapers which facilitates left turning trunk road traffic to slow down and leave the trunk road without obstructing following through traffic, see Figure 3-3 above.

The deceleration length for a 120kph design speed on a 0-4% gradient is detailed as 110 metres. This is consistent with the diverging taper and nose length provided on entry to the lay-by in TD 69 (70 metres + 40 metres).

TD 42[4] sets out similar dimensions for nearside diverging tapers. The deceleration lengths of the diverging taper are illustrated within Figure 3-4.



a Deceleration Length

Design Speed (kph)	Up Gradient		Down Gradient	
	0-4%	Above 4%	0-4%	Above 4%
50	25	25	25	25
60	25	25	25	40
70	40	25	40	55
85	55	40	55	80
100	80	55	80	110
120	110	80	110	150

Figure 3-4: Extract of Figures 7/11 and 7/5b from TD 42

The deceleration length for a 120kph design speed road on a 0-4% gradient is dimensioned as 110 metres. This is the same dimension as the TD 41 diverge taper and provides further support that 110 metres is sufficient length for a diverging taper and nose on entry to a lay-by from the mainline.

The dimensions associated with diverge facilities in TD 22[2] have been ruled out of this study, as they accommodate entry into a slip road (typically of design speed minimum 70kph) and therefore perform a different function from the lay-by taper.

The width of the lane entering the lay-by in TD 69 is 3.5m. This is consistent with TD 41 and TD 42.

TD 41[3] para 2.32, '*Diverge tapers shall be formed by a direct taper to a width of 3.5m at the corner into the direct access (preferably of radius 20m).*'
TD 42[4] para 7.54, '*Nearside diverging tapers shall be formed by a direct increase to a width of 3.5m contiguous to the corner into the minor road*'

3.3 Visibility on Entry

Visibility criteria on approach to a Type A lay-by is set out in paragraph 3.5 of TD 69. This refers to TD 9[5], Table 3, which details the Desirable Minimum Stopping Sight Distance for the design speed of the major road. This allows drivers on the major road to be aware of traffic entering the lay-by and to slow down and stop safely if required. This is consistent with TD 42 which details similar guidance with respect to major/minor priority junctions.

3.4 Central parking area

TD 69[1] details a minimum width for the parking area of 3.5 metres. The Transport Scotland *Roads for All Good Practice Guide for Roads* (July 2013)[6] details a minimum 3.6 metre width for the parking area which takes precedence over TD 69. For the purposes of this study, the dimension of 3.5 metres has been used to follow the current TD 69 design criteria, however designers should be aware of the 3.6 metres requirement when preparing lay-by designs.

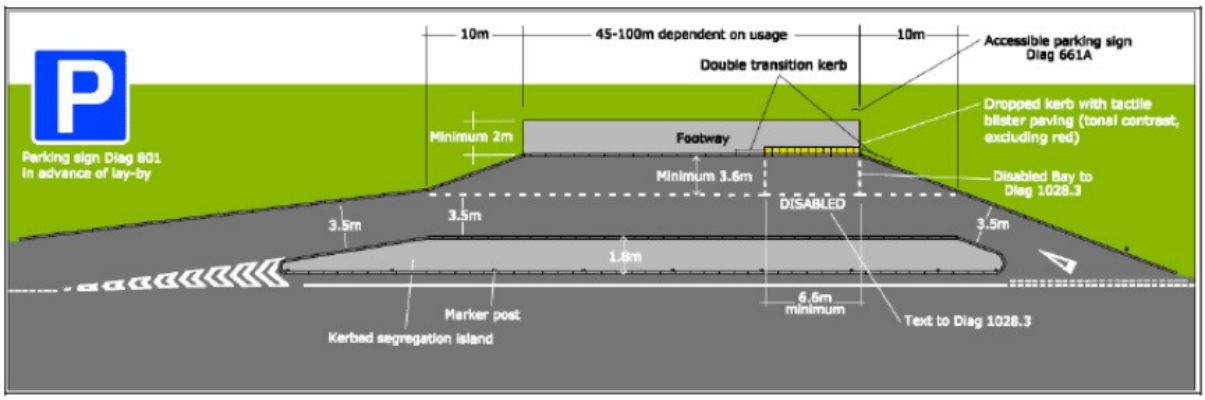


Figure 3-5: Extract from the Good Practice Guide

3.5 Merge Taper and Nose

The merging length within TD 69[1] is 130 metres for a design speed of 120kph.

This length includes a 40 metre length of nose and segregation island (as it reduces from full width). There is no clear explanation within TD 69 as to the reason for the dimensions set out within Figure 3-6.

