

# A9 Keir Roundabout to West of Broxden Roundabout Corridor Study - DMRB Stage 1 Route Study Assessment Report



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# 1 Introduction

## 1.1 Introduction

AECOM has been appointed by Transport Scotland to undertake a study of the A9 trunk road between Keir Roundabout and Luncarty to allow Scottish Ministers to be better informed on future programming of work on this section of the A9.

This report summarises the findings of a Design Manual for Roads and Bridges (DMRB) Stage 1 Scheme Assessment for the A9 route between Keir Roundabout and west of Broxden Roundabout. The assessment has been carried out in accordance with DMRB TD 37/93 and as such only a broad assessment of the engineering issues has been made at this stage.

## 1.2 Background

In 2008 Transport Scotland published their Strategic Transport Projects Review (STPR) which set out the transport investment priorities for the Scottish Government's over the next 20 years.

This review identified recommendations that contributed most effectively towards the Government's Purpose of increased sustainable economic growth. Means of potentially addressing transport issues were appraised to ensure that the Government's priorities of a Wealthier and Fairer, Healthier, Safer and Stronger, Smarter and Greener Scotland would be met and that investment was targeted on those recommendations that most effectively support improving Scotland's sustainable economic development.

The STPR supports the delivery of the three strategic outcomes identified in the National Transport Strategy:

- Improving journey times and connections;
- Reducing emissions; and
- Improving quality, accessibility and affordability.

Twenty route corridors were assessed under STPR to identify strategic transport issues and two of the route corridors correlate directly with this commission. These are Corridor 6 – Inverness to Perth and Corridor 9 – Glasgow to Perth.

Specific objectives were identified for each corridor, urban network and strategic node (of which Perth is one) and subsequently, twenty-nine interventions were determined to address these including STPR 16 – A9 Upgrading from Dunblane to Perth.

### 1.2.1 STPR 16 – A9 Upgrading from Dunblane to Inverness

STPR 16 confirmed the Scottish Government's commitment to the dualling of the A9 between Dunblane and Inverness, and provided further detail on additional interventions for wider improvements to this section of the A9.

It acknowledged that many of the collisions on the A9 have occurred at the at-grade junctions; and that removal of these would significantly reduce the severity of collisions on this route.

It further acknowledged that grade separation of Keir Roundabout, Broxden Roundabout, and Inveralmond Roundabout would remove congestion at these locations contributing to reduce journey times, reliability and improved road safety.

The proposed route improvements, including the provision of a consistent carriageway standard along the A9, are expected to significantly contribute towards the Scottish Government's Purpose of increasing sustainable economic growth.

Proposed improvements included the following specific intervention measures:

- Grade Separation of all junctions on the A9 from (and including) Keir Roundabout to south of Broxden Roundabout;
- Grade Separation of Broxden Roundabout and Inveralmond Roundabout at Perth.

### 1.2.2 Infrastructure Investment Plan

The Scottish Government's Infrastructure Investment Plan (IIP), published in December 2011, reiterated the Scottish Government's commitment to improve the A9 between Dunblane and Inverness.

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At the time of publication, expenditure for the A9 improvements between Dunblane and Inverness was predicted to be in the order of £1.5bn to £3bn with scheme delivery between 2015 and 2030. It was anticipated that the costs and timescale for delivery will be revisited and firmed up in future spending reviews.

The dualling of the A9 from Perth to Inverness is being taken forward separately by Transport Scotland and is not considered in this report.

### 1.3 Study Objectives

#### 1.3.1 National Transport Strategy

The National Transport Strategy sets out three Key Strategic Outcomes for transport:

- Improving journey times and connections, to tackle congestion and the lack of integration and communications in transport that impact on the potential for continued and economic growth;
- Reducing emissions, to tackle the issue of climate change, air quality and health improvement; and
- Improving quality, accessibility and affordability, to give people a choice of public transport, where availability means better quality transport services and value for money or an alternative to the car.

The STPR established the following objectives Intervention 16 - A9 Upgrading from Dunblane to Inverness.

#### 1.3.2 STPR Intervention 16 Objectives

- Promote journey time reductions between Inverness and the Central Belt;
- Improve the operational effectiveness of the A9; and
- Reduce the severity of collisions and address driver frustration.

#### 1.3.3 Study Objectives

The National Transport Strategy Objectives and STPR Intervention Objectives have been used to establish specific Study Objectives for this element of the commission. These are as follows:

- Make improvements to tackle congestion and support the promotion of journey times reductions on this section of the A9, particularly through Keir Roundabout;
- Reduce collision severity and the number of collisions on the A9 between Keir Roundabout and west of Broxden Roundabout.

### 1.4 The Project Brief

This DMRB Stage 1 Route Study Assessment forms one part of a wider commission considering the A9 between Keir Roundabout and Luncarty. The main work packages as outlined in the brief comprise:

- STAG Appraisal assessing the road issues around Perth;
- DMRB Stage 1 Route Study Assessment Report considering the A9 from Keir Roundabout to west of Broxden Roundabout; and
- DMRB Stage 1 Environmental Assessment.

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## 2 Existing Conditions

### 2.1 Introduction

The A9 forms the main road link between the Central Belt of Scotland and Inverness. The route between Keir Roundabout, south of Dunblane, and Luncarty, just north of Perth is dual carriageway for its full length and is the longest single section of dual carriageway on the A9 road. Despite this, the route experiences problems arising from congestion during peak traffic hours; a poor collision history; unreliable journey times and operational difficulties particularly during the winter months.

This DMRB Stage 1 Route Study Assessment Report considers improvements to the route between Keir Roundabout and to the west of Broxden Roundabout (See Figure 1 below),

### 2.2 Background

This section of the A9 carries over 20,000 vehicles a day and national speed limits apply throughout the study length. The standard of junction along the route is variable with a mixture of grade separated and at grade junctions serving both public and private roads, as well as farm and residential accesses. Consequently there is conflict between high speed trunk road traffic and local traffic. Within this section of the A9, land uses are predominantly rural, with some areas being designated for commercial woodland, arable farmland and pasture land. This can result in agricultural/forestry vehicles and machinery coming into conflict with high speed trunk road traffic.

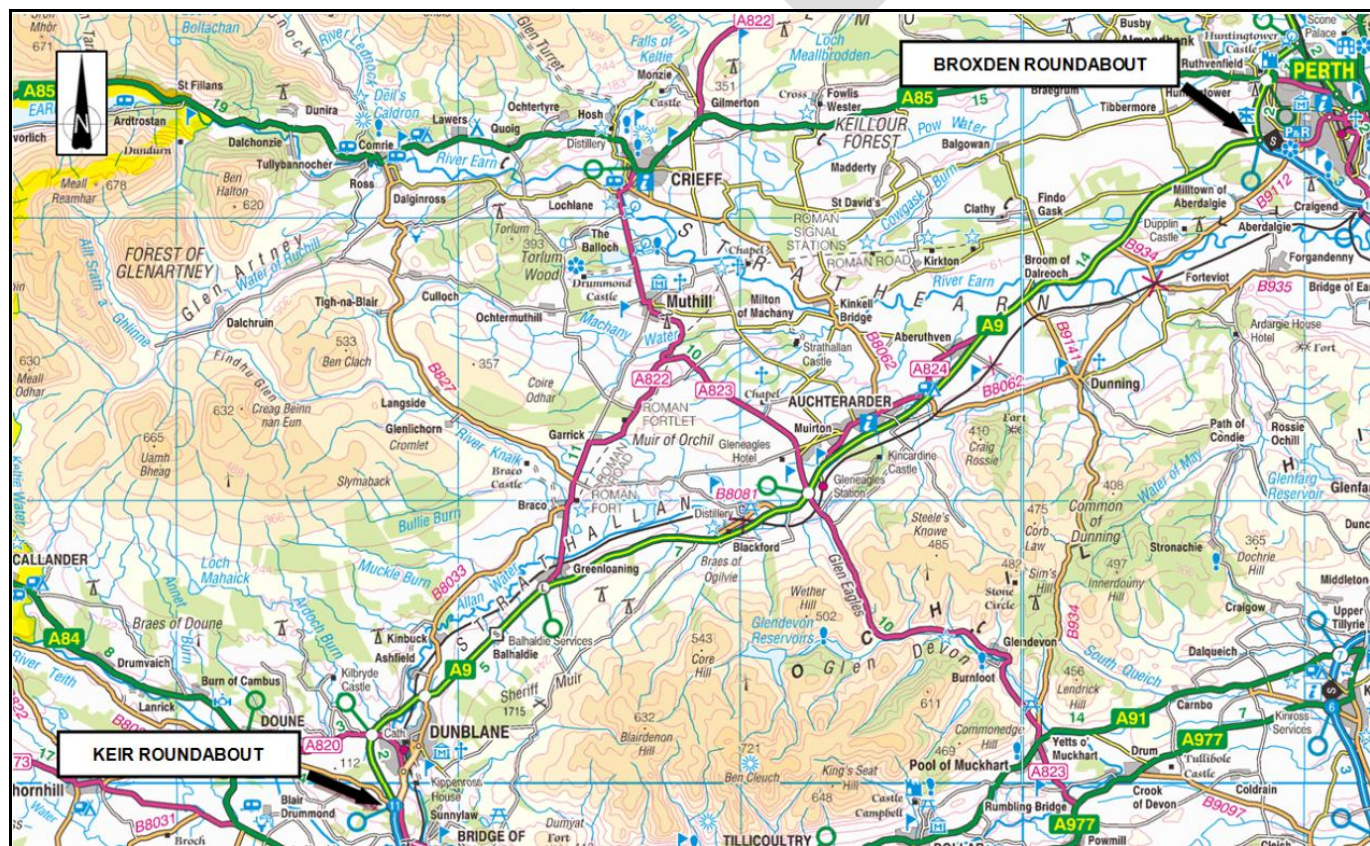


Figure 1 - Existing Road Network - Keir Roundabout to Broxden Roundabout



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## 2.3 Route Description

From Keir Roundabout the road leads north west, up a gradual incline towards the A820 grade separated junction before sweeping north east, passing just north of Dunblane. The A9 crosses over the Auchinlay underpass, the Highland Mainline railway and Annan Water in relatively quick succession before passing under the B8033 overbridge.

The road straightens toward Greenloaning, passing under overhead cables and over various watercourses which have been culverted under the road. A pedestrian walkway on the near side of the northbound carriageway extends from the B8033 grade separated junction to the Balhaldie Services. Balhaldie services, which includes a petrol filling station currently operated by Shell, and a vacant road side restaurant once operated by Little Chef, is located approximately half way between Dunblane and Greenloaning on the southbound carriageway.

By-passing just south of Greenloaning, the A9 passes under a single lane overbridge which serves south bound traffic heading south on the A9 from Greenloaning and beyond. Between Greenloaning and Blackford, the road passes through areas of arable and pasture land as well as passing over various watercourses which have been culverted under the dual carriageway.

The road continues past Blackford, passing over Annan Water and the Highland Mainline railway, and just past Loaninghead petrol filling station where it passes under the A823 Loaninghead Interchange. The A9 bypasses Gleneagles and Auchterarder to the south, again crossing over a number of minor watercourses. Two significant structures cross the A9 along the Auchterarder bypass section of the A9, namely the Abbey Road overpass and the Shinafoot underpass.

Continuing in a north easterly direction, the road leads to a large bridge structure over the River Earn. It then climbs the Cairney Braes, a long incline for approximately 2 miles, within large sections of cutting where exposed rock can be observed. The terrain levels out and the A9 passes through a mixture of woodland and agricultural land before arriving at the Broxden Roundabout, the northern end of the study corridor.

Plans showing the existing road layout and the location of existing road features are contained in Appendix 1.

## 2.4 Existing Traffic Conditions

### 2.4.1 Introduction

The study corridor connects the town of Dunblane (population 8,900) with the city of Perth (population 48,000). The principal settlements between Dunblane and Perth (all located on the northern side of the A9) are:

- Greenloaning (population 330);
- Blackford (population 740; and home to Highland Spring and the Tullibardine distillery);
- Auchterarder (population 4,200; including Gleneagles Hotel and golf courses); and
- Aberuthven (population 390).

With the exception of the above settlements, the road corridor is generally sparsely populated.

### 2.4.2 Traffic Flows

#### 2.4.2.1 A9 Keir – Broxden Traffic Flows

There are a number of automatic traffic count sites located along the route from Keir to Broxden. The locations of these are shown in Figure 2, together with the Annual Average Daily Traffic (AADT) flows of the counters located at the Dunblane Bypass, Blackford, and west of the Broxden Roundabout.

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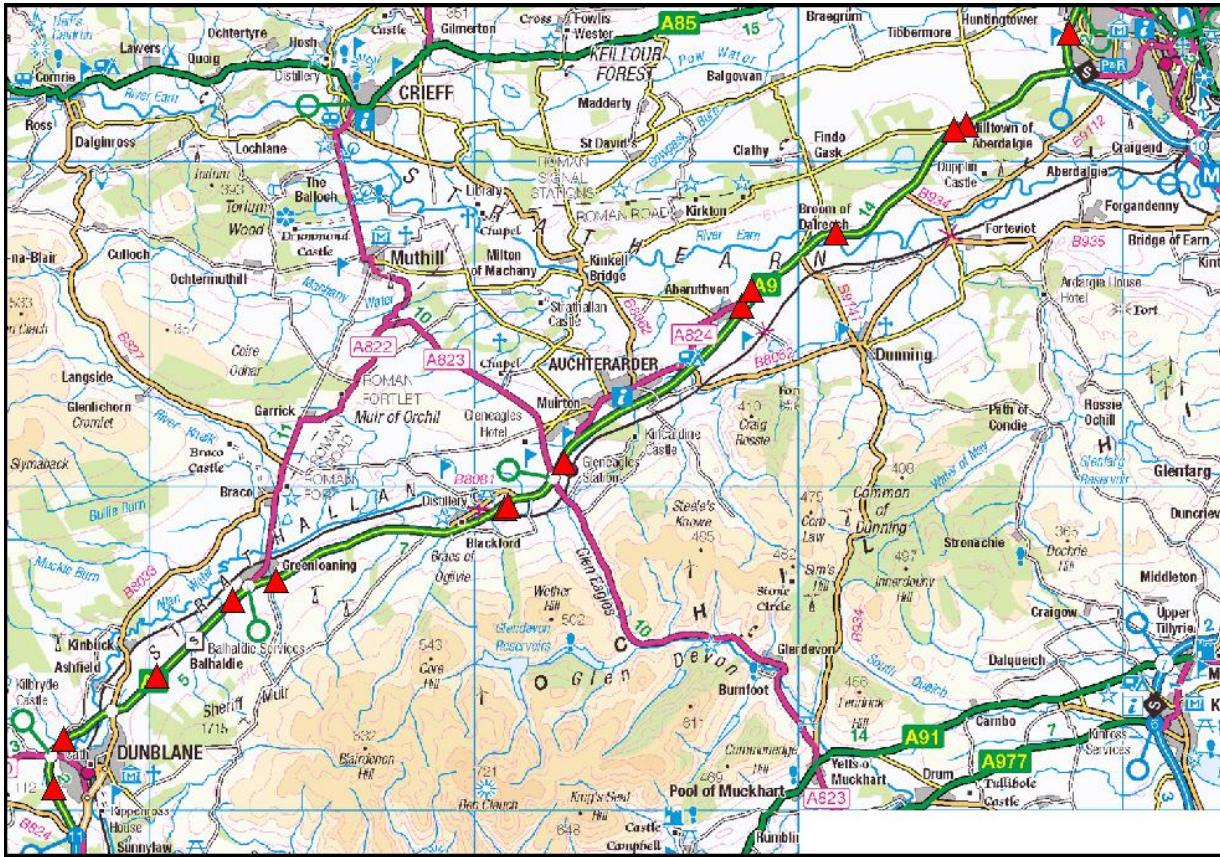


Figure 2 - Scottish Trunk Road Database Count Sites on the A9 Corridor (Keir – Broxden) – Annual Average Daily Traffic Flow

A summary of the main points regarding traffic flow on the corridor are shown below in the accompanying figures.

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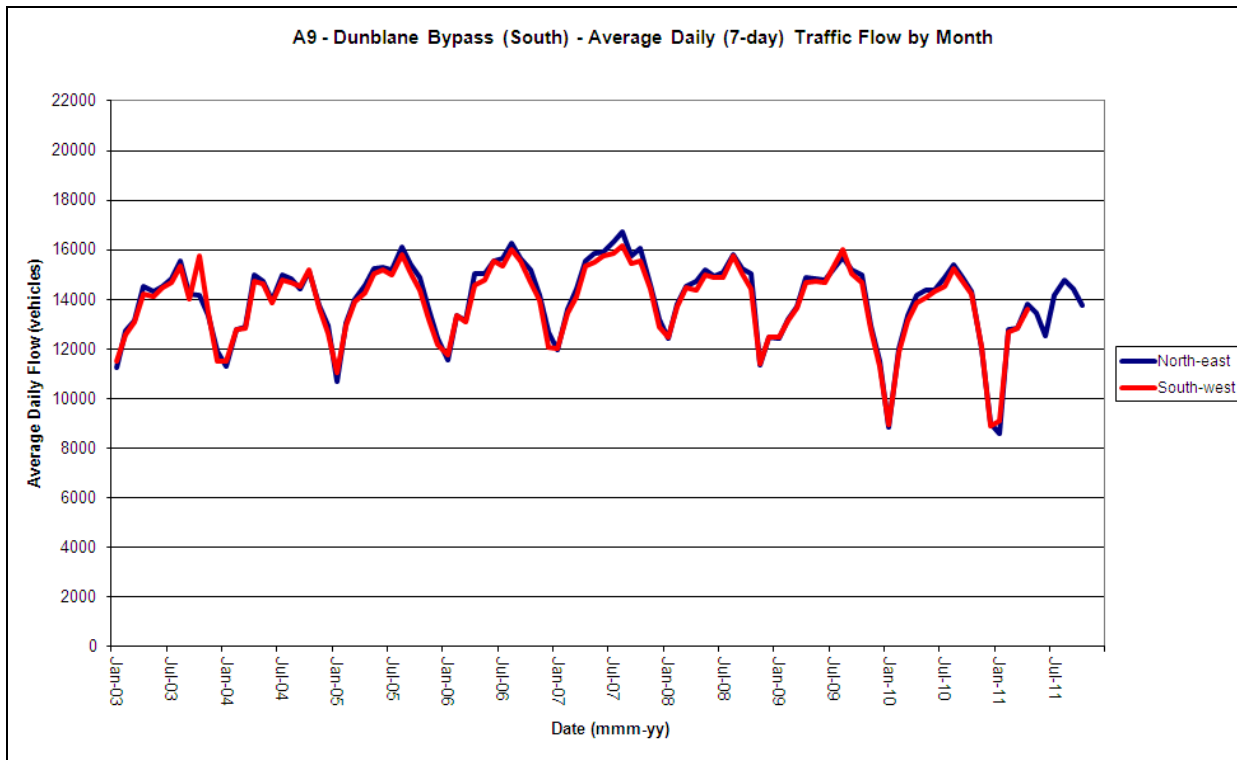


Figure 3 - A9 Dunblane Bypass (South) - Monthly Flow Profile over Time (JTC00012, 2003-2011)

Traffic flow along the route varies throughout the year and over time. Figure 3 (for the A9 Dunblane Bypass) is typical of the pattern for other sites along the route. The main points of note are that:

- Strong seasonality patterns exist along the corridor, where summer flows along the route are between 2,000 and 5,000 vehicles higher per day than compared with during the winter months;
- There is a small peak observed around the Easter holiday period;
- The lowest flows observed in the last eight years have been observed in the winters of 2010/11 and 2011/12; and
- Prior to 2008, there was a general upward trend in traffic using the route year on year. Following a short period of stabilisation, flows have been on a downward trend since 2008.