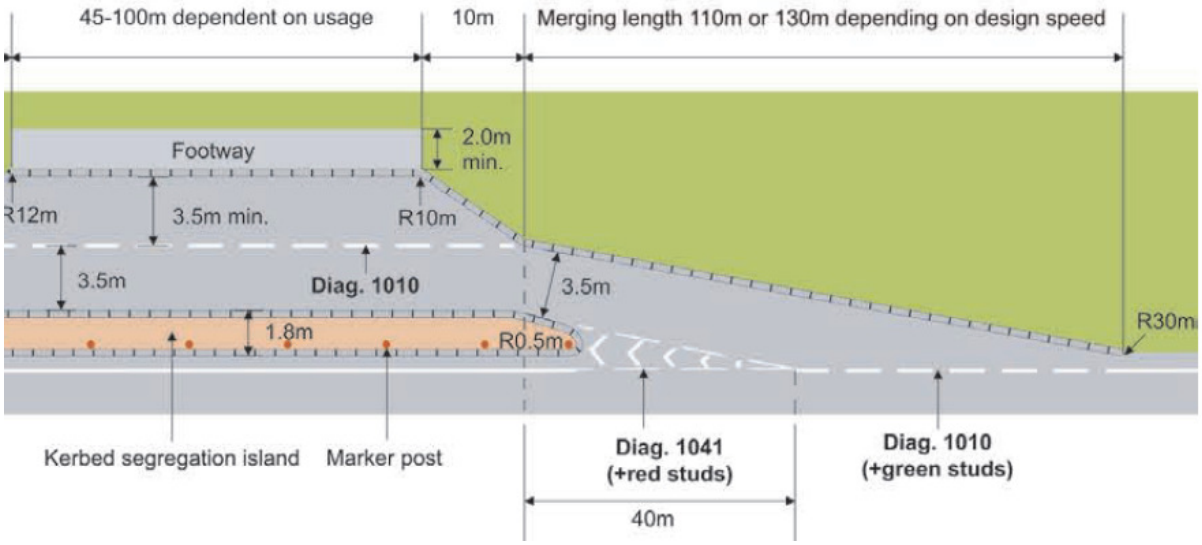
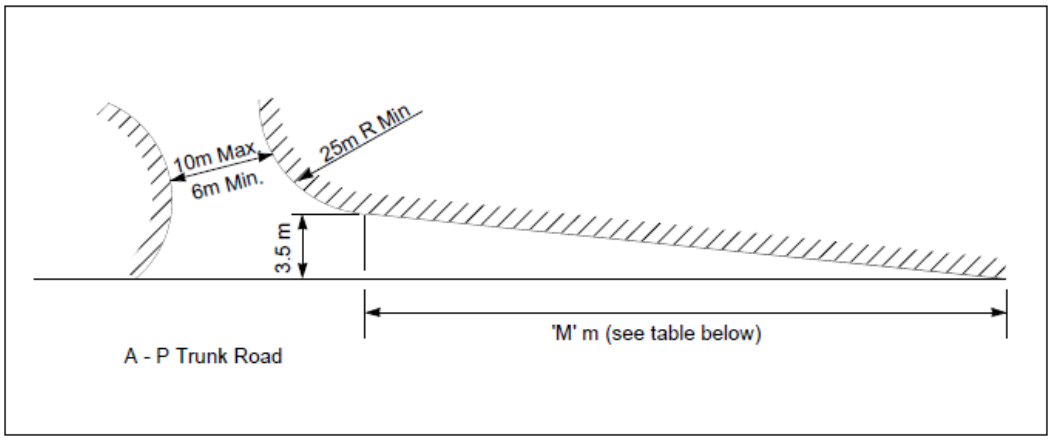


Figure 3-6: Standard TD 69 merge taper and nose length.

A review of various DMRB standards has sought to explain rationale behind the dimensions above.



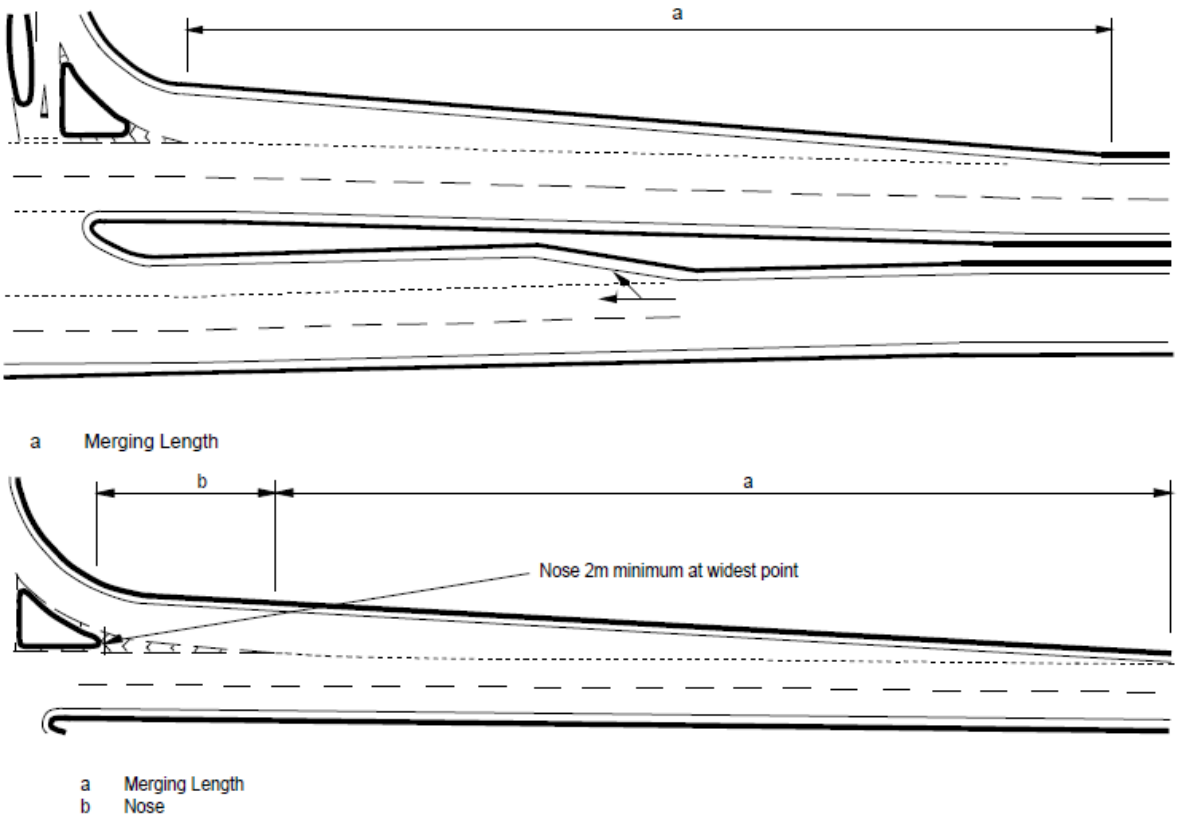
Design Speed (kph)	Merge Taper Length M (m)
120	110
100	90
85	70
[70]	50

Figure 3-7: Layout 10 from TD 41

TD 41 sets out the dimensions for merge tapers which facilitates left turning traffic from the direct access to accelerate before joining the trunk road traffic, see Figure 3-7 above.

The merge taper length detailed within Layout 10 is 110 metres for a 120kph design speed. This would be consistent with the merge taper length provided on exit from the lay-by in TD 69. It is equivalent to a one design speed step reduction from the standard geometry as per TD 42.

TD 42 sets out dimensions for merging tapers at priority junctions. The merging lengths of the merge taper are illustrated within Figure 3-8 overleaf.



Design Speed (kph)	Merging Length (m)
85	90
100	110
120	130

Figure 3-8: Figures 7/13, 7/14 and Table 7/6 from TD 42.

The merging length for a 120kph design speed road is dimensioned as 130 metres. This provides support that 130 metres is sufficient in length for the taper on exit from the lay-by.

The dimensions associated with merge facilities in TD 22 have been ruled out of this study, as they accommodate exit from a slip road (typically of design speed minimum 70kph) and therefore perform a different function from the lay-by taper.

The width of lane exiting the lay-by in TD 69 is 3.5 metres. This is consistent with TD 41 within layout 10 and TD 42.

3.6 Visibility on Exit

Visibility criteria on exit from a Type A lay-by within TD 69 refers to TD 42. Drivers exiting the lay-by should have adequate visibility to see the oncoming major road traffic in sufficient time to permit them to make their manoeuvres safely. This requires clear visibility over the segregation island where the visibility envelope cuts through the island. Low cut, maintained grass should be considered within the segregation island in order to fulfil the visibility requirements.

Drivers approaching a lay-by along the major road shall be able to see the lay-by exit, defined by the back of the paved nose on the mainline merge, from a distance corresponding to the Desirable Minimum Stopping Sight Distance for the design speed of the major road.

SECTION 4

International practice

The following standards were assessed in this study to consider international practice and any implications on the proposed enhanced lay-by design.

- USA: Guide for Development of Rest Areas on Major Arterials and Freeways 3rd Edition, American Association of State Highway and Transportation Officials (AASHTO), 2001[7]
- Australia and New Zealand: The Guide to Road Design - Part 6B: Roadside Environment: Geometric Design, Austroads, 2009[8]
- Sweden: Requirements for Road and Street Design, 2015[9]

These four countries were considered to have driving and cultural similarities with the UK. It was concluded there were limited direct comparison between the chosen international standards and the UK Type A lay-by design standards. The reviewed international standards all have design slip roads leading to rest areas built a distance from the major road. This, in most cases, lead to larger parking and rest area facilities.

There are examples of small Type B style lay-bys which are mainly used for emergencies and short duration stays, but they do not offer comparisons with the Type A lay-by standard.

SECTION 5

Collision data and analysis

5.1 Collision Data

Collision data for each trunk road route was provided for the study to ascertain any trends in lay-by related collisions. A total of 515 Type A lay-bys (365 Type A, and 150 Type A with Merge Taper) are recorded in the inventory of the Scottish trunk road network, refer to Table 5-2 overleaf. From these a sample of three trunk road routes were chosen based on the following criteria:

- Routes to include single and dual carriageway sections
- Routes well used by HGV traffic
- Routes to be a mixture of urban and rural

The three chosen routes were:

- A1: Edinburgh to the Scottish border
- A75: Gretna Green (M74) to Stranraer
- A77: Kilmarnock to Stranraer

A summary of each route and collisions recorded within the vicinity or in the lay-by is outlined below.

Table 5-1: Location of Type A Lay-bys on each of the three routes

	Road Name	Section Code	Area	Rmms Xsp	Start Metre	End Metre	Easting	Northing	Lay by Type	Width	Item
1	A1	10120/05	South East Unit	Right Additional Nearside Lane 1	1832	2017	389814.1	662181.2	TYPE A WITH TAPER	4.2	657388
2	A1	10120/05	South East Unit	Right Additional Nearside Lane 2	1843	1953	389843.4	662183.9	TYPE A WITH TAPER	2.5	657389
3	A1	10105/06	South East Unit	Left Additional Nearside Lane 1	554	667	397405.8	657108.6	TYPE A WITH TAPER	5.8	657396
4	A1	10128/50	South East Unit	Left Additional Nearside Lane 2	1747	1910	379551.1	667985.4	TYPE A WITH TAPER	3.8	657405
5	A1	10128/50	South East Unit	Left Additional Nearside Lane 2	1822	1873	379572.5	667977.6	TYPE A WITH TAPER	2.5	657406
6	A75	11526/58	South West Unit	Left Additional Nearside Lane 1	843	850	291118.3	575094.7	TYPE A WITH TAPER	3	176056
7	A75	11526/58	South West Unit	Left Additional Nearside Lane 1	776	843	291081.6	575091.1	TYPE A WITH TAPER	4.5	176057
8	A75	11526/58	South West Unit	Left Additional Nearside Lane 1	730	776	291025.8	575080.6	TYPE A WITH TAPER	3	176058
9	A75	11558/60	South West Unit	Left Additional Nearside Lane 1	1681	1860	247239.1	557618.2	TYPE A WITH TAPER	6.8	176197
10	A75	11558/60	South West Unit	Left Additional Nearside Lane 1	1641	1681	247288.1	557517.9	TYPE A WITH TAPER	2.8	176198
11	A77	11638/60	South West Unit	Left Additional Near side Lane 1	1233	1400	235869.5	620583.3	TYPE A WITH TAPER	6	176411
12	A77	11617/05	South West Unit	Left Additional Near side Lane 1	6054	6152	216625.9	594833.2	TYPE A WITH TAPER	4	176474
13	A77	11617/05	South West Unit	Left Additional Near side Lane 1	1021	1130	213596.8	591025	TYPE A WITH TAPER	4.9	176479
14	A77	11614/35	South West Unit	Left Additional Near side Lane 1	2436	2571	211562.6	588822.4	TYPE A WITH TAPER	6	176486
15	A77	11611/07	South West Unit	Left Additional Near side Lane 1	109	210	205700.9	571425.7	TYPE A WITH TAPER	7.1	176499

5.1.1 A1 Trunk Road

There were two collisions recorded near lay-by 1 and 2, detailed in Table 5-1. The first, a serious collision, recorded in 2012. From the information available, this is unlikely to be due to vehicle movement from the Type A lay-by or on approach/exiting the Type A lay-by. The second collision was recorded as a slight injury in 2015. There is insufficient available data to comment on this collision.

5.1.2 A75 Trunk Road

There were three collisions recorded in the vicinity of lay-bys on the A75. A slight severity collision took place near to Type A lay-bys 6, 7 and 8. No further information was available. A collision occurred near lay-by 9 and has been determined as not being related to movements within the vicinity of the

Type A lay-by from the accident information available. A serious collision occurred near lay-by 10. From the information available, it cannot be determined if the geometric layout of the lay-by had any effect on this collision.

5.1.3 A77 Trunk Road

Five Type A lay-bys were reviewed. No collisions were recorded within the vicinity of any of the Type A lay-by locations.