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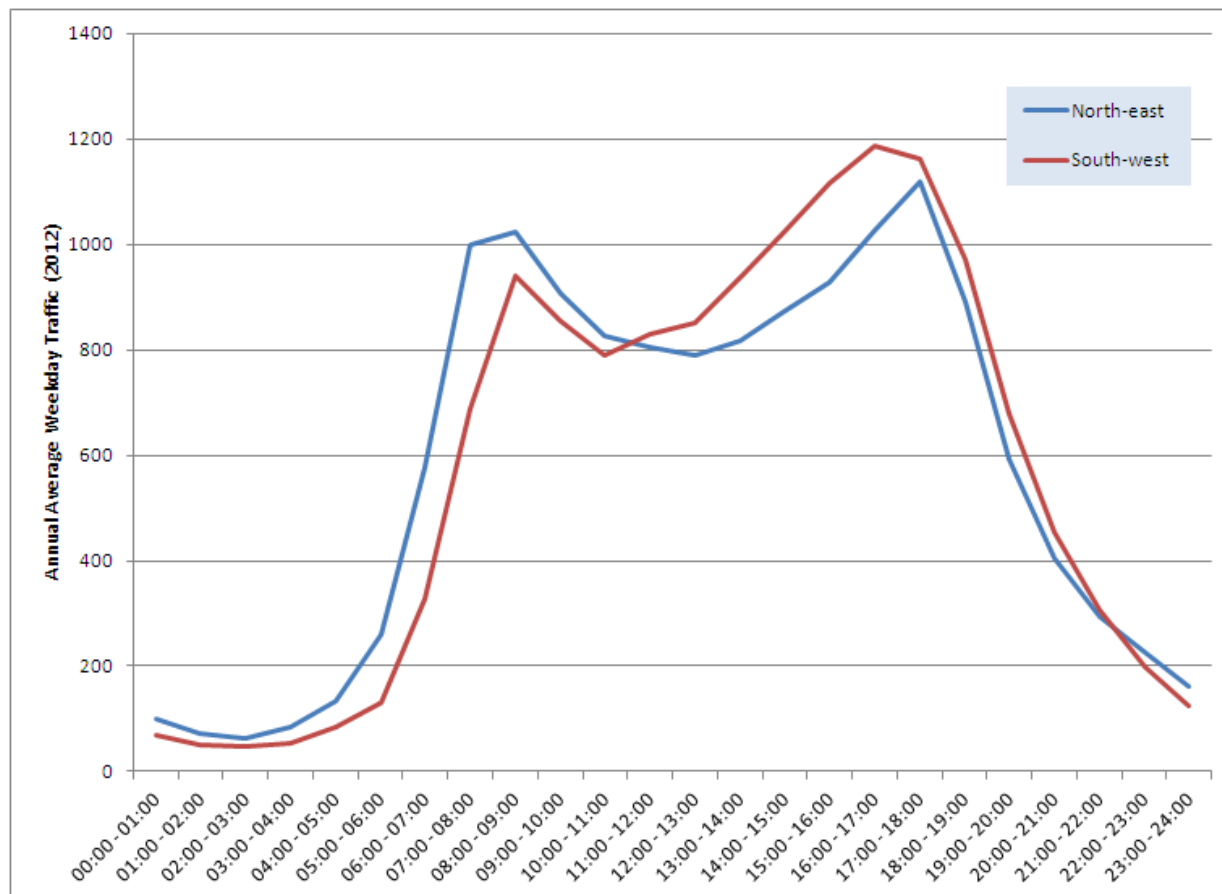


Figure 4 - A9 Dunblane Bypass (South) - Annual Average Weekday Traffic Profile (JTC00012, 2012)

Figure 4 shows that the morning peak traffic is heaviest in the north-eastbound direction but with the difference between the south-westbound flow only around 100 vehicles per day. In the evening peak the south-westbound direction is busier with the peak occurring between 16:00 and 17:00 instead of the more traditional 17:00-18:00 hour.

This pattern is typical of the daily traffic flows on the A9. Nearer to Perth, the flow is typically tidal toward Perth in the morning and from Perth in the evening peak in a south-westerly direction.

#### 2.4.2.2 Traffic Composition

HGVs using the A9 are a key component in the movement and shipment of goods from the Central Belt to Inverness, the far North and North East Scotland. In the opposite direction goods such as timber, fresh fish and whisky are being transported south.



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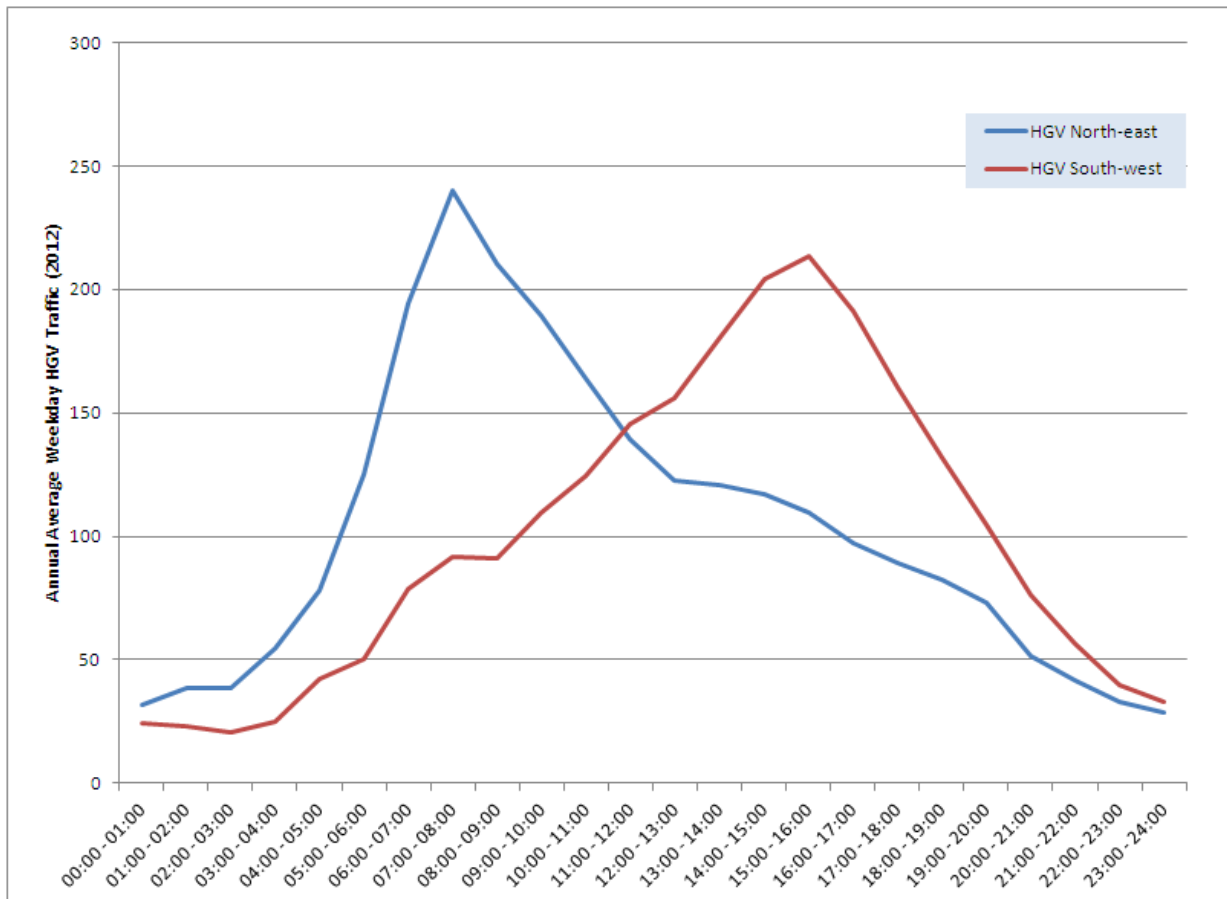


Figure 5 - A9 Dunblane Bypass (South) - Annual Average Weekday HGV Traffic Profile (JTC00012, 2012)33

The profile of hourly Heavy Goods Vehicles (HGV) movements on this section of the A9 shows that the flow is tidal. It peaks at almost 250 HGVs in the north-eastbound flow between 07:00 and 08:00, with a slightly lower peak of just over 200 HGVs in the south-westbound flow between 16:00 and 17:00 (as shown above). This confirms the use of the route to supply locations such as Perth, Dundee, Aberdeen and Inverness from Central Belt locations.

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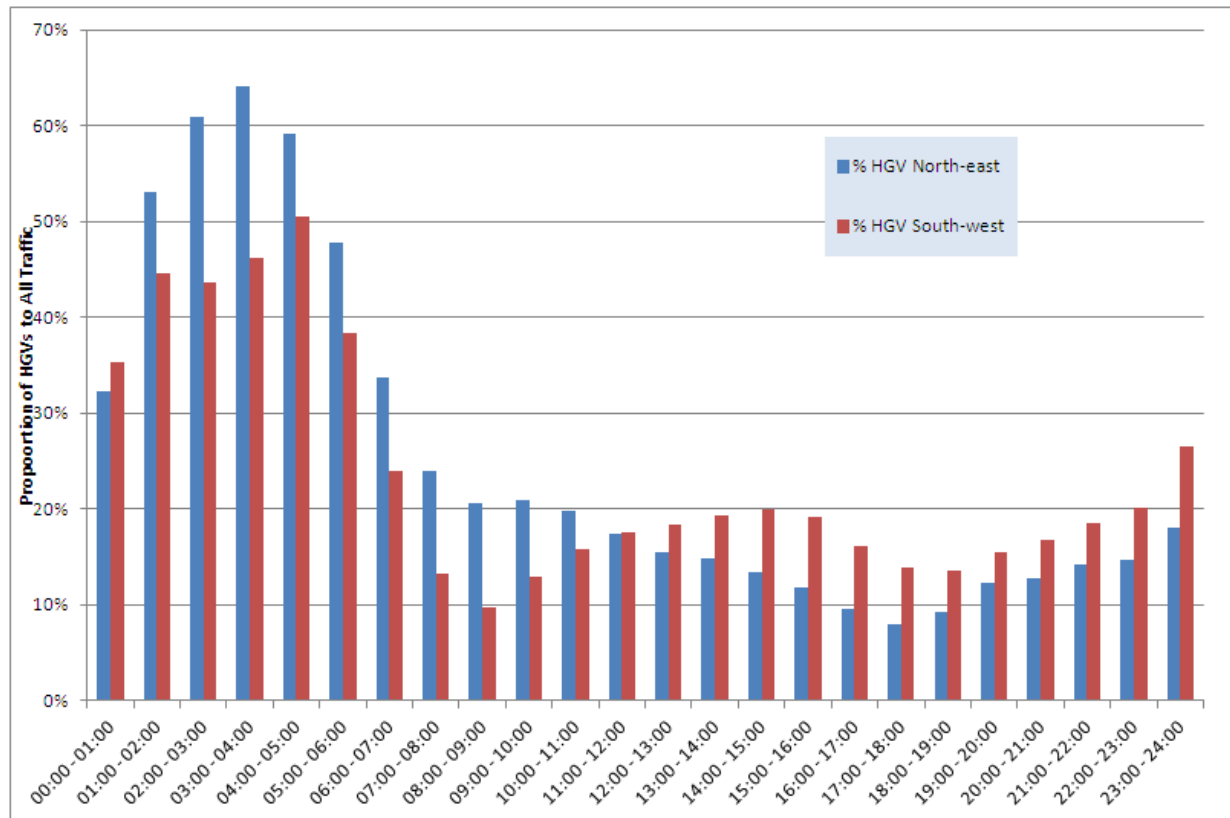


Figure 6 - A9 Dunblane Bypass (South) - Proportion of HGVs to All Traffic by Hour of the Day (2012) (JTC00012)

Figure 6 shows the typical weekday profile of HGVs to all traffic. Notably, between the hours of 00:00 and 06:00, HGVs comprise between 30% and 60% of the total traffic flow and even through the busiest parts of the day, between 10% and 20% of the total flow. Again, the profile demonstrates that the flow is tidal.

Due to the nature of the land along the route corridor, and particularly at the section south of Greenloaning, the conflict with agricultural vehicles is particularly prevalent on the A9. An Accident Analysis Report report written by BEAR, the operator responsible for this section of the A9, in November 2012 noted the prolific number of farm and field accesses within this area. On the section between Keir Roundabout and the Greenloaning junction, 6% of collisions involved an agricultural vehicle compared with 2% over the whole of the North East Trunk Road Network. The report has recommended remedial measures to highlight the potential presence of agricultural vehicles.

#### 2.4.2.3 Comparison of Corridor Flows

As can be seen from Figure 7 below, the A9 from Broxden to the Auchterarder bypass carries around 24,000 vpd with a peak Average Daily Weekday Traffic (ADWT) of 29,000 vpd. Along the Auchterarder and Blackford bypasses, the AADT flows fall slightly to 22,000 vpd before rising to 28,000 vpd south of Greenloaning. From Greenloaning to Dunblane, the AADT is 28,000 vpd with a peak ADWT of 32,000 vpd.

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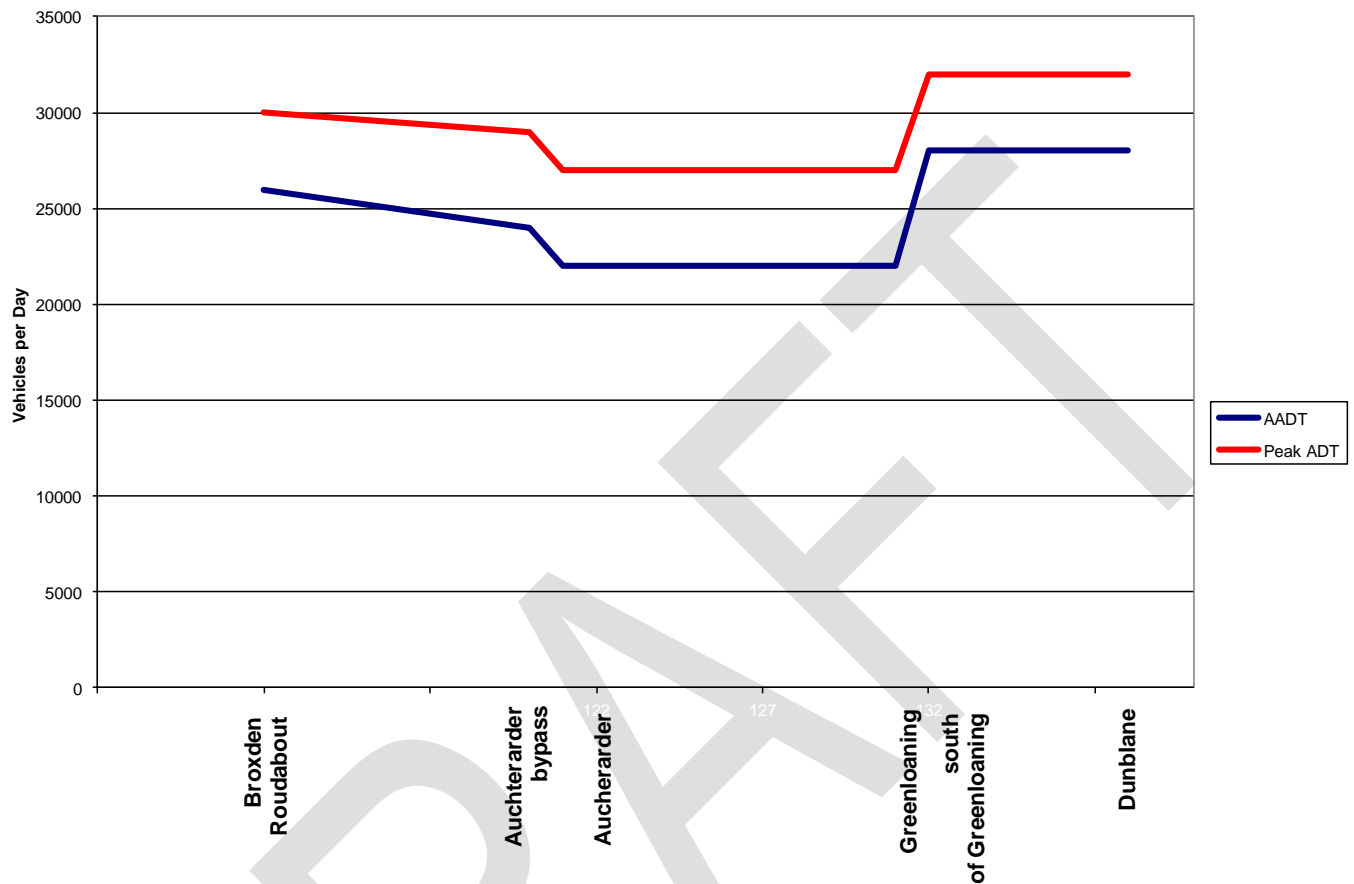