Table 5-2: Total number of Type A lay-bys

Road Name	No of Type A Lay-by	No of Type A with Merge	Total No of Type A Lay-by
A1	16	5	21
A68	14	0	14
A7	67	1	68
A701	3	0	3
A720	0	4	4
A725	5	0	5
A75	38	5	43
A76	4	2	6
A77	7	5	12
A78	6	7	13
A8	0	1	1
A82	9	4	13
A828	9	3	12
A83	0	1	1
A830	1	4	5
A835	25	10	35
A84	0	3	3
A85	15	1	16
A86	12	1	13
A87	24	16	40
A876	8	0	8
A887	6	0	6
A889	1	0	1
A898	1	0	1
A9	24	59	83
A90	20	0	20
A92	1	4	5
A95	7	0	7
A96	31	13	44
A977	3	0	3
A985	1	0	1
A99	1	1	2
M73	2	0	2
M80	1	0	1
M9	1	0	1
M90	2	0	2
Total	**365**	**150**	**515**

Total number of Type A lay-bys on Trunk Network.

5.2 Conclusion

The small number of collisions combined with limited detail attributing lay-by design as a contributing factor to any of the incidents has produced little evidence for this study. Collision analysis has the potential to influence future design of lay-bys, however the sample analysis within the study produced no meaningful data.

SECTION 6

Technical Assessment

6.1 Diverge Taper Options

The diverge taper and nose has been reviewed against the existing DMRB standards described in Section 3 of this report. This review has resulted in the development of four separate options for the 'enhanced lay-by' layout, which are detailed in the following section.

6.1.1 TD 69 Design Standard

The standard TD 69 layout incorporates a separation island with a maximum 1.8 metre width with an additional 1.0 metre hard strip. This is developed over a length of 55 metres which produces a taper ratio of 1 in 19.6. The standard TD 69 layout has an approximate area of 960m^2 through the diverge.

The four options which follow have all been modelled at the maximum segregation island width of 4 metres. In order to provide an equivalent comparison of land-take, all options have been developed with inclusions and assumptions as follows:

- Full mainline stopping sight distance (295 metres) is provided to the start of the parking area
- The first 33.2 metres of the parking area is included in the area measured
- The lay-by is on a straight section of mainline

6.1.2 Option 1

This option maintains the standard nose ratio of 1:19.6. This has resulted in an increase of 43.2 metres compared to TD 69, refer to Figure 6-1. The increase in nose length provides more opportunity to reduce speed prior to entering the parking area, though this is not addressing any known problem.

The total area of option 1 is approximately 1416m^2.

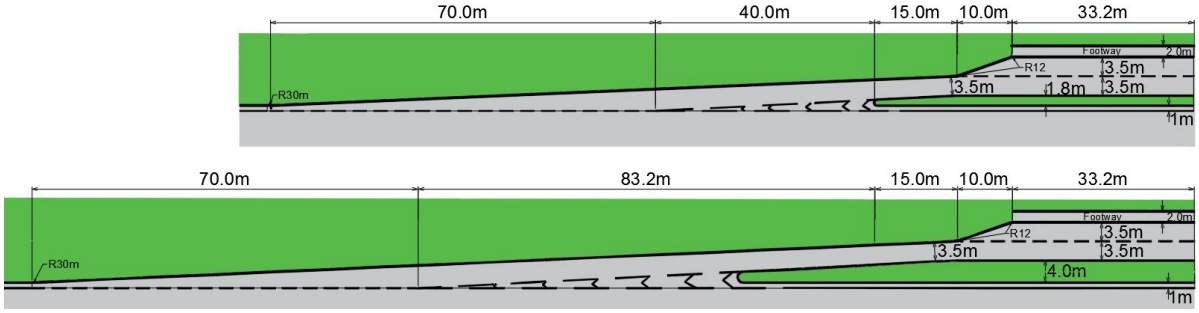


Figure 6-1: Diverge taper of option 1 versus the TD 69[1] Standard

6.1.3 Option 2

As per option 1, this maintains the standard taper ratio of 1:19.6. The resultant additional 43.2 metres has been used to extend the island beyond the nose and create a parking zone as shown in Figure 6-2. The total area of option 2 is approximately 1003m^2**.**

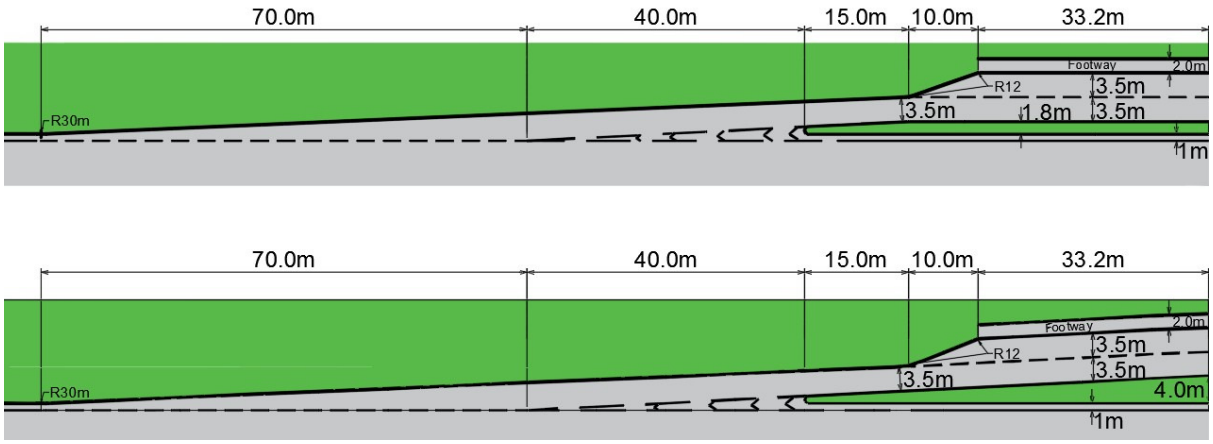


Figure 6-2: Diverge taper of option 2 versus the TD 69 Standard

This option does not maintain a minimum continuous segregation island width between the start of the parking area and the mainline. Although this is not a specific requirement of TD 69, the objective of the 'enhanced lay-by' is to maintain a 4 metre segregation island to help ensure pedestrians feel safe within the parking area.