Figure 7 - A9 Broxden to Keir Roundabout – Differences in Traffic Flow

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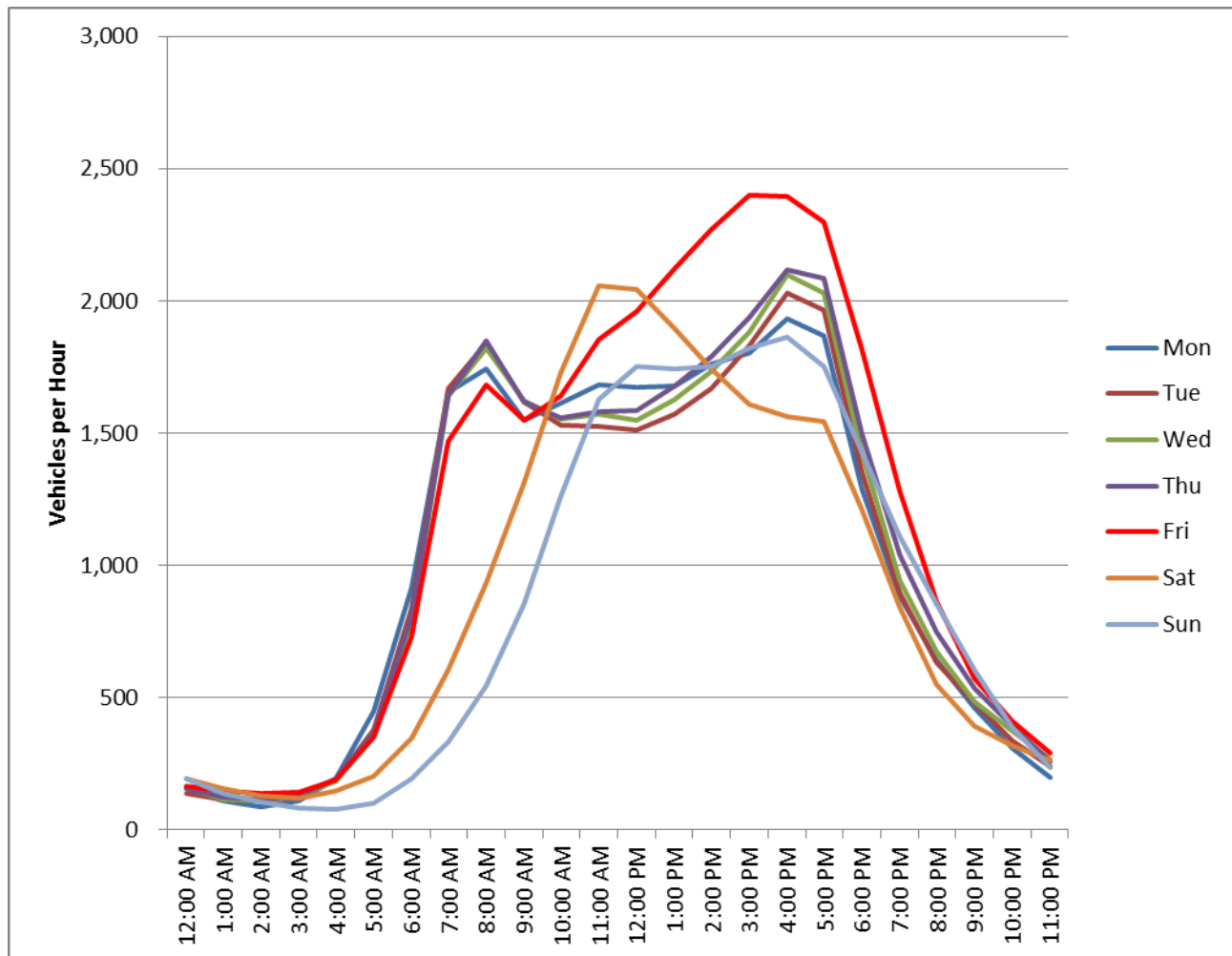


Figure 8 - A9 West of Broxden - Annual Average Weekday Traffic Profile (JTC00568, 2012)

The graph above highlights that on the A9 West of Broxden, traffic flows from Monday to Thursday typically have a traditional morning/evening peak profile. However, the profile of traffic on Fridays varies significantly with traffic increasing after the morning peak from about 10am onwards throughout most of the afternoon with the peak flow between 3-4pm. The peak in the number of vehicles per hour is also higher on Friday than any other day in the week. This data would support the perception that the A9 is a key access route to leisure services at destinations north of Perth. This is also evidenced by the high flow of traffic on Saturday.

#### 2.4.2.4 Performance Review

The average speed on the A9 between Dunblane and Perth in the morning peak is approximately 64 mph (TMfS07). It is anticipated that over time, under the status quo and in the absence of any improvements on the corridor, travel speed will decrease by 2 mph up to 2032.

The major congestion hotspot is at Keir Roundabout where traffic from the M9 heading to either Dunblane or Bridge of Allan contributes to the reduction in gap opportunities for south-westbound traffic on the A9. A recent BEAR Scotland report into queuing on the A9 approach to the roundabout concluded that queues typically start to form when the flow exceeds 1,400



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vehicles per hour. Queues of up to 2.5km in length can be anticipated where entry flow exceeds 1,500 vehicles per hour. Sunday, Monday and Friday evenings are typically the worst effected periods with notable queuing extending over three hours from 3pm onwards at these times. The BEAR report noted that the maximum time recorded for a single vehicle waiting in a queue to reach the roundabout was 16 minutes.

70% of collisions at the roundabout involved queuing vehicles, but the majority of these were categorised as slight. The collisions at Keir Roundabout accounted for 31% of collisions at all junctions on this section of the A9.

The recent (October 2012) "Speed Limit Review of Scottish Trunk Roads" concluded that there was no need to implement any reduction in the current National Speed Limit of 70 mph on this section of the A9.

In summary, the A9 does offer competitive and reliable journey times between the Keir Roundabout and Broxden Roundabout throughout most of the day. However, delays are noted at both ends of the route during both the morning and evening peaks. The cause of which is largely down to the volume of circulating traffic on each respective roundabout which in turn causes significant delays to traffic on the mainline A9.

#### 2.4.3 Congestion

As through traffic is considerably higher than any traffic joining the A9 between Keir and Broxden Roundabout, traffic normally flows well, with only short waiting times at junctions. The only significant delays reported on this section are at the roundabouts at the start and end of the study area. Broxden Roundabout is covered under a separate study, so this part of the report will concentrate on Keir Roundabout. As noted above this roundabout experiences significant delay, particularly during pm peaks. The outcome of this study noted the persistence of these collisions and recommended for advance signing to be erected.

#### 2.4.4 Safety

A key part of this study has been the need to review the collision and safety record on the A9 between Dunblane and just to the west of Broxden Roundabout. Collision data for the last five full years (2007-2011) has been provided from the detailed STATS19 records. Analysis of this data identified:

- Collision Rates;
- Total Collisions and Casualties;
- Average Collision Costs; and
- Fatal/Severity Rates.

A summary of the total number of road collisions and the severity of collisions that have taken place on the route from 2007 to 2011 is shown in Table 1.

COLLISION SEVERITY	SLIGHT	SERIOUS	FATAL	TOTAL
2007	38	9	2	49
2008	22	3	3	28
2009	23	10	0	33
2010	21	8	2	31
2011	20	6	1	27
2007 to 2011	124	36	8	168

Table 1 - Breakdown of Road Collisions from 2007 to 2011, A9 (Keir to West of Broxden (Perth))

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The A9 between Dunblane and Broxden saw a fall in traffic demand of nearly 10% over the three-year period 2007 to 2010. The figures in Table 1 suggest that this has contributed to the general downward trend in the total number of collisions on the route, although it is considered that the increase in collisions from 28 in 2008 to 33 in 2009 could have been as a result of the adverse and enduring winter weather conditions that occurred in late 2009. Remedial measures implemented as part of ongoing moving cursor programme are also considered to have influenced the reduction in collisions.

An analysis of the location of where collisions have occurred can be seen in Table 2. It is evident that the majority of road collisions have taken place at Roundabouts, Priority Junctions or on Link Roads. However, if the severity of collisions occurring is taken into account it is evident that a greater percentage of serious or fatal collisions occur at Priority Junctions or on Link Roads, than at Roundabouts.

TYPE OF JUNCTION	JUNCTION				NOT AT OR WITHIN 20M OF JUNCTION (LINK ROAD)
	ROUNDABOUT	SLIP ROAD	PRIORITY JUNCTIONS	OTHER JUNCTION TYPE	
2007	4	1	15	0	29
2008	6	0	6	0	16
2009	4	3	7	0	19
2010	6	1	8	1	15
2011	2	2	5	1	17
2007 to 2011	22	7	41	2	96

Table 2 - Junction Type/Proximity in the Instance of a Collision from 2007 to 2011, A9 (Keir to West of Broxden (Perth))

Table 3 shows the breakdown of the total number of collisions that have occurred at a specific type of junction/link road and the severity of the collision. Not including collisions at 'Other' junction types, Slip Road Junctions have the lowest number of collisions for the period 2007 to 2011 with only 7 collisions occurring. There were no 'Fatal' collisions at Slip Roads for the reporting period. Roundabouts have the second lowest number of collisions for the period from 2007 to 2011. The majority of collisions occurring at roundabouts were classed as 'Slight' (approximately 91%) with the remaining collisions classed as 'Serious' (approximately 9%). As with Slip Road junctions, there were no 'Fatal' collisions at roundabouts for the period 2007 to 2011. It is worth noting that all roundabout collisions occurred at Keir roundabout. It was also observed that a number of collisions were observed on A9 southbound arm into the Keir Roundabout; these are not included directly in the roundabout figures but are included in the link road data. It has been estimated that as many as "three serious" and "five slight" collisions in the reporting period are associated with queuing traffic and shunt related collisions on the southbound arm of the A9.

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LOCATION OF COLLISION		COLLISION SEVERITY	NO. OF COLLISIONS	% OF TOTAL NUMBER OF COLLISIONS (SPECIFIC JUNCTION TYPE)	% OF TOTAL NUMBER OF COLLISIONS (ALL JUNCTION TYPES)
Junction Type	Round-about	Slight	20	91	12
		Serious	2	9	1
		Fatal	0	0	0
	Slip Road	Slight	5	71	3
		Serious	2	29	1
		Fatal	0	0	0
	Priority	Slight	28	68	17
		Serious	9	22	5
		Fatal	4	10	2
	Other	Slight	1	50	1
		Serious	1	50	1
		Fatal	0	0	0
Link Road		Slight	70	73	42
		Serious	22	23	13
		Fatal	4	4	2
Total			168	-	100

Table 3 - Breakdown of the Total Number of Collisions by Location and Severity for the Period 2007 to 2011, A9 (Keir to West of Broxden (Perth))

Table 3 highlights that whilst the highest number of 'Fatal' collisions occurred on Link Roads and priority junctions, the highest probability of a collision being 'Serious' or 'Fatal' was for collisions occurring at Priority Junctions (approximately 10% of collisions at Priority Junctions were classed as 'Fatal' compared to approximately 4% of collisions at Link Roads being classed as 'Fatal').

A previous study in 2005 also reported collision data for the same corridor for the period 2000-2004. This data has been included below for comparison purposes only, together with the current NESAs (Network Evaluation from Survey and Assignment) collision rates for "rural – dual carriageways".

Table 4 and Figure 9 show the results of this comparison.

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	2007-2011		2000-2004	
	No. of Collisions	No. of Casualties	No. of Collisions	No. of Casualties
Fatal	8	17	20	33
Serious	36	62	41	69
Slight	124	161	159	240
Total	168	240	220	342

#### Collision Severity Comparison

	2007-2011	2000-2004	NESA
Fatal	0.048	0.091	0.025
Serious	0.214	0.186	0.148
Slight	0.738	0.723	0.827
Fatal/Serious	0.262	0.277	0.173

Table 4 - Comparison of Road Collisions / Casualty Totals, A9 (Keir to West of Broxden (Perth))

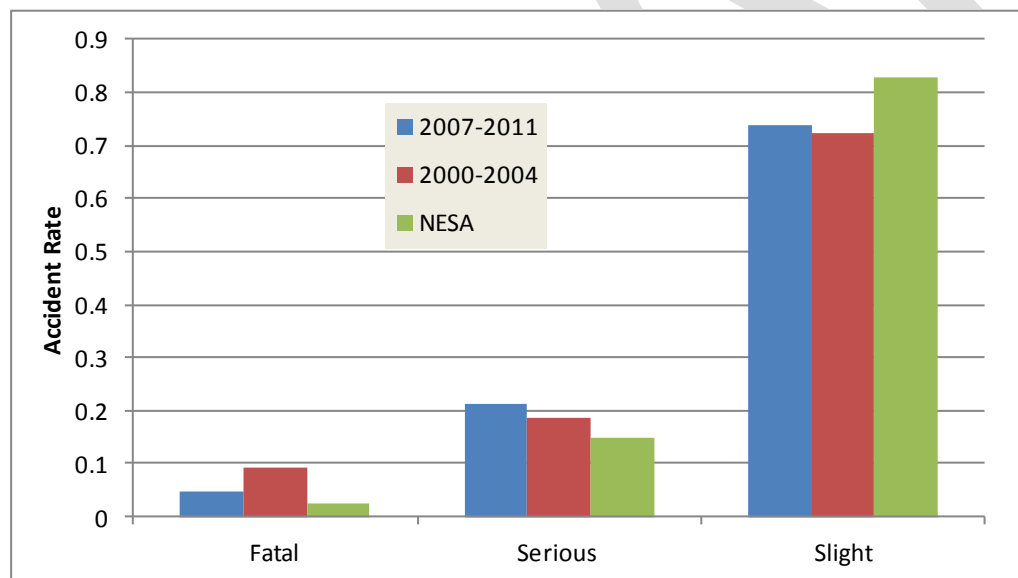


Figure 9 - Summary of Road Collisions / Casualty Totals, A9 (Keir to West of Broxden (Perth))

Observations on the comparison of the 2000/2004 and 2007/2011 data are:

- Overall, the latest five years collision statistics have seen a significant drop in the total number of both collisions and casualties when compared with the period 2000-2004;



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- In the period 2007-2011, there has been more than a 50% reduction in the number of fatal collisions that occurred in the period 2000-2004. This trend is similar to that observed nationally across Scotland between 2001-2011;
- The consequence of this is that the fatal collisions rate has dropped from 0.091 to 0.048 which is something closer to that reported as the NESA value for similar standard road of 0.025; and
- However, the fatal/serious severity rate for the period 2007-2011 (0.262) is only slightly lower than that observed in the period 2000-2004 (0.277). This is a measure of the higher serious collision rate observed between 2007- 2011.

A thorough review of the collision data has revealed a number of key issues on the route:

- Drivers are more than twice as likely to be involved in an collision while “turning right” or “waiting to turn right” when compared to driving elsewhere on the trunk road network (excluding motorways);
- Drivers are also 25% more likely to be involved in an collision while “overtaking a moving vehicle”;
- The proportion of collisions involving HGVs in 2007 and 2008 was significantly higher on this section of the A9 when compared to the Scottish Trunk Road average, however, this has fallen back broadly in line with the national trend in more recent years;
- The average age range of drivers involved in an collision is generally lower or on parity with the national average, except in the “30-59” age band. Here this is approximately 15% higher;
- There is a distinct spike in collisions in February (potentially due to the winter weather) and in June (potentially associated with tourist / leisure traffic and drivers unfamiliar with the road);
- Drivers are almost twice as likely to be involved in an collision occurring at a roundabout than elsewhere on the trunk road network; and
- A key point to note is that, approximately, 50% of all fatal collisions (in the period 2007-2011) have occurred while waiting to “turn right” or whilst actually making a right turn manoeuvre into or out of an at-grade junction. This is a key indicator of the importance of the closure of the central median gaps as part of any future strategy.

Table 5 contains a summary of the local collision rates, costs and severity rates and the comparative national rates for a Rural Dual 2 Lane road.

	A9 Keir to Broxden		NATIONAL (NESA)
	2007-2011	2000-2004	
Collision Rate	0.081	0.106	0.226
Ave. Collision Cost	£162,390	£227,999	£95,910
Fatal/Serious Severity Rate	0.262	0.277	0.173
Fatality Rate	0.048	0.091	0.025

Table 5 - Summary of Road Collision Rates & Costs

Table 5 indicates that the national collision rate is more than twice that of the A9 between Keir and Inveralmond. However, the fatality and serious/fatal rates for the route are almost twice as high when compared with the national figures contained in NESA.

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### Scottish Trunk Roads Speed Limit Review

The recent Scottish Trunk Roads Speed Limit Review (October 2012) has also provided a useful comparator for the safety of the route. In assessing whether a particular section of any route may require a review of the speed limit, the following assessment approach was applied:

“As the Scottish Government's 'Setting Local Speed Limits' did not cover rural dual carriageways the following guidance from the Chief Highways Engineer (CHE), was used to assess sections to discover:

- Collision Rate – if the collision rate was above a threshold of 0.4 per million vehicle kilometres for current speed limits of 70mph or above 0.86 per 100 million vehicle kilometres for current speed limits of 60 mph. If the collision rate is not above the threshold then the speed limit review process is complete for the section.”

Table 6 reports the results of this recent analysis and includes a ranking indicator based on the sections' collision rate (1 = worse collision rate; 10= the least worst).

SECTION DESCRIPTION	LENGTH OF SECTION (KM)	3 YEAR COLLISION RATE: COLLISIONS PER MILLION VEHICLE KILOMETRES	RANKING BASED ON LOCAL COLLISION RATE
Keir Roundabout (N) to A820 overbridge	2.535	0.097	4
A820 Overbridge to Junction (L) B8033	2.555	0.014	9
Junction (L) B8033 to council boundary, Balhaldie	3.265	0.072	5
Council boundary, Balhaldie to Junction (L) A822	2.275	0	10
Junction (L) A822 to Junction (L) B8081 Blackford	6.865	0.058	6
(L) B8081 Blackford to A823 Loaninghead Interchange	3.45	0.125	2
A823 Flyover to Junction (L) A824 Auchterarder	1.505	0.166	1
Junction (L) A824 Auchterarder to Abbey Road Bridge	2.97	0.056	7
Road Bridge to Junction (L) A824 Aberuthven	4.085	0.051	8
Junction (L) A824 Aberuthven to Broxden Roundabout (S)	12.825	0.097	3

Table 6 - Results of the Initial Analysis of the A9 (Keir to Broxden) Speed Limit Review

It should be noted that on no section of the A9 between Keir and Broxden was the speed review threshold met and hence there was no proposed change to the speed limit on this part of the A9. However, the section with the worst collision rate is between the A823 Loaninghead Interchange to junction (L) A824 Auchterarder and although this does not meet the speed review threshold (at 0.166 collisions per million vehicle kilometres), it should be acknowledged that this high level analysis does not take into account collision severity.

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### Key Road Collision Locations

Data plotted for the A9 between Keir and Broxden provides further clarification of the key locations where collisions occur on the route, whilst also identifying the severity of collision.

In the south-west section of the corridor, the principal location of collisions is at the Keir Roundabout, with the majority of collisions clustered at this location classed as slight. This is a further reflection of the characteristics of collisions at roundabouts on the route, which typically involve shunting of vehicles. Moving north-east towards Greenloaning, collisions (both slight and serious) are dispersed randomly along the route and show no particular clustering along the corridor.

At Blackford, there is a cluster of collisions at the southern end of the B8081 where it joins the A9 at the at-grade junction. Between this junction and the Loaninghead Interchange, there is an occurrence of slight collisions in particular for around one mile.

Between the Loaninghead Interchange and Aberuthven (i.e. south of Auchterarder), collisions have occurred at several locations, including fatal collisions south of the Gleneagles Station Access Road, and at the A824/A9 (south) junction. There are also collisions at the A824/A9 (north) junction at Aberuthven, but considerably less on both north and south approaches to this junction than the A824/A9 south junction at Auchterarder.

Collision clusters exist at the A9 junctions with the roads to Findo Gask/Dunning, and between the former and the approach to Windyedge Cottages.

#### 2.4.5 Non-Motorised Users

Although the majority of trips on the study corridor are vehicular, there are also movements involving non-motorised forms of transport. These include pedestrian movements to and from Gleneagles Rail Station, which is located via an at-grade access from the southbound A9 carriageway between the grade separated junction at Loaninghead with the A823 and the at-grade junction with the A824.

In November 2012, Transport Scotland commissioned a week long survey of pedestrian movements to/from the station. Table 7 below shows the daily average number of pedestrian movements over the course of the survey period from the principal pedestrian origin and destination points in the Gleneagles Rail Station vicinity.

ORIGIN	DESTINATION	AVERAGE PEDESTRIANS/ DAY
A9 (SB) North of Gleneagles Station Road End	Gleneagles Rail Station	0
A9 (SB) Bus stop South of Gleneagles Station Road End		0
A9 (NB) opposite Gleneagles Station Road End		3
Gleneagles Rail Station	A9 (SB) North of Gleneagles Station Road End	0
	A9 (SB) Bus stop South of Gleneagles Station Road End	1
	A9 (NB) opposite Gleneagles Station Road End	2

Source: Adapted from Gleneagles Rail Station Survey (Transport Scotland, November 2012)

Table 7 - Gleneagles Rail Station Survey – Pedestrian Movements

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Although pedestrian movements to/from Gleneagles Rail Station are very few in number (which highlights that the majority of access to the site is made by car), the survey did demonstrate that where pedestrian movements do occur, these are generally likely to necessitate pedestrians crossing the A9 carriageway itself on foot (e.g. as part of journeys likely to be starting or finishing in Auchterarder or possibly the Gleneagles Hotel complex). A new road access to Gleneagles station is currently under construction to provide access via the new roundabout south of the Loaninghead junction,

A number of other facilities for non-motorised users also exist on the A9 between Keir and Broxden as follows:

- Pedestrian Footbridge, Dunblane;
- Pedestrian Subway, East Auchterarder;
- Agricultural Underbridge but usable by pedestrians, Cairnie Braes;
- Agricultural Underbridge but usable by pedestrians, Windyedge; and
- Agricultural Underbridge but usable by pedestrians, Lamberkine.

#### 2.4.6 Public Transport Network

##### **Bus and Coach Services**

The study corridor is served by a number of bus and coach services as shown in below. Local and regional services are typically operated by Stagecoach Perth and Docherty's Midland Coaches who are based in Auchterarder. The majority of services provided by these operators within the study corridor generally necessitate operation along the A9 on at least part of their scheduled route. A key junction for these services is the A9/A824 junction at Aberuthven, where southbound bus services from Perth require turning right and crossing the A9 to access the settlements on the north side of the carriageway.

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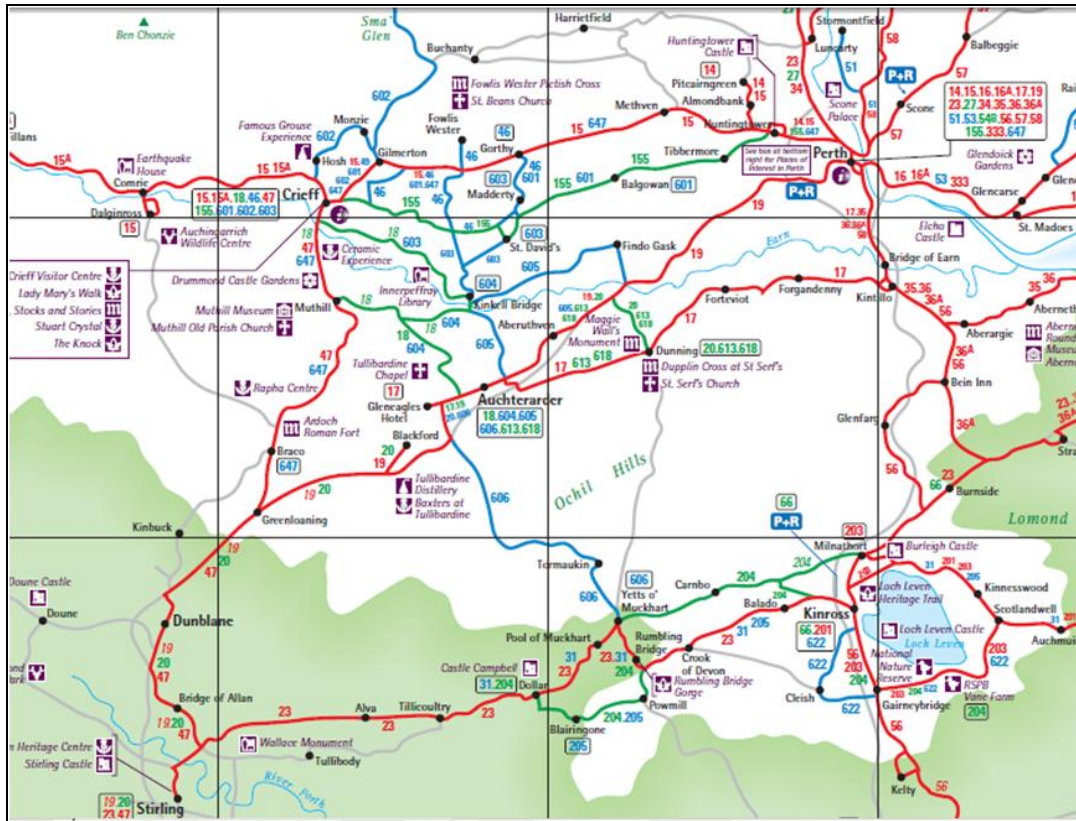


Figure 10 – Local Bus Service Routes

Inter-urban bus services in the corridor operate about twice an hour or more during the peak periods. Most of these also serve the Broxden Park & Ride site in Perth. This is located adjacent to the Broxden Roundabout and is accessible from each of the principal trunk road junctions at Perth. The site has 400 free car parking spaces, CCTV, and houses a waiting area with toilets.

Megabus.com uses the site as an interchange point for long distance coach services. In addition to being a key hub for services between Glasgow and Aberdeen, Broxden Park & Ride is also a hub for services between Edinburgh and Aberdeen that route via Perth and Dundee. A local Park & Ride service is also operated by Stagecoach Perth on behalf of Perth & Kinross Council.

### Rail Services

The southern section of the 0 Main Line (linking Glasgow to Inverness, and Glasgow to Dundee and Aberdeen) broadly follows the route of the A9 between Dunblane and Perth. North of Dunblane, the rail line passes under the A9 and there is a level crossing at Blackford.

At Perth Station, the line branches, with the Highland Main line continuing north, closely following the A9 towards Luncarty and onwards to Inverness. The Dundee/Aberdeen branch continues along the north of the River Tay from Perth.

Rail journeys between Dunblane and Perth are comparable with car journey times, particularly when compared with centre to centre journeys. This is similar for those travelling from Gleneagles, although the service frequency reduces the attractiveness of using the train from this location as reflected in the low level of patronage from this station. It is also noted that the rail network on the Glasgow-Perth corridor experiences significant overcrowding at peak times – both in terms of passenger and rail line capacity – on the approach to Glasgow (Queen Street) and constraints also exist at Perth.

The table below provides an overview of the Rail Services operating within the A9 Luncarty study area.



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STATION	RAIL SERVICE PROVISION
Dunblane	2 services per hour to Edinburgh 1 service per hour to Glasgow Queen Street (supplemented by trains from the north) 3 services per day to Inverness 4 services per day to Aberdeen
Gleneagles	14 daily services to Glasgow Queen Street. 15 daily services to Perth (some extending to Inverness). Daily train to/from London Kings Cross.
Perth	Hourly services to Edinburgh, Glasgow Queen Street and Aberdeen. 11 services per day to Inverness.

Table 8 - Rail Services Overview

## 2.5 Future Conditions

On the section between Dunblane and Perth, Transport Model for Scotland (TMfS07) forecasts include a drop in traffic demand in the short-term to 2012, although not as significant as that which has actually occurred. Figure 11 shows the expected growth in traffic over the period to 2032 at Blackford.

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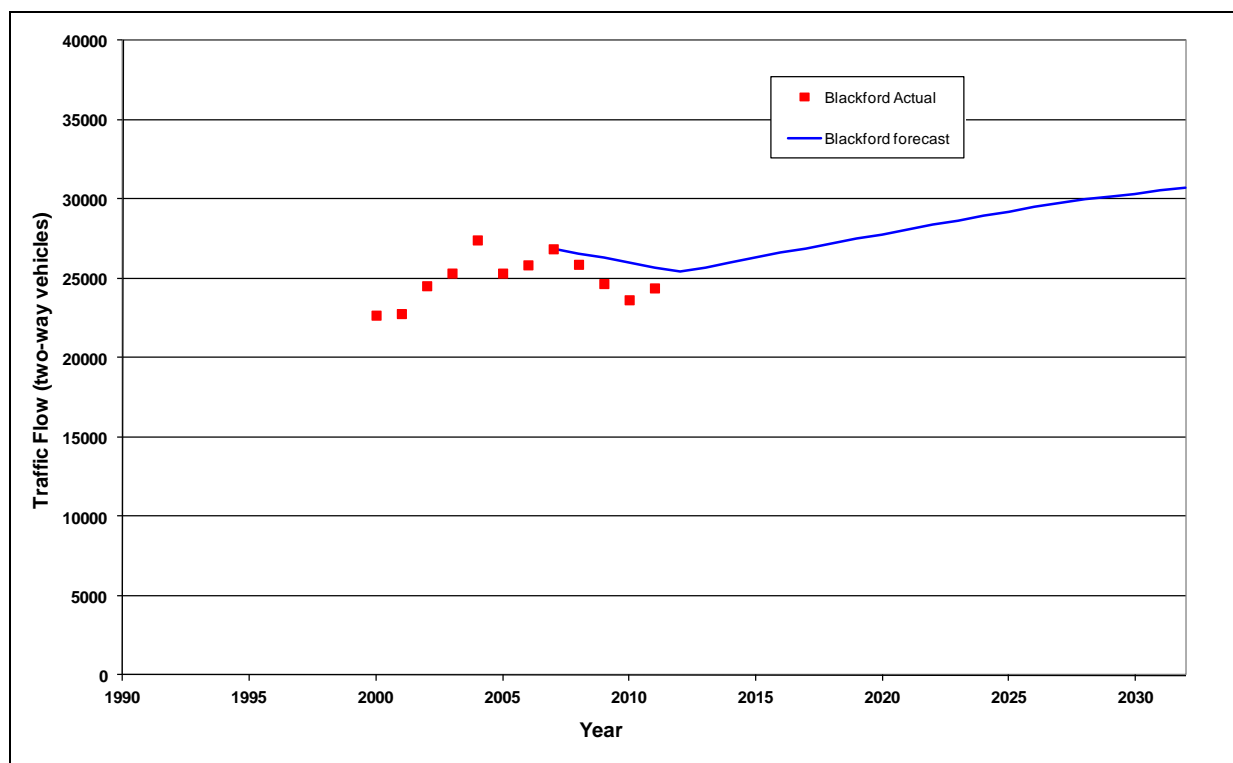


Figure 11 - Forecast Traffic Growth to 2032 (Blackford) (Vehicles per Day)

#### Forecast vs. Observed Traffic Growth 2007 to 2010

The Transport Model for Scotland (TMfS07) growth forecast over the short-term has been more optimistic than that realised in actual traffic volumes.

However, in terms of the relative levels of forecast growth, this has been reflected in the relative levels of actual traffic flow changes. TMfS07 forecasts strongest growth at the north end of the corridor and decline at the southern end of the corridor. Observed out-turn traffic growth has seen the northern end of the corridor experience a much smaller decline on 2007 traffic levels than the southern end of the corridor.

#### Comparison of Corridor against National Forecasts

Over the period 2007 to 2032, TMfS07 forecasts nearly 40% growth in traffic flows for the whole of Scotland. Conversely, the growth in traffic on the A9 corridor over this period is considerably lower from 15% at the southern end (Dunblane / Perth) to 20% at the northern end (Aviemore / Inverness).

#### A9 Corridor – Future Development Proposals

Table 9 below summarises the principal proposals for the main settlements on the A9 between Keir and Broxden in the period to 2024 and beyond.

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SETTLEMENT	KEY LDP PROPOSALS
Dunblane	<p>Existing infrastructure constraints and Green Belt limit development potential.</p> <p>Dunblane is identified as a 'high pressured area' (high house prices and a small proportion of social rented accommodation).</p> <p>As development is constrained by available infrastructure, future development in the town will be subject to further assessment as part of future Local Development Plans (LDP) reviews.</p> <p>Land safeguarded around the Keir Roundabout for future transport improvements.</p>
Greenloaning	<p>Not identified for growth (spatial strategy).</p> <p>No new housing allocation identified.</p>
Blackford	<p>Blackford currently has an effective housing supply, with no further growth identified in the LDP period.</p> <p>Land south of the railway line will continue to be protected to account for investigations into the long-term possibility of introducing rail passenger or rail freight services from this settlement.</p>
Auchterarder	<p>Key settlement for the provision of employment and housing land in Strathearn.</p> <p>Auchterarder Development Framework (adopted by P&amp;KC) provides for 800 houses and employment land.</p> <p>The boundary of Auchterarder has been modified to reflect completed residential areas and to ensure separation from the town and the A9.</p> <p>Open space / recreation areas maintained by the LDP.</p> <p>Community School of Auchterarder requires extension to meet future development needs.</p>
Aberuthven	<p>Following recent significant growth, Aberuthven is not identified for housing growth in the LDP period.</p> <p>A site has been identified for small scale employment use.</p> <p>The LDP also notes that there may be potential in the future to extend Aberuthven with residential development south-west of the site that has been identified for small scale employment use.</p>

Table 9 - Stirling /Perth & Kinross Local Development Plans - Key A9 Corridor Settlements

In addition to the above, 100 new houses at Dunblane are also proposed, and planning permission has also recently been granted for a new supermarket and petrol station adjacent to the A9 junction at Dunblane North.

At Auchterarder, under existing planning permission, a new junction (with southbound on and off slips) will need to be constructed at the Shinafoot underpass, and improvements made to the B8062 prior to construction of new housing beyond a threshold of 500 dwellings. However, the future requirement for this junction may be removed based on the initial findings of this DMRB Stage 1 work but will need to be confirmed at detailed option assessment phase (i.e. DMRB Stages 2/3).

### A9 Dualling

In 2008, a proposal was made in the Strategic Transport Projects Review (STPR) to dual the A9 between Perth and Inverness. Subsequently, in December 2011, there was a ministerial commitment to complete the dualling by 2025 as part of the

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Infrastructure Investment Plan. Advanced design work on three sections is currently underway. Construction on the section between Luncarty (north of Perth) and the Pass of Birnam is anticipated to start in 2017.

## **2.6 Existing Road Network**

### **2.6.1 Alignment**

The A9 between Keir Roundabout and Broxden Roundabout is an all purpose dual carriageway road with a design speed of 120kph. The standards set out in Table 3 TD9/93 "Highway Link Design" of the DMRB states that the desirable minimum horizontal curvature of a 120kph road is 1020m. There are six sections of road, totalling a distance of just under 2km, where the minimum radii of a curve falls below that appropriate for the design speed. Four out of the six sub-standard curves are between the one step below and the desirable minimum curve radius whilst the remaining two curves sit between two and one steps below the desirable minimum radius. These curves constitute relaxations in horizontal curvature and although this does not offer the optimum service of road, it should generally not pose safety issues or result in an unsatisfactory road alignment. When these relaxations occur on approach to a junction however, they are considered a departure from standard under the DMRB.

In addition to the sections of sub-standard curvature, there are four sections of the route comprised of compound curves. A compound curve is made up of two or more circular arcs in the same direction which should generally be avoided in road design to reduce driver involvement and help maintain a smooth flowing alignment. This is of particular relevance where a larger radius curve leads in to a tighter radius curve as a driver may not perceive the approach of a tighter bend.

A plan highlighting the sections of road where sub-standard curves and compound curves have been used is included in Appendix 2. The collision information available does not indicate any specific correlation between the sections of the alignment that do not meet the desirable minimum and the collision occurring at those locations.

The vertical alignment of this section of the A9 has not been reviewed as there is insufficient topographical data available to allow this to be undertaken at this time. It is recommended that a this be undertaken at subsequent stages of Scheme Assessment. Topographical information will also permit an assessment of junction visibility to be undertaken.

### **2.6.2 Junctions**

There are 90 existing junctions (see Table 10 below) that currently connect the A9 dual carriageway to various types of side roads and accesses. A summary and brief description of the types of junctions is given below.

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TYPE OF JUNCTION		NUMBER OF JUNCTIONS
At Grade Junctions	Roundabout	1
	A & B Class Road	6
	C Class & Unclassified Road	28
	Private Access	24
	Agricultural Access	18
	Woodland Access	6
	Services	3
Grade Separated Junctions		4

Table 10 - Summary of Existing Junctions on the A9 from Keir Roundabout to West of Broxden Roundabout

#### 2.6.2.1 Grade Separated Junctions

There are four existing grade separated junctions between Keir Roundabout and Broxden Roundabout.

- A820/Doune Road grade separated junction west of Dunblane.
- Queen Victoria Slip Roads north of Dunblane, which connects the B8033 to the A9.
- A822 southbound merge from Greenloaning.
- Loaninghead Interchange (Gleneagles) which connects the A823 to the A9.

Whilst the first, second and fourth junctions listed above are considered fully grade separated, the Greenloaning junction only provides grade separation for traffic travelling southbound from the A822. Traffic turning into the A822 from the southbound carriageway on the A9 is still required to undertake an at-grade manoeuvre at the north-eastern end of Greenloaning.

#### 2.6.2.2 Roundabouts

Keir Roundabout forms the southern terminal point of the A9 dual carriageway after which the A9 continues as a single carriageway local road through Bridge of Allan, Stirling and Falkirk. It is a five armed roundabout that provides additional connections to the M9 motorway, which continues south towards the Central Belt, the B8033 and the B824 which lead to the towns of Dunblane and Doune, respectively. The roundabout has an inscribed circular diameter of approximately 140 metres and a circulatory carriageway width of 9.5 metres.

#### 2.6.2.3 A & B Class Roads

Two A Class road junctions and four B Class road junctions currently connect the A9 dual carriageway.

- A824 south of Auchterarder;
- A824 north of Aberuthven;
- B8081 south of Blackford;
- B8081 northbound merge only located just north of Blackford;
- B9141 located at Broom of Dalreach; and
- B934 priority junction which leads to the village of Forteviot.



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The layout of the A and B class roads varies significantly from appropriate lengths for both diverge and merge lane, to short diverge and no merge, to a simple priority junction. Each of the junctions connecting the A and B class roads accommodates right turning traffic in both directions through gaps in the central reserve.

#### 2.6.2.4 C & Unclassified

There are 28 C Class or Unclassified (U) side roads which connect to the A9 via simple priority junctions which cater for right turning vehicles entering or exiting the A9 through gaps in the central reserve. A number of these junctions include a short diverge taper for traffic leaving the A9.

#### 2.6.2.5 Private, Agricultural and Woodland Access

There are 24 private accesses which serve residential and commercial properties adjacent to the A9. The standard of junction varies along the A9 route with a number including a short diverge taper lane. The majority of these junctions include a gap in the central reserve for right turning manoeuvres.