6.1.4 Option 3

This option incorporates a nose ratio of 1:11. This is achieved through the diverge taper remaining at the same angle and length as the standard design. The 4 metre width at the back of nose results in an increase in the angle and subsequently a nose ratio of 1:11. To ensure vehicles negotiate safely the increase in nose ratio, a curve of radius of 1020 metres has been included between where the tangent points intersect based on a straight mainline. The curve length required is 49.1 metres. This is equivalent to a near straight as defined in TD 22 and is therefore considered an appropriate radius for drivers leaving the mainline to negotiate. The total area of option 3 is approximately 1290m^2.

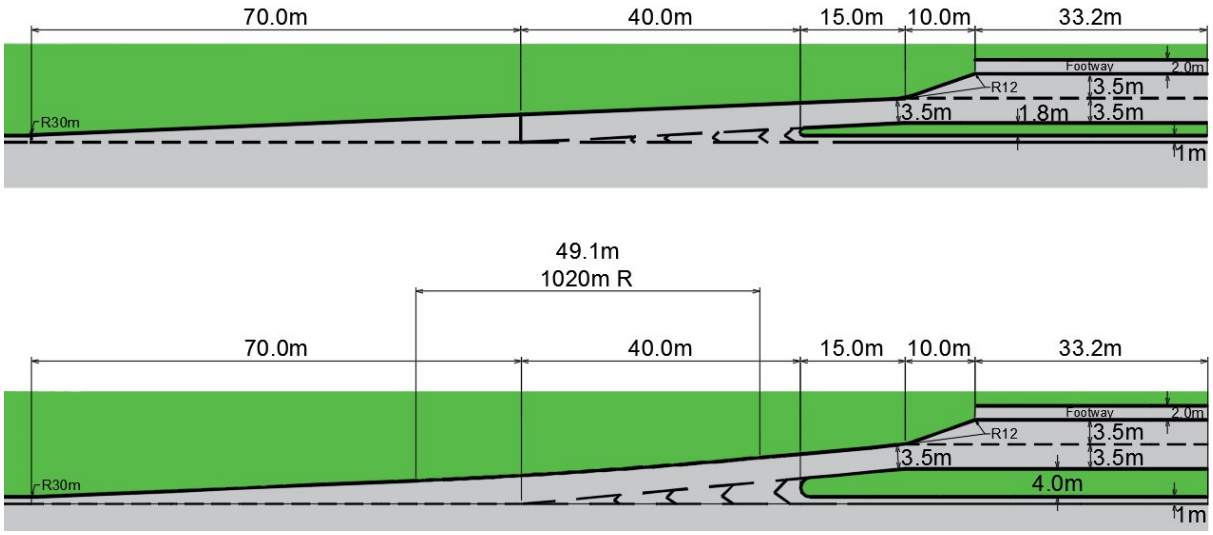


Figure 6-3: Diverge taper of option 3 versus the TD 69 Standard

6.1.5 Option 4

This option maintains the standard nose ratio of 1:19.6 through the introduction of a chicane between the back of the nose and the start of the central parking area. This is formed by using two 40 metre radii back to back. The design has been created from researching TD 42 which details that where a radius is to be used at the end of a diverge taper, a 40 metre radius be should be used for speeds greater than 85kph. The total area of Option 4 is approximately 1297m^2.

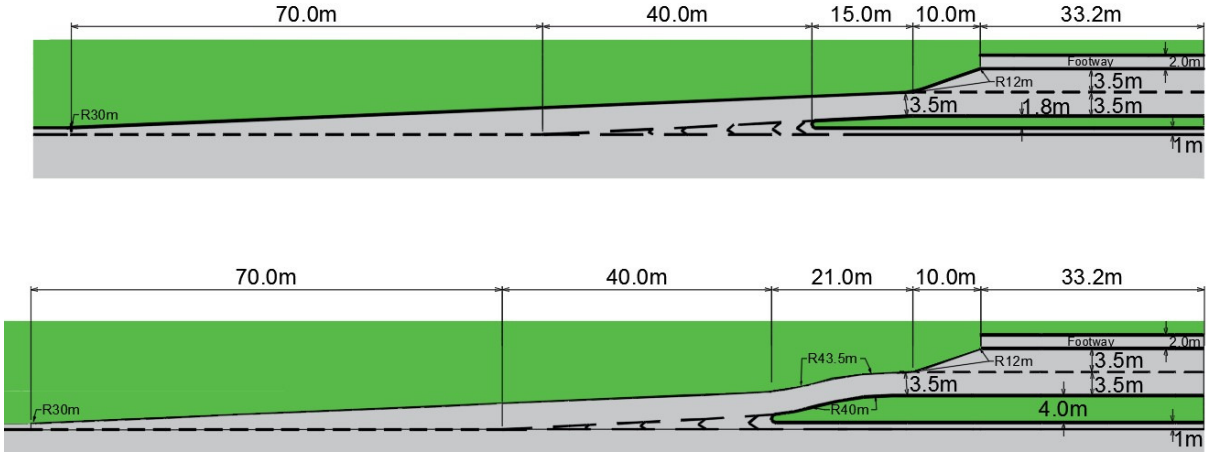


Figure 6-4: Diverge taper of option 4 versus the TD 69 Standard

A length of 21 metres is required to develop 4 metre wide segregation island through the chicane. It introduces an effective solution in order to keep vehicle speeds low approaching the parking area.

6.2 Diverge Taper Conclusions

The four options have been assessed against the following differentiating criteria.

- Speed
- Visibility
- Land take area

Option 1 is taken as the baseline against which all other options are compared to consider advantages and disadvantages. Road user safety has been considered within speed and visibility. Table 6-1 below identifies the merits of each option, with additional supporting information provided against each differentiating criteria.

Table 6-1: Diverge Taper option assessment

Rating				
Positive		**Neutral**		**Negative**
Diverge Taper	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Speed	Increased length of diverge taper provides opportunity for vehicles to slow down, though this is not addressing any known problem.	With no change in direction prior to entering the parking area, the potential for higher speeds increases. No constant segregation island width between mainline and parking area. This non-standard parking layout increases risk of conflict collisions.	Maintains the current TD 69 taper length. A radius equivalent to TD22 'near straight' is provided between the taper and the increased nose ratio.	Chicane has potential to ensure speed reduction on entry to layby. However, the chicane geometry is considered undesirable on exit from the mainline, where there is risk of vehicles encountering it unexpectedly and at excessive speed.
Visibility	Requires a similar visibility area behind the kerb line as required in the TD design standard.	Provides the required visibility from the mainline to the parking area.	Provides the required visibility from the mainline to the parking area.	Provides the required visibility from the mainline to the parking area.
Land take area	Baseline case.	29.2% < baseline Less land is required to construct this option than the baseline.	8.9% < baseline Less land is required to construct this option than the baseline.	8.4% < baseline Less land is required to construct this option than the baseline.