In addition to the private accesses, there are a further 18 agricultural and 6 woodland accesses with direct access onto the A9 dual carriageway. Many of these accesses face a gap in the central reserve and therefore cater for both right and left hand turn movements.

It should be noted that certain assumptions have been made in relation to the classification of U class roads and the various forms of private side road based on the available information. Consultation with the relevant local authority will be necessary at a more advanced stage of the assessment process to determine the precise status of these roads.

#### 2.6.2.6 Services & Rest Areas

The A9 between Keir Roundabout and Broxden Roundabout has 3 online services and rest areas located along its length.

Balhaldie Services is located roughly half way between Dunblane and Greenloaning. On the southbound carriageway, services include a Shell fuel station and a vacant restaurant. On the northbound carriageway there is access to another vacant restaurant, the now closed Oliver's Grill and Diner.

The Loaninghead fuel station lies just west of the Loaninghead Interchange on the northbound carriageway. The proximity of the exit lane of the fuel station and the off slip road for Loaninghead Interchange result in below standard weaving lengths that may pose safety issues.

Local services available within the village of Blackford are also signed from the A9.

#### 2.6.2.7 Review of Junction Geometry

The geometry of existing side road junctions was reviewed against current DMRB standards detailed within TD42/95. The key geometric requirements for minor road junctions with a dual carriageway with a design speed of 120kph are summarised in the table below.

Capabilities on project:  
Transportation

Geometric Design Feature	DMRB Reference	Geometric Standard
Corner Radii: Simple Priority Junction	TD42/95, Para. 7.17	Where no provision is to be made for large goods vehicles, it is recommended that the minimum circular corner radius at simple junctions....should be 10m in rural areas. Where provision is to be made for large goods vehicles, the recommended circular corner radius is: a. 15m at rural simple junctions, with tapers of 1:10 over a distance of 25m; b. 15m at ghost island junctions, with tapers of 1:6 over a distance of 30m; c. 15m at simple staggered junctions, with tapers of 1:8 over a distance of 32m; d. 20m radius in all other circumstances.
Corner Radii: Diverge Taper/Lane	TD42/95, Para. 7.54	Above a design speed of 85kph, a radius of at least 40m shall be used to introduce the diverging taper/lane into the minor road.
Corner Radii: Merge Taper	TD42/95, Para. 7.61	Above a design speed of 85kph, a radius of at least 30m shall be used to introduce the merging taper from the minor road.
Diverge Taper/ Lane Length	TD42/95, Para. 7.55	The desirable lengths for a diverge taper/lane are as follows: - Up Gradient, 0 – 4% = 110m - Up Gradient, Above 4% = 80m - Down Gradient, 0 – 4% = 110m - Down Gradient, Above 4% = 150m <i>(If a diverge lane is provided, the above distances are inclusive of any taper length used to introduce the diverge from the nearside lane)</i>
Merge Taper Length	TD42/95, Para. 7.62	The desirable length for a merge taper is 130m. <i>(This distance may be proceeded by a short nose of 40m length)</i>

Table 11 - Geometric Standards for Side Road Junctions

This review identified instances at nine junctions where one or more geometric feature (corner radii, diverge taper/lane length and/or merge taper length) do not satisfy the current design standards. These are summarised in the table below; details from the geometric analysis of all junctions are contained in Appendix 3.

Junction	Location (NB – Northbound SB – Southbound)	Geometry Element	Provision at junction	Design standard min.
Greenloaning	NB Ch 12460m	Diverge corner radius	16m	40m
		Exit corner radius	15m	20m
Blackford South	NB Ch 18570m	Diverge corner radius	30m	40m
Blackford South	SB Ch 18570m	Entry in corner radius	14m	20m
		Exit corner radius	15m	20m
A9 A824 (N)(C9)	NB Ch 30620m	Diverge corner radius	23m	40m
Findo Gask	NB Ch 33080m	Diverge corner radius	32m	40m
Forteviot	NB Ch 36740m	Entry corner radius	12m	20m
		Exit corner radius	11m	20m
Forteviot	SB Ch 36810m	Entry corner radius	15m	20m
		Exit corner radius	15m	20m
Windyedge Cottage	NB Ch 40410m	Entry corner radius	10m	20m
		Exit corner radius	10m	20m

Table 12 - Junctions with sub-standard geometric features

The table below details the elements of the service station junctions which do not meet the current design standards.

Capabilities on project:  
Transportation

Service Station	Location	Geometry Element	Provision at junction	Design Standard min.
Balhaldie Shell Filling Station	SB Ch 9470m – 9530m	Diverge corner radius	16m	40m
		Exit corner radius	16m	20m
		Merge Taper	0m	130m
Balhaldie (Former Little Chef)	NB Ch 9610m	Diverge taper/lane length	37m	110m
		Diverge corner radius	30m	40m
		Exit corner radius	11m	20m
Loaninghead Filling Station	NB Ch 21700m	Diverge taper/lane length	71m	110m
		Exit corner radius	4m/9m (compound)	20m
		Merge taper	0m	130m

Table 13 - Service Area junctions with sub-standard geometric features

It should be noted that this analysis has been undertaken using OS Mapping Data and not topographical survey data. It is recommended that a review of this exercise be undertaken once topographical survey data is available.

### 2.6.3 Roadside Features

#### 2.6.3.1 Laybys

There are 28 existing laybys between Keir Roundabout and Broxden Roundabout, 13 on the northbound carriageway and 15 on the southbound. With reference to TD69/07 “The Location and Layout of Laybys and Rest Areas” of the DMRB, there is 1 Type A layby with the remaining laybys Type B. The standards as set out in TD69/07 state that for a 120kph dual carriageway road all laybys must be designed to Type A standard and include a diverge taper.

#### 2.6.3.2 Rail Services

Rail services run parallel to the A9 between stations at Dunblane and Perth. This section of the rail network is served by a single intermediate station at Gleneagles which is currently accessed by vehicular and pedestrian traffic via a direct access to the A9. Perth and Kinross Council are promoting a scheme to close this existing access and construct a new access to the Gleneagles Station via the Loaninghead Interchange. This work is expected to be complete by mid 2014.

#### 2.6.3.3 Bus Stops

There are 16 bus stops on the A9 dual carriageway, 9 on the northbound carriageway and 7 on the southbound carriageway. These are generally provided for with a bus layby of varying design and layout. However, at a location just west of Windyedge Cottages the bus stop is incorporated into a vehicular layby. There are a number of bus routes, both national long distance (inter-city) and local services, which serve the small towns and villages alongside the A9 that use the route.

#### 2.6.3.4 Non-Motorised User Provision

There is no longitudinal provision for Non Motorised Users (NMUs), however, a number of NMU facilities are provided at some of the towns and settlements that the route intersects. These facilities include:

- Uncontrolled pedestrian crossing, Keir Roundabout;
- Pedestrian footbridge, Dunblane;
- Uncontrolled pedestrian crossing, Greenloaning;
- Uncontrolled pedestrian crossing, west of Blackford;
- Uncontrolled pedestrian crossing, Blackford;
- Uncontrolled pedestrian crossing, Gleneagles Train Station;
- Uncontrolled pedestrian crossing, East Auchterarder;
- Pedestrian underpass, East Auchterarder;

Capabilities on project:  
Transportation

- Uncontrolled pedestrian crossing, Findo Gask;
- Uncontrolled pedestrian crossing, near Duplin Loch Road;
- Agricultural underpass, Windyedge; and
- Agricultural underpass, Lamberkine.

Equestrians also cross the A9 at various locations, both at grade and using existing underpasses. Consultation with the British Horse Society identified a list of crossing points on this section of the A9. This list is contained in Appendix 4.

There is no provision for cyclists along the A9 mainline, and consultation with the cycling charity CTC Scotland notes that while cycle traffic on the A9 is negligible, cyclists use crossing points at various locations throughout the study area to access the local road network. CTC note that safe crossing of the A9 to enable use of the rural road network on either side of the trunk road is important. CTC have provided further background on the A9 in a letter contained in Appendix 5.

#### 2.6.3.5 Street Lighting

The A9 is generally rural in nature between Keir Roundabout and Broxden Roundabout and therefore road lighting is limited to the following major junctions along the route:

- Keir Roundabout;
- Mill Hill Road Junction, Greenloaning;
- Blackford South;
- Auchterarder Junction;
- Aberuthven Junction; and
- Broxden Roundabout.

#### 2.6.4 Cross Section

Carriageways widths are in accordance with current standards, providing a width of 7.3m in both directions. Central median widths vary as described in Chapter 1 and existing verge widths vary significantly along the length of the route.

The edge of pavement details of both carriageways within the study area vary and include a kerb and gully arrangement, combined kerb and drainage and parallel filter drains with one metre hard strips. The widths of hard strips vary along the length of the road ranging from a negligible width to one metre – see plan in Appendix 6. TD27 of the DMRB notes that 1m hard strips offer an improved level of service and comfort for drivers. The additional width afforded by hard strips also contributes to lower driver stress. An overview of the edge of pavement details for each section of the study area is shown in the table below.

Capabilities on project:  
Transportation

SECTION OF ROUTE	EDGE DETAILS
Keir Roundabout to Queen Victoria Slips	One metre hard strips are present on both carriageways.
Queen Victoria Slips to Greenloaning	<p>For 1.8km beyond the end of Queen Victoria slip roads, on the northbound carriageway, combined kerb and drainage is used. Thereafter, a kerb and gully arrangement with hard strips of between 0.2m and 0.4m is used to Greenloaning.</p> <p>The kerb and gully arrangement with hard strips of approximately 0.2m to 0.4m wide is used on the whole of the southbound carriageway from Queen Victoria Slips to Greenloaning.</p>
Greenloaning to Loaninghead Interchange	<p>One metre hard strips are present from Greenloaning to just west of Blackford before reverting back to a kerb and gully arrangement with 0.2m hard strips. This arrangement is apparent on both carriageways.</p> <p>From Blackford to Gleneagles, kerb and gullies with negligible hard strip widths of approximately 0.2m are found. Again, this arrangement is mirrored either side of the carriageway.</p>
Loaninghead Interchange to Findo Gask	<p>The kerb and gully arrangement with negligible hard strips continues for the majority of the northbound carriageway between Gleneagles and Findo Gask. There is however approximately 600m of combined kerb and drainage immediately south of the Abbey Road overbridge.</p> <p>A 2.5km section directly south of Auchterarder has 1 metre hard strips on the nearside of the southbound carriageway. The remaining 8km of the section between Loaninghead Interchange and Findo Gask has a kerb and gully arrangement with hard strips roughly 0.2m wide.</p>
Findo Gask to Broxden Roundabout	<p>On the northbound carriageway, the kerb and gully arrangement with 0.2m hard strips continues to Broxden roundabout.</p> <p>On the southbound carriageway there is a 1km stretch of road with one metre hard strips immediately north east of Findo Gask. The remainder of pavement from Findo Gask to Broxden mirrors the kerb and gully arrangement found on the northbound carriageway.</p>

Table 14 – Review of route edge details

Capabilities on project:  
Transportation

## 2.7 Other Potential/Proposed Improvements

There are two notable improvements currently planned or under construction for this section of the A9. Perth and Kinross Council is promoting an improved access to the Gleneagles Railway Station that will close off the access with the A9 and provide direct access via the Loaninghead interchange.

Also, approval for house building in the Auchterarder area is conditional based on the provision of southbound slips on the A9 at the Shinafoot Underpass once a 500 house threshold is reached.

## 2.8 Existing Environmental Conditions

An Environmental Scoping exercise in line with the requirements of Volume 11 of the DMRB has been undertaken to consider the existing environmental conditions on the A9, identify key constraints and the scope of future assessments. This exercise included a baseline assessment to establish the existing conditions which summarised below under the following headings:

- Air Quality;
- Cultural Heritage;
- Landscape;
- Ecology and Nature Conservation;
- Geology & Soils;
- Community & Private Assets; and
- Road Drainage & Water Environment.

### 2.8.1 Air Quality

An Air Quality Management Area (AQMA) for PM10 (Particulate Matter up to 10 micrometers in size) and NO<sub>2</sub> is in place to the east of the A9 section of road encompassing the town of Perth. The border of the AQMA lies at the Broxden roundabout. Any changes to traffic flows within the AQMA will need to be carefully considered.

There are no local monitoring stations affiliated to the UK Automatic Urban and Rural Network (AURN) in the area. Background concentrations were provided by DEFRA<sup>4</sup> for the proposed upgrade section of the A9 and background points selected within Perth, Kinross and Sterling Council areas. These suggest that air quality objectives for annual mean NO<sub>2</sub> and PM10 were easily met at background locations.

The monitored concentrations indicate that existing air quality in the populated areas to the east and west of the study area are within the current annual mean NO<sub>2</sub> objective of 40 µg/m<sup>3</sup>, therefore it would be expected that concentrations along the scheme route, away from the influence of the A9, would also achieve objective values. However, an AQMA has been declared for Perth to the east of the A9.

### 2.8.2 Cultural Heritage

A total of 144 heritage assets are recorded within a 500m radius of significant junction locations as outlined in Table 15.



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SIGNIFICANT JUNCTIONS ON A9	HERITAGE SITES		
	SCHEDULED MONUMENTS	LISTED BUILDINGS	UNDESIGNATED SITES
Bridge of Allen Junction	1	10	17
Greenloaning Junction and associated access tracks	2	5	7
Blackford Junction and associated access tracks	1	0	5
Junction to the south of Auchterarder and associated access tracks	6	2	10
Junction to the north of Auchterarder and associated access tracks	2	0	24
Aberuthven Junction and associated access tracks	2	4	11
Cairnie Braes Junction and associated access tracks	0	0	11
Junction to the south of Perth and associated access tracks	0	1	23
<b>TOTAL</b>	<b>14</b>	<b>22</b>	<b>108</b>

Table 15 - Heritage Sites Summary

There are no World Heritage Sites, Historic Battlefields or entries on the inventory of Gardens and Designed Landscapes within 500m of the junction locations.

There are a total of 14 Scheduled Monuments located within the study areas. These date between the prehistoric and medieval periods and comprise standing stones, enclosures, the site of a cup marked stone, a burial mound, forts, settlements and the site of a long barrow.

There are three Conservation Areas located along the route at Dunblane, Ashfield and Bridge of Allen.

### 2.8.3 Landscape

#### 2.8.3.1 Description of Study Area

The baseline landscape has been described within a 5km buffer of the proposals, which are located along an existing section of the A9 dual carriageway between the Keir Roundabout to the south of Dunblane and the Broxden Roundabout on the western edge of Perth, where the A9 joins the M90 motorway.

Between Dunblane and Auchterarder the A9 passes through Strathallan and the broad valley of the Allan Water which runs to the north of the road corridor. Between Auchterarder and Perth the A9 passes through Strathearn, with the meandering River Earn to the north. These valleys are flanked by the rolling Sidlaw hills to the north and the Ochils to the south. To the north of the A9 the

Capabilities on project:  
Transportation

study area is primarily agricultural. To the south of the, A9 arable agriculture on the valley floor gives way to more pastoral farming in the rolling hills to the south.

The study area contains parts of the large settlements of Stirling and Perth, as well as a number of smaller towns including Dunblane, Bridge of Allan, Doune and Auchterarder. There are numerous smaller villages as well as individual dwellings and farmsteads throughout the landscape.

Views to and from the A9 road corridor are variable, with mature tree planting and embankments screening the road corridor in some sections. The A9 is a visible linear element cutting through the landscape.

#### 2.8.3.2 Landscape Character

Regional and local landscape character for the study area is described within SNH Review No. 122 Tayside Landscape Character Assessment (1999) and SNH Review No. 123 Central Region Landscape Character Assessment (1999)

The study area falls within the Tayside Lowlands Regional Character Area (RCA), as described in SNH Review No. 122, and comprises a series of lowland valleys flanked by the Ochil and Sidlaw Hills, which rise to over 500m in places. Much of the area is in intensive agricultural use, although woodland and field boundary trees have a strong influence over the character of the area. There are a large number of wealthy land estates, due in part to the productivity of the agricultural areas, relative proximity to Stirling and Edinburgh, and location of the area at the junction of key communication routes.

Within the study area there are thirteen local Landscape Character Types (LCTs): Lowland Hills, Forested Moorland Hills, Inland Loch, Lowland River Valleys, Lowland Hill Fringes, Lowland Valley Fringes, Farmed Moorland Hills, Flat Arable Farmland, Lowland River Corridors, Igneous Hills, River Valley Farmland, Broad Valley Lowland and Firth Lowland. Parts of Stirling and Perth also fall within the study area, these are classified as urban areas.

The A9 Keir to Broxden passes through five Landscape Character Areas (LCAs), which are outlined below:

- Teith / Forth / Allan LCA (part of the Lowland Valley Fringes LCT)
- Allan Water LCA (part of the Lowland River Valleys LCT)
- Strathearn and Strathallan LCA (part of the Broad Valley Lowland LCT)
- The Gask Ridge LCA (part of the Lowland Hills LCT)
- Firth of Tay LCA (part of the Lowland River Corridors LCT)

#### 2.8.3.3 Landscape Designations

##### Gardens and Designed Landscapes (GDLs)

GDLs are nationally important sites listed on the Historic Scotland Inventory of Gardens and Designed Landscapes in Scotland. The A9 passes through the designed parkland landscape of Keir House, to the south of Dunblane. The road corridor is also in close proximity to the smaller 18th century parkland landscape of Kippenross House approximately 1km to the east, along the valley of the Allan Water. Both of these Gardens & Designed landscapes contain areas of ancient and semi-natural ancient woodland. To the south-west of Auchterarder the A9 passes Gleneagles Hotel, set in a 20th century designed landscape noted for its golf courses. In the vicinity of Perth the road corridor is in close proximity to Dupplin Castle and Scone Palace.

##### Areas of Great Landscape Value (AGLV)

AGLVs are locally designated for their scenic quality and identified in the relevant Local Plan. The A9 passes through two AGLVs – one to the south and east of Dunblane, as identified in the Stirling Council Local Plan (1999) and another which surrounds Perth, as identified in the Perth Area Local Plan (1995).

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#### 2.8.3.4 Conservation Areas

The A9 does not pass through or adjoin any Conservation Areas, however the following lie within the wider study area. From south-west to north-east: Cambuskenneth, Stirling, Drip Bridge, Bridge of Allan, Blairlogie, Doune, Dunblane, Ashfield, Dunning, Forgandenny, Pitcairngreen and Perth.

#### 2.8.3.5 Planning Designations

The A9 passes through land designated as Green Belt in the Stirling Council Local Plan (1999) encircling the western side of Dunblane and surrounding Perth, as described in the Perth Area Local Plan (1995).

#### 2.8.3.6 Landscape Quality

The quality of a landscape is a reflection of its attributes, such as the condition of its components, attractiveness and sense of place. Overall the study area is considered to be "Attractive." It is a distinctive landscape with a strong sense of place and integrity; a composition which is aesthetically and scenically pleasing; and a good example in the area of a reasonably well cared for landscape or set of features.

#### 2.8.3.7 Visual Receptors

Visual receptors in close proximity to the A9 have been described from south-west to north-east.

The A9 wraps around the western and northern sides of Dunblane, coming into close proximity with residential receptors on the north-eastern fringes of the settlement. The town is not visible from parts of the road due to screening by roadside tree planting and embankments, however some residential properties on the western edge of the settlement have elevated views of the road corridor.

North-east of Dunblane, the A9 is visible from properties on the southern edge of the village of Greenloaning and from several individual dwellings and farmsteads in the local area. There are open views of the A9 from the settlement of Blackford, partially filtered by vegetation between the village and the road corridor, particularly from residential receptors at the western end of the village.

The settlements of Auchterarder and Aberuthven are well screened from the A9 by mature roadside tree planting on embankment, however there are several dwellings and farmsteads at the A824 road junction with open views of the road corridor.

A group of residential receptors at the small hamlet of Broom of Dalreach, off the A9, have open views of the road corridor.

At the junction of the A9 and B934 at Upper Cairnie there are several dwellings with views of the road corridor.

At a junction with a minor road to the north of Windyedge there are several dwellings and a farmstead with open views of the A9 road corridor.

Although some screening is provided by tree planting and existing road infrastructure, the A9 and the Broxden Roundabout are visible from residential receptors in southwest Perth.

### 2.8.4 Ecology and Nature Conservation

#### 2.8.4.1 Designated Sites

There are a number of statutorily designated sites within 2km of the A9 between Keir and Broxden. There are a total of nine Sites of Special Scientific Interest (SSSI), three Special Areas of Conservation (SAC), one Special Protection Area (SPA) and one Geological Conservation Review Site (GCRS). A list of such sites is outlined below:

- Dupplin Lakes SSSI;
- Bog Wood & Meadow SSSI;
- South Tayside Goose Roosts SPA;
- South Tayside Goose Roosts Ramsar;
- Shelforkie Moss SAC;
- Carsebreck and Rhynd Lochs SSSI;
- Kippenrait Glen SAC;
- Kippenrait Glen SSSI;

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- Quoigs Meadow SSSI;
- Gleneagles Mire SSSI;
- Wolf's Hole Quarry SSSI;
- Craig Rossie SSSI;
- Craig Rossie GCRS; and
- River Teith SAC.

Additional to the sites listed above, there are a number of non-statutory designated sites within the Study Area. The A9 lies within or within close proximity of number of Semi-Natural Ancient Woodlands (SNAWI) and Ancient Woodlands (AWI).

In relation to RSPB Important Bird Areas, two sections of the South Tayside Goose Roosts IBA are located within the study area. These cover the same areas as Caresebreck and Rhynd Lochs SSSI and Duplin Lakes SSSI.

There are also a number of Local Nature Conservation Sites (LNCS) within close proximity of the scheme. Seven wildlife sites are located within 1km of the A9 between Keir and Broxden. Two of these sites have been surveyed and meet LNCS criteria, with five being provisional sites. The adopted LNCS includes Biggins Wood and greenyards Fen and Laighills/Allan Water (Barbush). Proposed sites include Allan Water (Kippenross-B of Allan), Auchinlay Moor, Ashfield Railway Cutting and Pond, Whiteston Moss and Shanraw Meadow.

#### 2.8.5 Geology & Soils

##### 2.8.5.1 Geology and Geomorphology

The superficial deposits recorded along the study route generally comprise Glacial Till and Fluvio Glacial Deposits (gravel, sand and silt). Alluvium and River Terrace Deposits (gravel, sands, silt and clay) associated with the Allan Water flood plain and the River Earn flood plain to the south and north of the study route respectively are also present. Peat is recorded in the vicinity of the roundabout adjacent to Gleneagles Station.

Borehole logs relating to the study route indicate the thickness of superficial deposits to be between 4 and 6m, although Fluvio Glacial deposits were recorded to a depth of 20m in the vicinity of Gleneagles Station.

The underlying bedrock is recorded as the Dunblane Sandstone Member between Dunblane and Greenloaning with a band of Buttergask Flagstone (sandstone and mudstone) along the south of the study route. Sheriffmuir Sandstone is shown between Greenloaning and Aberuthven. Between Aberuthven and Broom Dalreoch the bedrock is recorded as the undifferentiated sandstone, siltstone and mudstones of the Arbutnott-Gavock Group and Strathmore Group. The remaining study route to Perth is underlain by the Scone Sandstone Formation.

Quartz-Microgabbro Dykes are recorded within the study route in the vicinity of Gleneagles Station and between Broom of Dalreoch and Broxden roundabout.

##### 2.8.5.2 Hydrogeology

The different types of bedrock along the study route are classified as moderately productive aquifers. Borehole logs relating to the study route recorded groundwater levels at 1.2m, 6m and 9m bgl at the Keir roundabout, Blackford junction and Loaninghead Interchange respectively.

The study route is located within a Drinking Water Protected Area.

A total number of eight groundwater abstraction wells are located within the vicinity of the study area.

#### 2.8.6 Noise and Vibration

The existing noise climate is dominated by noise from road traffic on the A9. In addition there is a railway which runs parallel to the A9 to the north from Dunblane to Blackford and then continues south of the A9 to Perth.

Part of the A9 from Broxden Roundabout to Cotton Cottages has been noise mapped by the Scottish Government under the EU Directive 2002/49/EC and can be viewed at the following website:

<http://www.scottishnoisemapping.org/public/view-map.aspx>

Capabilities on project:  
Transportation

The noise contours shown on the map for this area of the A9 will be typical for most parts of the A9 between Dunblane to Perth as the terrain is reasonably flat, open countryside.

Day and Night Noise Contours alongside rural areas A9 Dunblane to Perth<sup>1</sup> indicate that any properties within about 500m of the A9 are already dominated by noise from traffic on the A9 where the view of the road is not screened both during the day and to some extent during the night dependent on their exact location. This assessment is based on approximate day and night noise contour locations.

Due to the noise from road traffic on the A9, noise from trains on the railway between Dunblane to Perth are unlikely to affect the noise climate at the sensitive receptors near to where any potential graded separated junctions may be located<sup>1</sup>.

## 2.8.7 Community and Private Assets

### 2.8.7.1 Land Use Of The Wider Area

Within north central Scotland, primarily consisting of the Perth and Kinross Council area, the landscape is dominated by a rural landscape. The land is undulating with more severe gradients found to the north and west of the area where the Grampian mountain range presides.

Throughout the region, scattered areas of ancient and planted woodlands are common, although the majority of the land in the area is used for agricultural purposes. However under the Macaulay Land Use Capability for Agriculture (LCA) the quality, or grade, of the land is low, typically ranging from Grade 3.1 to 6. The LCA is a seven class system, of which four have been further subdivided into divisions. Class 1 represents land that has the highest potential flexibility of use whereas Class 7 land is of very limited agricultural value.

Due to the variability in the quality of the land, the agricultural purposes also vary, but are typically mixed crops, improved grassland and rough grazing. There is also a significant water course, the River Earn that runs north-west to the east as a tributary to the River Tay. Relevant rivers and smaller water courses are discussed in Chapter 12 Road Drainage and the Water Environment.

Where settlements occur, they're typically small with medium to low density residential properties and contain few local community amenities such as shops, post offices, churches, parklands and open spaces. Settlements typically lie at the south and east of the district, with Perth and Stirling being the bigger towns in the area. Other towns and villages include: Crieff, Auchterarder, Comrie, Callander and Dunblane.

### 2.8.7.2 Designations

Along the Keir-Broxden route of the A9 the road passes through or within the vicinity of several statutorily designated sites. These areas are primarily recognised for their biological importance, particularly pertaining to the provision of habitat types, such as the Kippenrair Glen Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC), Quoigs meadow SSSI, Carsebreck and Rhynd Lochs SSSI, Shelforkie Moss SAC, Bog Wood and Meadow SSSI, Gleneagles Mire SSSI, Kincardine Castle Wood SSSI, and South Tayside Goose Roosts Ramsar.

Other sites in the area are also noted biologically in relation to protected fauna found within the area. These sites are the South Tayside Goose Roosts SPA which includes the Carsebreck and Rhynd Lochs and Dupplin Lakes SSSIs for their ability to support populations of Greylag and Pink-footed Geese, waterfowl and winter duck. The River Teith SAC is also within the study area and supports four international qualifying features including River lamprey, Brook lamprey, Sea lamprey & Atlantic salmon.

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<sup>1</sup> Noise contours are for free-field propagation: day noise levels  $L_{A10,18h}$  are derived from EU noise index  $L_{den}$ : P G Abbott and P M Nelson *Converting the UK Traffic Noise index  $L_{A10,18h}$  to EU noise indices for noise mapping* Project Report PR/SE/451/102 TRL Limited. 2002 (<http://webarchive.nationalarchives.gov.uk/20111214082045/http://archive.defra.gov.uk/environment/quality/noise/research/crtn/index.htm>)

Capabilities on project:  
Transportation

There are a further two areas that are recognised for geological importance; Wolf's Hole Quarry SSSI and Craig Rossie SSSI & Geological Conservation Review Site (GCR), as well as the Braco, The Gleneagles Hotel and Dupplin Castle Gardens and Designated Landscapes.

#### 2.8.7.3 Non-Statutory Designated Sites

Throughout the entire area there are several sites of ancient and semi-natural woodlands, some of which lie within close proximity of the road route which may be impacted as a result of the Development. The sites at which there is a greater likelihood of these woodlands being affected by the development are of the grade separated junction works at Keir Roundabout, Cairnie Braes (B934) and the A9/ Roman Road junctions, however there are other patches which are present that line or lie adjacent to the road which may also be impacted during the works associated with the closure of the central reserves.

There are no country parks, regional parks or local nature reserves within the study area.

The designated and protected areas are further detailed and assessed within their relevant chapters within this report (Chapter 5 Landscape Effects, Chapter 6 Ecology & Nature Conservation, and Chapter 7 Geology & Soils).

#### 2.8.7.4 Public Rights Of Way & Core Network

There are a number of core paths along and within the vicinity of the A9 predominantly around the settlement areas on the route.

At Keir roundabout (Dunblane), the local access track that joins at the east is part of a Core Path that runs to the south and east of the junction, and this is another Core Path that runs parallel to the east of the A9, north of the Keir roundabout from Hungryhill Wood to Dunblane High School.

Around Blackford and two miles to the west there is a network of Core Paths, which further extend and join with those in Gleneagles and lies within close proximity to the A9 and then in to Auchterarder. From Auchterarder, these Core Paths extend further east along the route of the A9 to Broom of Dalreoch and discontinuously on to Cairnie (A9 and B934 junction).

At the western end of the route, at Broxden roundabout, as with Dunblane there is a cluster of Core Paths within Perth and to the north, east and south-east of the current roundabout.

#### 2.8.7.5 Community

The A9 between Dunblane and Perth covers a distance of approximately 42km and expectedly passes through various land use types. These two major settlements are assumed to contain a number of the community facilities set out by the DMRB guidance (as listed above under 11.2 Community) and therefore have not been individually identified.

Running from west to east (Dunblane to Perth), the community facilities that are offered to the local population are centred within the smaller settlements, typically running adjacent to the course of the road.

At Greenloaning and Braco there are two schools (Greenloaning and Braco Primary Schools), areas of open space that could be used for recreational purposes and a church.

Within Blackford, there is the Blackford primary School, a church, a small number of local shops (one of which offers post office facilities) and some parkland and open areas.

Gleneagles, Auchterarder and Aberuthven villages are located in close proximity to each other and together create the largest populated area between Perth and Dunblane. This cluster of villages is entirely to the north of the A9, and is further accessed from the north of the village by a network of B-roads, entering Auchterarder from the B8062.

These communities support two schools (Ochil Tower School and the Community School of Auchterarder), St Margaret's Health Centre and a number of dentistry practices, several churches, numerous open spaces, parks and Live Active Leisure centre are also present within the area. Further to this the area also has a post office (Auchterarder) and three aged-person homes. The vast majority of these amenities lie on or directly adjacent to Church Rd/ Orchil Rd/ Townhead/ High St/ Feus/ Main Rd which passes from Gleneagles, through Auchterarder, to Aberuthven and runs parallel to the A9. This road, particularly at Townhead



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and High Street (in Auchterarder) has a greater density of local shops and businesses than the surrounding areas, and is further identified for commercial development within the Local Plan and the Proposed Plan for the Strathearn area.

There are no other community facilities further east of Aberuthven on the A9. The other closest facilities are in Dunning, a small settlement 4km south of the A9 at Broom of Dalreoch.

Table 16 below shows the populations of the settlements found on the A9 within the Study Area between Dunblane and Perth. Data was gathered from the General Register Office for Scotland, and figures show the estimated populations from mid-2010.

SETTLEMENT	POPULATION
Auchterarder (inc. Aberuthven and Gleneagles)	4,760
Blackford	700
Dunblane	8,930
Greenloaning	141
Perth	45,770

Table 16 - Settlements on the A9 between Keir and Broxden

#### 2.8.7.6 Private Assets

##### Agricultural Land

The vast majority of the land adjacent to the A9 between Keir and Broxden roundabouts is agricultural. As is consistent with the surrounding area, the grade of the land is typically between Class 3.2 and 4.1 under the Macaulay Land Use Research Institute (MLURI) (now known as the James Hutton Institute) definitions, providing the potential to support mixed agriculture (various crops and improved grasslands).

To the south east of the A9 at Broom of Dalreoch (B9141 junction), and continuing west towards the north of Aberuthven, is an area of Class 2 land (a highly productive area, able to support a wide range of arable agriculture). This is the only area of Class 2 agricultural land in this area.

At the Cairnie Brae junction (A9 and B934), the east side (southern side of the A9) is of Class 3.1 (moderate range of crops, with high yields of cereals and grass and can also produce potatoes and other vegetables), which is termed Prime Quality Land. The western side of this junction the land is Class 3.2, as described previously.

This trend of better quality land on the southern side of the A9 road, and lower classified agricultural land to the north and west is also present at the Roman Road junction to the east of Cairnie Brae, which is also subject to grade separation.

There have been 37 agricultural buildings identified within the near surroundings of the A9 road. For the purpose of this desk-based study farm clusters have been considered a single unit and the count has included barns and other out-buildings as well as farm houses within the 'agricultural' stream.

##### Non-Agricultural Land

As noted previously there are several settlement areas along the course of the A9 between Keir and Broxden roundabouts. Further to afore mentioned community assets that these urban areas provide, there are also additional industrial and commercial sites within and between these areas. These have been summarised within the subsections below.

##### Residential Properties

Out with the main settlements (as shown in Table 16), a total of 35 properties have been identified within the near vicinity of the A9 road, many of which have direct access to the road itself. It is predicted that none of these properties will be required to be

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demolished to accommodate the Development, however it is predicted that there will be a requirement to take land (i.e. gardens) from some of these residential properties to accommodate works.

#### Temporary Or Holiday Accommodation

There have been four holiday-type accommodation properties identified along the length of the A9 corridor between Dunblane and Perth. The properties identified are diverse in nature and include a B&B, caravan park, holiday apartments and Duchally Country Estate. Excluding the country estate hotel, all of these facilities have direct local access to the A9.

#### Services

Two service stations are located on the A9 within the survey area. The first is located just east of Dunblane, and the second (Loaninghead Filling Station) is west of the Loaninghead Interchange.

#### Other Commercial

A total of five commercial (other than those at service stations, as noted above) and industrial buildings have been identified within the Study Area. For the purpose of the study this count has included those buildings that have direct access to the A9 and those immediately adjacent to the site of likely works. The units that have been found include the Scottish Water Auchterarder water treatment plant, the Tillibardine Distillery, Highland Spring Ltd factory unit and two small independent businesses.

#### Community Land

In Scotland, community land is determined as common or open space where “common” is defined as including any town or village green, and “open space” means any land laid out as public parks or used for the purpose of public recreation, or land which is a disused burial ground.

There are three golf clubs within the study area. Gleneagles Golf Club is the largest of these with three courses and additional practice areas within its complex. The other clubs in the area are Auchterarder and Whitemoss Golf Clubs, both of which have one course.

There is also the Thistle Stables, a local riding centre just to the West of Blackford.

There are no heritage sites, listed buildings, scheduled monuments or battlefield sites within the study area surrounding the A9. Greater detail of the heritage in the area is provided in Chapter 4 Cultural Heritage.

#### Development Land

Within the DMRB Volume 11, Section 3 Part 6 guidance, development land is defined as ‘land identified in the local and structure plans that has been allocated for potential future development.’

For the purpose of the study, the development land relevant to the Development has been identified from the current and proposed plans of the Strathearn and Perth Areas and Stirling Council. The areas of proposed development are resigned to the urban areas.

Auchterarder – predominantly, land set for development is located to the north east of the town, with additional areas of land for housing development and open space within the town itself. Those areas of development land closest to the road are typically for industrial uses (at both east and west ends of the town) and are also unlikely to be affected by the works.

Aberuthven – the settlement is split between areas for housing development and industry/ business development, with the area directly adjacent to the road subject to landscaping works or open space. However, the main development sites are not likely to be affected by any potential improvements.

Blackford – within Blackford there are areas of committed development for housing, industry and business, open space and landscape treatment. The area surrounding the junction set for grade separation is currently used by industry (Tillibardine Distillery), and a potential housing site to the north west of the junction.

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Greenloaning – areas of landscape treatment are closest to the A9, and there are also housing sites within the village itself. Around the area to the west of the village, where the works are likely to take place, there are no areas identified for committed development.

For the additional urban areas in the region, Gleneagles and Braco, these areas are set back from the A9 and are therefore not likely to be affected by the works around the junction improvements. Around the other junctions that are set for grade separation there are no areas designated for future development.

#### Schedule Of Properties

Along the length of the A9 route subject to development, there are further individual and small local access points to the dual carriageway. Each of the properties that gain direct access to the A9 through local access tracks, or are otherwise deemed to be potentially impacted by the Development have been highlighted below in Table 17.

PROPERTY TYPE	NUMBER
Agricultural	37
Residential	35
Temporary/ Holiday accommodation (hotels, B&Bs, caravan parks etc.)	4
Services	2
Industry	5
Total	85

Table 17 - Schedule of Properties with Direct Access to A9

The properties listed above have been counted from out with the named settlement areas that have been previously mentioned (Table 16).

At the larger urban areas (Dunblane, Perth and Auchterarder), land use is highly diverse, and has been determined to include recreational land, farms, woodlands, parklands, urban centres, large complex buildings, low, medium and high density residential, retail parks, and industrial areas.

The land uses and community facilities of the smaller settlements that are predicted to be impacted by the Development are detailed below.

#### 2.8.8 Road Drainage and the Water Environment

##### 2.8.8.1 Designations

Within the study area there are a number of sites of international and national importance. Those relating to the water environment are the Carsebreck and Rhynd Lochs and the Dupplin Lakes Sites of Special Scientific Interest (SSSI). These areas are also part of the South Tayside Goose Roosts RSPB Important Bird Area, which is also an internationally recognised RAMSAR site (see Chapter 6 Ecology & Nature Conservation).