6.2.1 Summary

Option 1, the baseline, takes up considerably more land take than the other three options and in doing so does not provide any enhanced solution. This would rule this option out.

Option 2 has the lowest land take of the four options. This however is outweighed by the lack of directional change in advance of the parking area and the potential for increased speeds which could compromise safety for all users.

Option 3 has less land take required against the baseline but more than option 2, however it does maintain the current design standard taper length and provide a change in direction prior to entering the parking area without compromising safety. The curvature required is considered acceptable (and near straight) where the layby is located on a straight, however a specific solution or an alternative option should be considered for instances where the layby approach was located on the inside of a curve.

Option 4 requires the second most land take behind the baseline. This option does provide a change in direction prior to the parking area, however the nature of the tighter directional change applied by the chicane is not considered desirable on exit from the mainline with a relatively straight approach.

Overall option 3 provides the best solution in situations where the layby is located on a straight or the outside of a curve. However, on the inside of a curve, the geometry on the layby entry would have to be considered on an individual basis to determine the best solution or option.

6.3 Merge Taper Options

The merge taper and nose, as per the diverge, has been reviewed against the DMRB standards described in Section 3 of this report. This review has resulted in the development of four separate options which are detailed in the following sections.

6.3.1 TD 69 Design Standard

The standard TD 69 layout incorporates a nose length of 40 metres and a separation width of 2.8 metres, and therefore produces a taper ratio of 1 in 14.3.

Four options have been modelled at the maximum segregation island width of 4 metres, to provide an 'enhanced lay-by' layout. In order to provide an equivalent comparison of land-take, all options have been developed with inclusions and assumptions as follows:

- Full mainline stopping sight distance (295 metres) is provided to the back of merge nose
- The first 21.4 metres of the parking area is included in the area measured
- The lay-by is on a straight section of mainline.

The standard TD 69 layout has an area of 810m^2.

6.3.2 Option 1

This option maintains the existing taper ratio of 1:14.3. This option increases the nose length by 31.4 metres, compared to TD 69. The total area of option 1 is 1114m^2.

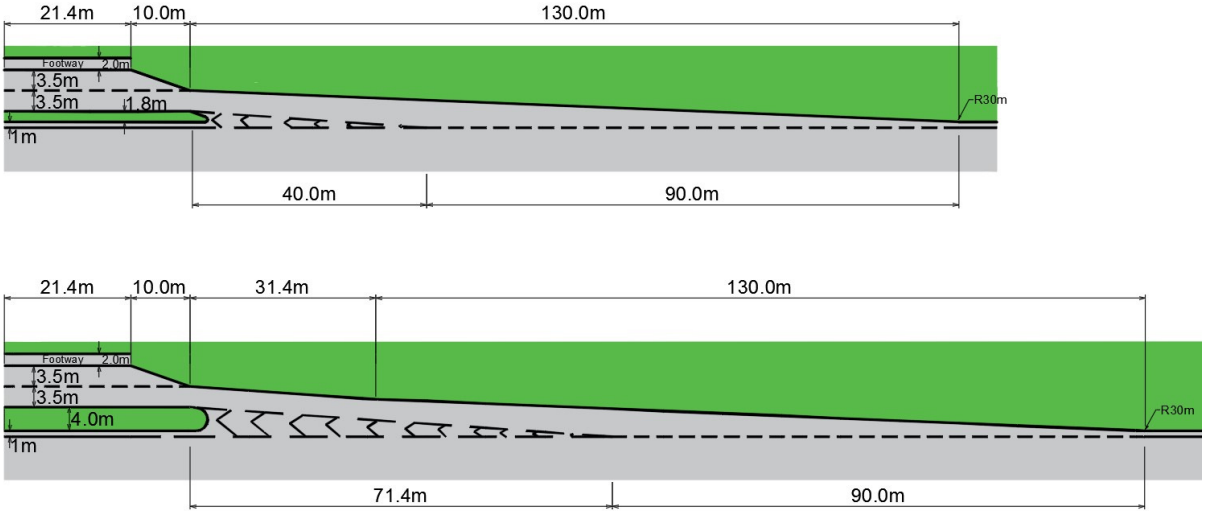


Figure 6-5: Merge taper of option 1 versus the TD 69 Standard

The increase in nose length provides opportunity to assess traffic on the mainline and adjust speed prior to entering the mainline, though this is not addressing any known problem.

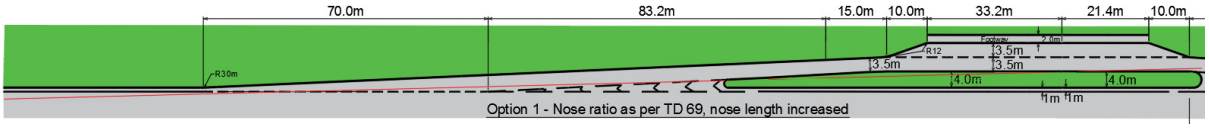


Figure 6-6: Illustration of the line of SSD from back of nose over island to mainline.

6.3.3 Option 2

As with option 1, this maintains the existing taper ratio of 1:14.3. The resultant additional 21.4 metres has been used to extend the island into the nose and create a parking zone as shown in Figure 6-7. The total area of option 2 is approximately 851m^2.