The Carsebreck and Rynd SSSI is approximately 500m north of the A9 between Greenloaning and Blackford, and over 2km from the Greenloaning/ B8081 junction. The Dupplin Lochs SSSI is approximately 300m from the A9.

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The entire study area is designated under the Fresh Water Fish Directive Salmonid Waters (2006/44/EC) as defined by the European Commission. Further to this, all groundwater catchments within the study area are designated under the Drinking Water Directive Groundwater SEPA, as is the River Earn.

The River Teith also passes through the study area ~1.8km south west of the Keir Roundabout. The river is Special Area of Conservation (SAC) for its populations of certain fish species.

#### 2.8.8.2 Waterbodies

There are a number of groundwater and surface waters within the study area that may be impacted by the Development. These waterbodies have been listed below. The waterbodies within the study area that SEPA (Scottish Environment Protection Agency) have information sheets for are: Allan Water (from source to Greenloaning, Greenloaning to Dunblane and d/s of Dunblane), River Knaik, River Earn, Pairney Burn and Ruthven Water. Of these surface waters only Pairney Burn and Ruthven Water have an overall status of 'good', whereas the others have a status of 'moderate' (Allan Water between Greenloaning and Dunblane), 'poor' (River Knaik and River Earn), or 'bad' (Allan Water from source to Greenloaning and d/s of Dunblane).

#### 2.8.8.3 Groundwater

Within the study area there are six groundwater catchments. As noted previously these are all designated under the Drinking Water Directive Groundwater. The catchments in the area are:

- Doune bedrock and localised sand and gravel aquifers
- Allan Valley sand and gravel
- Crieff bedrock and localised sand and gravel aquifers
- Glenfarg bedrock and localised sand and gravel aquifers
- Earn Valley sand and gravel
- Perth bedrock and localised sand and gravel aquifers

Predominantly these groundwater bodies are classified as being of 'good' overall quality, with the exception of Glenfarg and Earn Valley however these areas are expected to be of 'good' quality at the next target year in 2015.

#### 2.8.8.4 Surface water

There are two primary river catchments within the study, which are:

- Allan Water, from Keir Roundabout to the east of Blackford
- River Earn, from west of A823/Loaninghead Interchange to west of Broxden

The extreme east of the study boundary (Broxden roundabout) also has a further two catchment areas of Perth Coastal and the River Tay, the latter of which is also designated under the Fresh Water Fish Directive for Salmonid Waters.

From west to east, the main surface waters that are present within the study area are the River Teith. This passes to the south west of the Keir junction and is ~1.5km away from any likely areas of work, however as it is an SAC site it is recommended that further assessment is carried out in Stage 2 to determine whether or not it is likely to be impacted by the Development.

Allan Water, one of the rivers present within the study area that is designated under the Fresh Water Fish Directive for Salmonid Waters, flows from east to west within the same valley as the A9 route between Blackford and Dunblane. The majority of its tributaries come from the south from the Ochil Hills, with some others from Cromlet and Slynaback hills to the north.

Allan Water crosses the A9 at Blackford, where it joins with tributary Ogilvie Burn (which also crosses the A9); and travels adjacent to the A9 from Blackford through Greenloaning, where it is joined by a number of smaller tributaries such as River Knoick, and to north Dunblane, before re-crossing the A9. The river exits the study area running parallel to Keir roundabout to the east of the M9.

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The Ruthven Water joins the A9 route from the southern side at Auchterarder village and runs in a north easterly direction along the A9 to the east of the village where it is joined by the Pairney Burn, its point of confluence of which is at the A9 junction with the B8062. The river continues on the route of the A9 to Aberuthven, before flowing north and joining with the River Earn.

The River Earn, also designated under the Fresh Water Fish Directive Salmonid Waters, as well as the Drinking Water Directive River SEPA, and as a Nitrate Vulnerable Zone, enters the study area north of Aberuthven village, flowing in an easterly direction toward the Tay estuary. In regards to the Development, the river crosses the A9 to the east of Broom of Dalreoch, ~500m from the B9141 junction.

Tributaries to these main water bodies and other surface waters that cross, or are in close proximity to, the study area are listed below in Table 18.

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WATER BODY	TRIBUTARY TO	LOCATION DESCRIPTION
Ryland Burn	Allan Water	Source is within Sheriffmuir Big Wood to the north west of Dunblane and flows east to merge with Scouring Burn and then Allan Water within the town.
Scouring Burn	Allan Water	Crosses the A9 north of Dunblane, flowing due south through the town, joining Allan Water north of the town centre.
Bracklin Burn	Allan Water	Joins Allan Water upstream of Dunblane town, with its source from the upland area north of the A9 route. Does not cross the A9 with its point of confluence 1.8km north of the road.
Todhill Burn	Allan Water	Flows due north, crossing the A9 immediately west of the Balhaldie service station, before joining Allan Water north of the parallel road and rail lines.
Muckle Burn	Allan Water	Joins Allan Water from the north with its source at Slymaback. Its confluence with Allan Water lies to the west of Greenloaning and north of the A9.
Glassingalbeg Burn	Allan Water	Flows due north, crossing the A9 immediately east of the Balhaldie service station, before joining Allan Water north of the parallel road and rail lines.
Geordie's Burn	Allan Water	Flows due north, crossing the A9 between the Balhaldie service station and Greenloaning village, before joining Allan Water north of the parallel road and rail lines.
Millston Burn	Allan Water	Joins with Green Burn south of Greenloaning and flows due north to the immediate west of the village with the Allan Water confluence at the north of the village.
Feddal Burn	Allan Water	Flows from west to east from its source at Feddal Hill and joins Allan Water from the north at Braco/ Greenloaning. Does not cross the A9.
Keir Burn	Allan Water	Joins Allan Water from the north to the immediate west of Braco/ Greenloaning. Does not cross the A9 road.
Blueton Burn	Allan Water	As with Milston Burn, this water course flows due north through the route of the A9. The point of crossing is ~1.5km east of Greenloaning.
Danny Burn; Back Burn, Kinpauch Burn, Damakellis Burn and Bardrill Burn.	Allan Water	The Allan Water confluence with Danny Burn is the same as that of Ogilvie Burn, to the north west of Blackford village. The watercourse passes through the village, crossing the A9 at the B8081 junction.
Dairy Burn	Ruthven Water	Dairy Burn crosses both the railway track and A9 from south to north, joining Ruthven Water adjacent to the A9 (on the northern side)*. This point of confluence is ~500m from the B8062 junction, east of Auchterarder.

\* there are a further two unnamed water courses that join Ruthven Water immediately adjacent to the A9, but have not been included any further within the study as they are not likely to be subject to any further impacts from the Development.

Table 18 - Other Surface Water Bodies Within the Study Area



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#### 2.8.8.5 Lochs

Further to the designated lochs mentioned above, there is also White Moss Loch, south of Aberuthven and greater than 1.5km from the A9. Assuming that good practice measures are implemented during the construction phase of the Development, it is unlikely that this loch will be impacted and can be scoped out of further assessment.

#### 2.8.8.6 Flooding

Each of the points at which the aforementioned watercourses cross the A9 are subject to flooding (as mapped by SEPA). Much of these are areas of localised flooding from the smaller watercourses, however at Broom of Dalreoch where the River Earn crosses the A9 there is a substantial flood plain, from which the SEPA Indicative Flood Map shows the extent of a 1:200 year event to extend to the eastern edge of the junction.

The only other two grade separated junctions likely to be impacted by flood waters are those at Blackford (B8081) and Auchterarder (B8062), the extent of which is substantially smaller however still covering the current junction.

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## 3 Route Strategies and Options

### 3.1 Introduction

The Strategic Transport Project Review, published in 2008, affirmed the Scottish Government's commitment to improving the A9 between Dunblane and Inverness. STPR 16 supports the objectives to promote journey time reductions between Inverness and the Central Belt, improve the operational effectiveness of the A9, reduce the severity of collisions and address driver frustration.

The promotion of journey time reductions and reducing collision severity are particularly relevant for the section of the A9 between Dunblane and Perth.

This chapter provides a summary of the strategies considered in seeking to achieve the scheme objectives. The existing situation at Keir Roundabout is reviewed with particular reference to the congestion and collisions. This review considers the STPR recommendation to grade separate Keir Roundabout and recommends that it is appropriate to be carried forward for further consideration at subsequent stages of Scheme Assessment.

The chapter considers three strategies for dealing with the remainder of the route between Keir Roundabout and Broxden Roundabout.

Strategy 1 sought to make best use of the existing infrastructure by proposing to close all median gaps, and utilising the existing grade separated junctions to facilitate u-turn traffic.

Strategy 2 considered the construction of new roundabouts on the A9 to facilitate u-turning traffic.

Strategy 3 considered the provision of a number of grade separated junctions at various locations along the route. The assessment undertaken allowed for the testing of a number of individual scenarios to find a solution which would:

- Minimise the additional trip lengths;
- Reduce additional vehicles at existing junctions; and
- Provide travel time and accident benefits.

Scenarios comprising construction of grade separated junctions at individual locations and combinations of several locations were tested to allow comparison between options.

### 3.2 Grade Separation of Keir Roundabout

Keir Roundabout can experience significant congestion at peak periods. A recent BEAR Scotland Report into queuing on the A9 approach to the roundabout concluded that queues typically start to form when the flow exceeds 1,400 vehicles per hour. When flows exceeded 1,500 vehicles per hour, queues could extend up to 2.5km from the junction. Significant queuing was most typically anticipated on Sunday, Monday and Friday evenings and would extend over a three hour period from 3pm onwards.

The queuing that results during certain periods at Keir Roundabout has a significant impact on journey times. The BEAR report noted that the maximum time recorded for a single vehicle waiting in a queue to reach the roundabout was 16 minutes.

The queuing that arises at Keir Roundabout is also a significant factor in collisions at the junction with 70% of collisions involving queuing vehicles. The collisions at Keir Roundabout accounted for 31% of collisions at all junctions on this section of the A9, but the majority of these were categorised as 'slight'. Grade separation of Keir Roundabout would not only improve journey times for the corridor but would also improve the collision record for that junction.

The journey time and collision improvements that it is anticipated can be elicited from grade separation of Keir Roundabout strongly favour its inclusion in any improvement strategy for this section of the A9. Therefore, it is recommended that grade separation of Keir Roundabout be taken forward for further consideration at subsequent stages of DMRB Assessment.

### 3.3 Alternative Strategies for Grade Separation between Keir Roundabout and Broxden Roundabout

STPR16 recommended grade separation of all junctions on the A9 from Keir Roundabout to south of Broxden Roundabout as one of a number of first phase interventions. The collision statistics for this section of the A9 between Dunblane and Perth supports the STPR's position for improvements.

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### 3.3.1 Collisions

STPR identified that many of the collisions on the A9 between Dunblane and Perth have occurred at the at-grade junctions noting that these collisions are often serious or fatal. Removal of these junctions would significantly reduce severity rate on this route.

Analysis of the collision data indicated that drivers are more than twice as likely to be involved in a collision while turning right or waiting to turn right on this section of the A9 when compared to driving elsewhere on the trunk road network (excluding motorways);

Furthermore, approximately 50% of all fatal collisions (in the period 2007-2011) have occurred while waiting to turn right or whilst actually making a right turn manoeuvre into or out of an at-grade junction. This is a key indicator of the importance of the closure of the central median gaps as part of any future strategy.

Various strategies to remove all right turn manoeuvres are discussed below.

### 3.3.2 Strategy 1: Do Minimum

As noted in the previous chapter the A9 is already served by a number of grade separated junctions along this section. As an initial step in this assessment and in keeping with the aspirations of the STPR, consideration was therefore given to making best use of the existing infrastructure and implementing median closures without the construction of any additional grade separated junctions.

The traffic impact of closing the central reserve along the corridor such that only left-in / left-out movements were permitted, forcing any right-turning traffic to use the existing grade-separated junctions or Keir roundabout was considered. It should be noted that estimates for turning traffic have been made for the smaller access roads while data for the main junctions was collected in 2012. Assuming that all detours occurred on-line would result in an extreme 'worst case' position in that all existing right turning traffic would be allocated to the nearest grade-separated junction. This is a situation which is unlikely to occur where an alternative local route is available such as at Auchterarder/Aberuthven. For example, if the right turn out at Aberuthven junction was not permissible, it is anticipated that the traffic wishing to make that manoeuvre would divert through Auchterarder to the A823 Loaninghead junction. In such cases traffic was assigned to the alternative routes.

In addition, it is noted that work is currently under way to improve access to Gleneagles Station through the closure of the link from the A9 and construction a new link to the Loaninghead junction. This works also results in the closure of the private access to Millhill Farm from the A9.

The most significant impact of central median closures and subsequent re-routeing is likely to be experienced at the Loaninghead junction. Currently there are in excess of 1900 right turns in to the Aberuthven junction and over 800 right turns out of the Auchterarder junction. The nearest option for these vehicles is to utilise the Loaninghead junction. In addition, there are in excess of 400 right turners out of Blackford which would also be expected to use the Loaninghead junction resulting in over 3,100 additional movements at the junction. This excludes movements to/from Gleneagles Station, other local access roads or the alternative right turns at both A824 junctions which may be expected to divert to the A823 and make use of the Loaninghead junction from that approach. Overall, it is anticipated that there could be a doubling of movements at the junction.

Elsewhere along the route the scale of traffic diverting to alternative junctions is not as significant. The assessment would suggest 1,000 additional movements at the already congested Broxden Roundabout junction and 950 at the Queen Victoria slips. However, the length of diversion that would be required could be excessive, assuming all right in/right out manoeuvres are prohibited. For example, prohibiting the right turn from the Findo Gask road at the Broom of Dalreoch junction would result in a 12.5 mile diversion via Broxden junction which is considered unsatisfactory from economic and accessibility perspectives.

An estimate has been made of the economic impact, relative to travel time and vehicle operating costs (VOC), as a result of the diversions for an assumed design year of 2040. Taking in to account the possible alternative routes that may be available to traffic if right turns were completely restricted, the assessment suggests that the travel time cost disbenefit would be around £15,000/day with some 112,000 additional vehicle kilometres on the network.

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The daily diversion would be substantial and this would result in significant numbers of additional trips through the existing junctions, many of which would be at peak times when the junctions already experience various levels of congestion. In addition, despite the removal of the right in/right out (RIRO) movements it may be expected that, based on WebTAG collision rates, there would be increased additional collision costs due to the increase in journey lengths. Despite the benefits gained from removal of the RIRO collisions this scenario is anticipated to result in significant disbenefits to the network and economy. This strategy was therefore discounted and consideration was given to providing additional junctions on the network to facilitate u-turning traffic.

### 3.3.3 Dual Carriageway Categorisation

With the need for additional u-turning facilities established, any new junctions provided should be considered with respect to the dual carriageway categorisation set out in the DMRB.

TD9/93 provides a general guide to the layout features appropriate for various types of roads, recommending edge treatments, access treatments and junction types that would be suitable in broad terms for various road categories. This is summarised in Table 19 below.

This section of the A9 would currently be considered a Category 5 Dual Carriageway, which is the lowest standard of Dual Carriageway under the DMRB, in that the central reserve is effectively open over the length of the corridor, and the majority of junctions are at grade. Closure of all median gaps would raise the standard of this section of the A9 to at least Category 6.

CATEGORY	TYPE OF ROAD	ACCESS TREATMENT	MINOR ROAD TREATMENT	MAJOR JUNCTION TREATMENT
5	Dual 2 Lane	Restriction of access to avoid standing vehicles and concentrate movements	Priority junctions. No other gaps in the central reserve.	At-grade roundabouts. Grade separation if economically justified.
6	Dual 2 Lane	Restriction of access severely enforced. Clearway	No minor junctions at-grade. No gaps in the central reserve.	At-grade roundabouts at lower end of range. Otherwise full grade separation.
7A	Dual 2 Lane	No access except isolated existing access with left turns only. Clearway.	No minor junctions at-grade. No gaps in the central reserve.	Full grade separation

Table 19 - Excerpt from Table 4 of TD9/93 of the DMRB: Recommended Rural Road Layouts

TD9 notes that in a Category 6 Dual Carriageway, gaps in the central reserve for turning traffic are not permissible, and major/minor junctions shall not be used. Minor side roads shall be stopped up, provided with left in/left out connections, or grade separated without connection. Major intersection types, which may include roundabouts, would be determined by site conditions, traffic demand, and economic/environmental effect.

### 3.3.4 Strategy 2: Roundabouts to facilitate u-turning traffic

Whilst STPR 16 identified grade separation as an appropriate solution for the route, consideration was given to the construction of new roundabouts as an alternative for facilitating u-turning manoeuvres. Roundabouts can be provided at a significantly lower price when compared to a grade separated junction and typically less space is required in their construction. However, TD9 notes that the high costs of delays caused by roundabouts will normally result in more economic grade separated solutions for dual carriageways with higher traffic volumes.

The introduction of roundabouts to deal with u-turning traffic and provide additional access to the side road network is likely to result in significant delay and potentially lead to queuing on the A9 during peak periods. This would not support the STPR

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objective of promoting journey times reductions between Inverness and the Central Belt, therefore the provision of roundabout at major junctions along the route is discounted, in favour of grade separation.

This would bring this section of the A9 more in line with the features of a Category 7A Dual Carriageway, which would provide a greater degree of route consistency with the planned dualling between Perth and Inverness, and the M9 motorway to south of Keir Roundabout.

### 3.3.5 Strategy 3: Grade separation of junctions

As noted above the closure of all median gaps will result in vehicles that previously would have made a right turn manoeuvre having to undertake a diversion to the next available grade separated junction on the route.

The closure of all median gaps without the provision of new facilities for turning would result in a significant increase in vehicle kilometres travelled. Any strategy to provide grade separation along the route should, in the interests of delivering value for money, seek to strike a balance between maintaining a reasonable level of access to and u-turning points on the A9, without resulting in an economically prohibitive scheme. The location of any new proposed grade separated junction or junctions relative to other existing or proposed grade separated junctions will have a significant bearing on this.

Locating any new grade separated junctions at or near those side roads with the largest volumes of right turning traffic will significantly limit the additional vehicle kilometres travelled. The other most significant factor in developing any junction strategy will be the location of new GSJs relative to existing and any other proposed.

These factors were considered together by developing a spreadsheet model to assess the likely impacts and benefits that can accrue from various combinations of grade separated junctions. To support this exercise, it is first important to consider the junctions that exist along the route and identify those which it may be appropriate to consider for grade separation.

#### 3.3.5.1 Junctions

There are 90 existing junctions of various standards that currently connect the A9 dual carriageway to various types of side roads and accesses between Keir roundabout and west of Broxden junction. These are summarised in the table below.