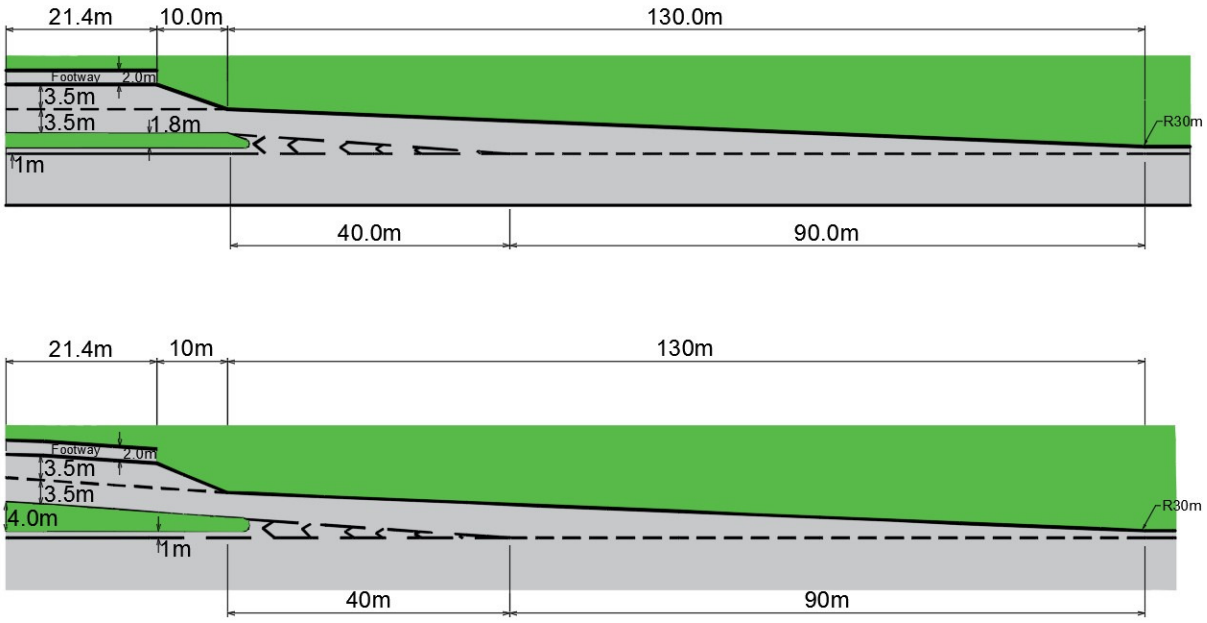


Figure 6-7: Merge taper of option 2 versus the TD 69 Standard

This option does not maintain a minimum continuous segregation island width between the parking area and the mainline. Although this is not a specific requirement of TD 69, the objective of the 'enhanced lay-by' is to maintain a 4 metre segregation island to help ensure pedestrians feel safe within the parking area.

This option does not require vehicles to change direction on exit from the parking area compared to the standard design, which may result in higher speeds within the parking area. As the segregation island reduces in width over the exit to the parking area this brings vehicles closer to the mainline making the angle of visibility the same as the design standard.

6.3.4 Option 3

This option incorporates a ratio of 1:8. This is achieved through the merge taper remaining at the same length as the design standard. To ensure vehicles can negotiate safely the increase in nose taper ratio, an edge radius of 1020 metres has been provided between where the tangent points intersect. This is over a length of 42.3 metres. This provides a near straight as detailed with TD 22. The total area of option 3 is approximately 943m^2.

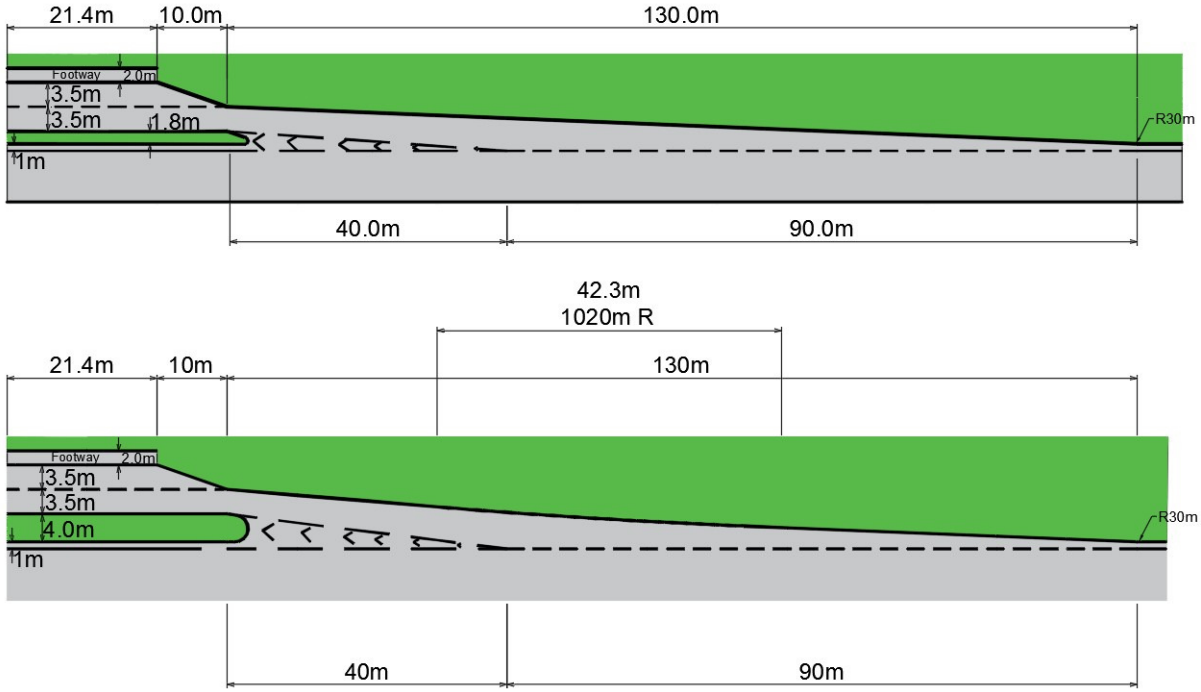


Figure 6-8: Merge taper of option 3 versus the TD 69 Standard

On exit the vehicle is set further back from the mainline when square with the back of the nose increasing the visibility angle. The whole area of the island is required to maintain visibility to the mainline.

6.3.5 Option 4

Option 4 maintains the 130 metre merge taper as per the design standard. This option introduces a chicane which is formed upstream of the merge nose by using two 40 metre radii back to back. The design has been created from researching TD 42 which details that where a radius is to be used to introduce a merging taper, at least a 30 metre radius be should be used for speeds greater than 85kph, (40 metres is used for consistency with the diverge). Using this guidance to create a chicane prior to the nose helps to mitigate the effect of the 4m wide segregation island over a 15 metre length. The total area of option 4 is approximately 995m^2.

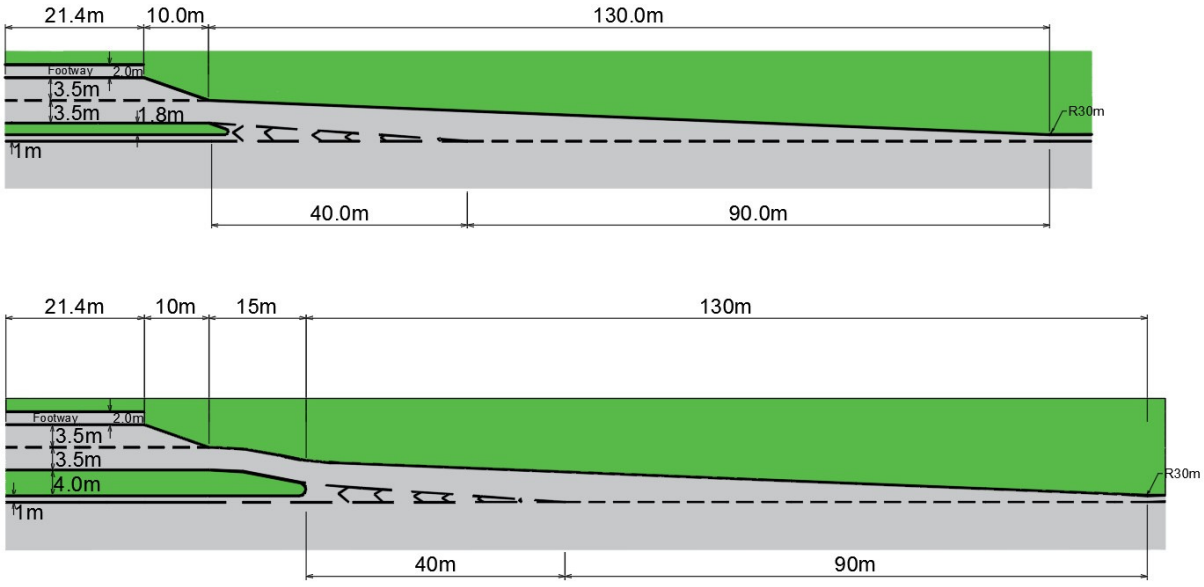


Figure 6-9: Merge taper of option 4 versus the TD 69 Standard

This option helps to reduce the acceleration within the parking area on exit through the change in direction.

Approximately half the area of the island is required to maintain visibility to the mainline. The vehicle will be closer to the mainline on exit which will help reduce the visibility angle.

6.4 Merge Taper Conclusions

The four options have been assessed against the following differentiating criteria:

- Speed
- Visibility
- Land take area

Option 1 is taken is taken as the baseline against which all other options are compared to consider advantages and disadvantages. Road user safety has been considered within speed and visibility. Table 6-2 identifies the merits of each option, with supporting information provided against each differentiating criteria.

Table 6-2: Merge Taper option assessment

Rating				
Positive		**Neutral**		**Negative**
Merge Taper:	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Speed	Increased length of merge taper provides opportunity for vehicles to enter mainline. No evidence to suggest that an increase in length is required.	No change in direction exiting parking area, the potential for higher speeds increase. No constant segregation island width between mainline and parking area. This non-standard parking layout increases risk of conflict collisions.	Maintains the current TD 69 taper length. A radius equivalent to TD22 'near straight' is provided between the taper and the increased nose ratio. This radius has no impact on the functionality of the merge taper.	Chicane ensures that acceleration does not occur within the parking area. Although this is not a not a known problem at present this will assist in preventing conflict collisions between users.
Visibility	A similar visibility area is required to TD 69. Most of the island area is required within the visibility envelope.	Approximately 60% of the island is required within the visibility envelope.	A similar visibility area is required to baseline. Most of the island is required within the visibility envelope. Vehicles are further from the mainline, therefore visibility angle increase.	Approximately half the island area is required within the visibility envelope. Vehicles are closer to the mainline, therefore visibility angle reduces.
Land Area	Baseline case	23.6% < baseline Less land is required to construct this option than the baseline.	15.4% < baseline Less land is required to construct this option than the baseline.	10.7% < baseline Less land is required to construct this option than the baseline.

6.4.1 Summary

Option 1, the baseline, takes up more land take than the other three options. This would increase construction costs and in doing so does not provide any enhanced solution. This rules this option out.

Option 2 has the lowest land take of the four options. This however is outweighed by the lack of directional change on exit from the parking area and the potential for increased speeds within the parking area which could compromise safety for all users.

Option 3 has more land take required against the baseline, however it does maintain the current design standard nose length through providing a 1:8 nose ratio without compromising safety. It provides a directional change on exit from the layby.

Option 4 requires the second most land take behind the baseline. This option incorporates a chicane which provide a significant change in direction on exit from the parking area, reducing the potential for acceleration within the parking area and the potential for collision conflict. This option also brings the vehicle driver closer to the mainline at mainline entry, therefore reducing the visibility envelope over the segregation island and reducing the angle back to the mainline for the vehicle existing.

SECTION 7

Conclusion

This study has reviewed the existing DMRB TD 69 and the reasoning and basis behind the current Type A lay-by design parameters through review of interlinked DMRB standards. An international review of design standards found limited direct comparisons with the UK Type A lay-by design. Collision data and sample analysis produced no meaningful data.

The technical assessment of four design options for the diverge taper and nose concluded that option 3, which maintains the standard TD 69 nose length with a nose ratio of 1:11, would be the most suitable design to accommodate a 4 metre wide segregation island and provide an entry to an 'enhanced lay-by' whilst ensuring no compromise of safety to any of the users. Specific geometry checks would be necessary where this option was incorporated on the inside of a curve.

The technical assessment of four design options for the merge taper and nose concluded that option 4, which incorporates a chicane before entry to the merging taper and has the potential to reduce collision conflict, is preferred. This would be the most suitable design to accommodate a 4 metre wide segregation island and provide an exit from an 'enhanced lay-by'.

In all of the options a hard island surface or low cut, maintained vegetation should be used within the segregation island to prevent any impairment of the visibility envelope on exit from the lay-by. Where enhanced laybys are proposed an appropriate environmental statement or similar may be required to define the requirements of the separation island.

SECTION 8

References

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