TYPE OF JUNCTION		NUMBER OF JUNCTIONS
Grade Separated Junctions		4
At Grade Junctions	Roundabout (Keir)	1
	A & B Class Road	6
	C Class & Unclassified Road	28
	Services	3
	Private Access	24
	Agricultural Access	18
	Woodland Access	6
<b>Total</b>		<b>90</b>

Table 20 - Summary of Existing Junctions on the A9 - Keir Roundabout to West of Broxden

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### 3.3.5.2 Grade Separated Junctions

Of the 90 junctions, there are four existing grade separated junctions:

- A820/Doune Road grade separated junction west of Dunblane;
- Queen Victoria Slip Roads north of Dunblane which connects the B8033 to the A9;
- A822 Greenloaning; and
- Loaninghead Interchange (Gleneagles) which connects the A823 to the A9.

However, as the Greenloaning junction only has south facing slip roads it does not provide grade separation for all movements at that location. Traffic turning into the A822 from the A9 north is still required to undertake a conflicting at-grade right-turn manoeuvre at the north-eastern end of Greenloaning.

### 3.3.5.3 A & B Class Roads

Two 'A' Class and four 'B' Class road junctions currently connect to the A9 dual carriageway:

- A824 south of Auchterarder;
- A824 north of Aberuthven;
- B8081 south of Blackford;
- B8081 northbound merge only located just north of Blackford;
- B9141 located at Broom of Dalreoch, leading to Findo Gask and Dunning; and
- B934 priority junction which leads to the village of Forteviot.



Capabilities on project:  
Transportation

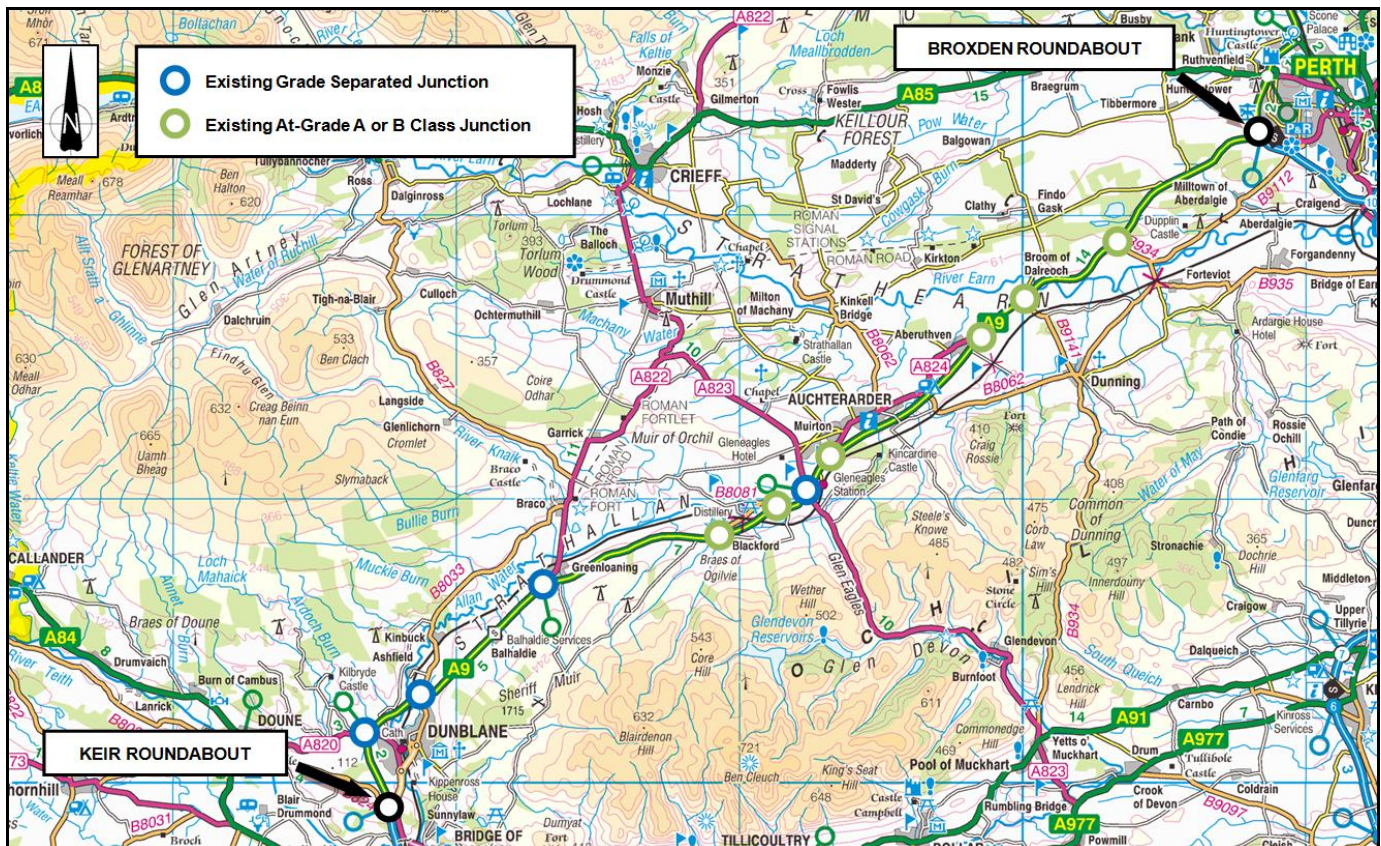


Figure 12 - Location of A Class and B Class road junctions with the A9

Each of the junctions connecting the 'A' and 'B' class roads accommodates right turning traffic in both directions through gaps in the central reserve.

#### 3.3.5.4 'C' & Unclassified

There are 28 'C' Class or Unclassified ('U') side roads which connect to the A9 via simple priority junctions that cater for right turning vehicles entering or exiting the A9 through gaps in the central reserve.

Services, rest areas, private, agricultural and woodland access are not considered appropriate for grade separation and are not considered further under this strategy.

#### 3.3.5.5 Traffic Flows

A review of available traffic data for the main carriageways and side roads was undertaken. As may be expected, due to the nature of the network no data was available for many of the side roads and for the purposes of reassignment under median closures, estimates have been made for these. In general, for the 'U' class roads which provide access to agricultural, residential and woodland premises/areas an annual average daily traffic (AADT) flow of 50 veh/day has been assumed. The service area/fuel stations on either carriageway are accessed via left in/left out junctions and estimates of up to 2000vpd have been made for movements in and out. A flow diagram indicating the traffic movements at each junction is provided in Appendix 7.

Capabilities on project:  
Transportation

There are ten 'C' class roads which have junctions with the A9 and flow levels vary from less than 100 vpd at the Buttergask junction west of Blackford to around 1200 at the Windyedge/Tibbermore junction.

Inclusive of the Queen Victoria slips there are six 'B' road junctions with the A9 however the only movement allowed at the B8081 at the north end of Blackford, is a merge for northbound traffic. This leaves the B8081 at Blackford (south), B9141 Findo Gask (Broom of Dalreoch) and B934 Forteviot as junctions where right turn manoeuvres are currently facilitated. The B8081 at Blackford is well used with the Highland Springs and Tullibardine Distillery both being serviced from it and, together with local traffic, producing around 2,300 traffic movements per day to and from the A9. At the B9141 there are around 1100 movements to/from the A9 while the B934 has around 650 movements suggesting that both of these are not as busy as the Tibbermore/Windyedge junction.

There are a number of 'A' road junctions;

- A820 Doune;
- A822 Greenloaning;
- A823 Loaninghead Interchange (Gleneagles);
- A824 Auchterarder (south); and
- A824 Aberuthven (north)

However, of these, only the A824 junctions are at-grade. The others are already grade separated although the Greenloaning junction only has south facing slip roads.

The A824 junctions have complementary movements in that the northern junction caters for significant left out / right in (2080 and 1940 respectively) while the southern junction primarily caters for left in / right out (1400 and 850 respectively). There are other conflicting right turn manoeuvres at each location but the numbers are low compared to the major turns.

The assessment has focussed on those minor roads with greater than 500 right turn vehicles movements per day in an assumed design year of 2040. These are summarised in Table 21 below. The proximity of the A824 (S) at Auchterarder to the Loaninghead Interchange would rule out the construction of a new grade separated junction here due to conflict arising from inadequate junction spacing. Therefore the construction of a grade separated junction with connection to the A9 at Auchterarder is not considered in this assessment.

Capabilities on project:  
Transportation

<b>NORTHBOUND</b>	<b>TRAFFIC FLOWS AADT (ASSUMED DESIGN YEAR OF 2040)</b>				
<b>JUNCTION NAME</b>	<b>LEFT IN</b>	<b>LEFT OUT</b>	<b>RIGHT IN</b>	<b>RIGHT OUT</b>	<b>SIDE ROAD TOTAL</b>
Dunblane / A820	1230	1496	-	-	2726
Dunblane North Grade Separated Junction	887	938	-	-	1825
Greenloaning	2409	-	-	-	2409
Blackford South (S)	824	557	976	583	2940
Blackford North (N)	-	761	-	-	761
Loaninghead Interchange A823	1408	-	-	-	1408
Loaninghead Interchange A9	-	964	-	-	964
A9 A824 (S)	1775	177	203	1077	3231
A9 A824 (N)	190	2637	2459	139	5425
Windyedge Cottage	393	646	418	291	1748

Table 21 – A9 Northbound side road traffic flows in excess of 500 AADT for an assumed design year of 2040

<b>SOUTHBOUND</b>	<b>TRAFFIC FLOWS AADT (ASSUMED DESIGN YEAR OF 2040)</b>				
<b>JUNCTION NAME</b>	<b>LEFT IN</b>	<b>LEFT OUT</b>	<b>RIGHT IN</b>	<b>RIGHT OUT</b>	<b>SIDE ROAD TOTAL</b>
Dunblane / A820	1560	1547	-	-	3107
Dunblane North Grade Separated Junction	1116	1230	-	-	2346
Greenloaning	-	2346	-	< 50	2346
Loaninghead Interchange	992	1902	-	-	2894
Findo Gask	355	342	279	406	1382
Forteviot	203	190	317	101	812

Table 22 – A9 Southbound side road traffic flows in excess of 500 AADT for an assumed design year of 2040

### 3.3.5.6 Collisions

Whilst collisions would typically be a useful indicator of those junctions that may merit grade separation, the provision of a central median barrier and closure of all median gaps would effectively remove all right turn manoeuvres onto and off the A9. The collisions resulting from these types manoeuvres would be eliminated and therefore collisions are not considered in this assessment.

The closure of median gaps will in some instances result in traffic diverting on to the side road network. It is recommended that further work be undertaken at subsequent stages of DMRB Assessment to assess the potential for collision migration.

Capabilities on project:  
Transportation

### 3.3.5.7 Economic Impacts

In order to provide an economic estimate of the impact of the median closures combined with the provision of new grade separated junctions, a spreadsheet assessment was developed which considered;

- turning counts;
- diversion distances; and
- travel times.

All costs were obtained from WebTAG.

The diversion distances also considered alternative local routes that may be used by motorists, such as those near Auchterarder, rather than the full A9 diversion.

Having determined the worst-case scenario under Strategy 1 (no new GSJs), subsequent iterations were tested with a view to optimising:

- additional trip lengths;
- additional vehicles at existing junctions; and
- travel time and collision benefits.

The scenarios tested provided grade separation at one or a number of the following locations in combination.

- Greenloaning;
- Blackford;
- Aberuthven;
- Findo Gask;
- Forteviot; and
- Windyedge Cottages.

The following tables summarise the findings indicating the site(s) which produced the best return through the addition of 1, 2, 3, 4, 5, or 6 junctions. For the purposes of the Stage 1 Assessment, it has been assumed that the cost of grade separated junction provision will be largely similar at each location and therefore this assessment was based on benefits only. The best performing combinations are summarised in Table 23 below. The 'Total Benefits' figure in the table includes for the collision savings made as a result of the RIRO restrictions.

NO. OF JUNCTIONS	LOCATION(S)	ADDITIONAL VEHKM/DAY	ANNUALISED TRAVEL TIME COSTS (£M)	ANNUALISED ADDITIONAL COLLISION COSTS (£M)	ANNUALISED TOTAL BENEFITS (£M)	ADDITIONAL DAILY MOVEMENTS		
						VICTORIA SLIPS	LOANINGHEAD INTERCHANGE	BROXDEN ROUNDAABOUT
1	A824 Aberuthven	64,570	-£3.37	-£0.73	-£2.06	1255	2061	1693
2	Blackford south	35,130	-£1.92	-£0.40	-£0.27	279	1326	1693
	A824 Aberuthven							
3	Blackford south	19,950	-£1.15	-£0.23	£0.67	279	1326	1156
	A824 Aberuthven							
	B9141 Findo Gask							
4	Blackford south	16,250	-£0.99	-£0.19	£0.87	92	1326	1156
	A824 Aberuthven							
	B9141 Findo Gask							
	Greenloaning							
5	Blackford south	11,850	-£0.70	-£1.35	£1.21	92	1326	101
	A824 Aberuthven							
	B9141 Findo Gask							
	Greenloaning							
	Windyedge							



Capabilities on project:  
Transportation

NO. OF JUNCTIONS	LOCATION(S)	ADDITIONAL VEH/KM/DAY	ANNUALISED TRAVEL TIME COSTS (£M)	ANNUALISED ADDITIONAL COLLISION COSTS (£M)	ANNUALISED TOTAL BENEFITS (£M)	ADDITIONAL DAILY MOVEMENTS		
						VICTORIA SLIPS	LOANINGHEAD INTERCHANGE	BROXDEN ROUNDABOUT
6	Blackford south	8,409	-£0.51	-£0.96	£1.44	92	1326	101
	A824 Aberuthven							
	B9141 Findo Gask							
	Greenloaning							
	Windyedge							
	Forteviot							

Table 23 - Junction Location Assessment

When the collision benefits of restricting the right in/right out movements are included, the results indicate that a minimum of three additional junctions may result in positive economic benefits in the first year (£0.67m). However, with three junctions the additional traffic on the existing grade separated junctions is anticipated to be relatively high.

With the six junction improvements the economic benefits are seen to increase to £1.44m with minimal additional traffic at the Victoria slips and Broxden.

In each case it can be seen that the overall benefits increase when compared to the previous scenario. In addition, there are slight reductions in the diverted flow at the Victoria slips junction.

This assessment has demonstrated that positive benefits can be achieved by a number of potential iterations, however it does not take construction costs into consideration. It has not yet been demonstrated that any particular scenario can deliver value for money and therefore further assessment would be required in this respect.

### 3.4 Additional Options for Grade Separation

The assessment undertaken and described above focussed on those junctions with greater than 500 right turn manoeuvres daily. It may be appropriate at subsequent stages of Scheme Assessment to give consideration to some form of grade separation at another two locations – the A824 at Auchterarder and Shinafoot.

#### 3.4.1 A824 Auchterarder/Loaninghead Interchange Link

The A824/A9 junction at Auchterarder was not included in the testing of scenarios described above due to its proximity to the Loaninghead junction. However, the various scenarios tested above all still result in over 1000 vehicles diverting through Gleneagles village. This additional traffic could be facilitated separately by providing an unconnected grade separated link from the A824 to the Loaninghead Interchange via the new Railway Link Road currently under construction. This would significantly reduce the volume of traffic diverting on the side road network whilst offering the added benefit of providing enhanced

Capabilities on project:  
Transportation

connectivity from the village of Auchterader to the railway station. A new link here would allow bus services to pass by the railway station further enhancing integration of the transport network

#### 3.4.2 Shinafoot

An existing underpass at Shinafoot offers further opportunity to provide a grade separated junction with the A9. The B8062 passes under the A9 midway between the towns of Auchterader and Aberuthven via the Shinafoot Underpass.

As a sensitivity test, the Shinafoot junction was included in the assessment to allow comparison to be made between a possible junction there and at A824 Aberuthven. The analysis undertaken suggests that a grade separated junction (GSJ) at Shinafoot does not provide as much benefit compared to a grade separated junction at A824 Aberuthven, however the difference was marginal.

### 3.5 Other Minor Roads/Accesses

TD9 states that for Category 6 or 7A Dual Carriageways, minor side roads shall be stopped up, provided with a left in/left out connection or grade separated without connection. Isolated existing accesses would revert to left in left out movements only and major junctions would be fully grade separated. Opportunities may exist to connect minor roads and accesses into proposed grade separated junctions, thus reducing the number that remain on the A9. This would offer the added benefit of providing improved access arrangements and potentially reducing the online detour distances for certain landowners.

Elsewhere, it may be appropriate to rationalise several side roads and accesses into a single left in left out junction.

The identification of suitable interventions at minor roads and accesses would be dependent upon the confirmation of those junctions to be grade separated, which should be undertaken at a later stage of DMRB scheme reporting process.

### 3.6 Alternative Strategy Conclusions

The assessment of alternative strategies concluded the following:

- The closure of median gaps and the prohibiting of right turn manoeuvres onto or off the A9 is considered necessary to deliver the scheme objective of reducing the collision severity for this section of the A9.
- The existing congestion and collisions indicate that it is appropriate to consider Keir Roundabout for grade separation as part of any option to provide improvements to this section of the A9
- The closure of median gaps without the provision of new grade separated junctions is not likely to deliver positive economic benefits, and is therefore dismissed as an alternative strategy.
- The provision of online roundabouts as a means of access to the A9, and u-turn facility is likely to result in increased delay to the network and is therefore dismissed as an alternative strategy.
- Full median closure would require at least three additional grade separated junctions north of Keir Roundabout to deliver positive economic benefits, subject to construction costs.

Therefore, based on the assessment of the Alternative Strategies, it is considered appropriate to take Strategy 3 forward for further consideration.



Capabilities on project:  
Transportation

## 4 Engineering Assessment

### 4.1 Introduction

The previous chapter proposed that further consideration be given to grade separation of Keir Roundabout, along with the grade separation of additional junctions on the A9 between Keir Roundabout and Broxden Roundabout. Locations where grade separation may be considered appropriate were identified and this chapter provides a broad assessment of the existing features at each which may influence any future improvements.

This chapter considers other engineering aspects of the A9 which may be relevant under any proposed route improvement strategy, particularly with respect to problems identified under Chapter 2. The chapter also provides a summary of existing utilities and services along the route corridor.

### 4.2 Locations considered for grade separation

At this stage of scheme assessment, the number, exact location and layout of any potential grade separated junctions to be provided under the strategy set out in Chapter 3 is yet to be established. However, based on the preliminary traffic analysis described in the previous chapter, consideration can be given to a number of locations where grade separation may be reasonable. The topographical, hydrological and geological features of the following locations are described below:

- Keir Roundabout
- Greenloaning
- Blackford
- Aberuthven
- Findo Gask
- Forteviot
- Windyedge Cottages

Capabilities on project:  
Transportation

### 4.3 Keir Roundabout

#### 4.3.1 Site Description

Keir Roundabout forms the node point where the A9, travelling north from Falkirk and Stirling, changes from a single lane carriageway to a two lane all purpose dual carriageway en route to Perth. It is a five armed roundabout that provides additional connections to the M9 motorway, which continues south towards the Central Belt, the B8033 to the north and the B824 to the west which lead to the towns of Dunblane and Doune, respectively. The Keir Roundabout study area is shown in below.

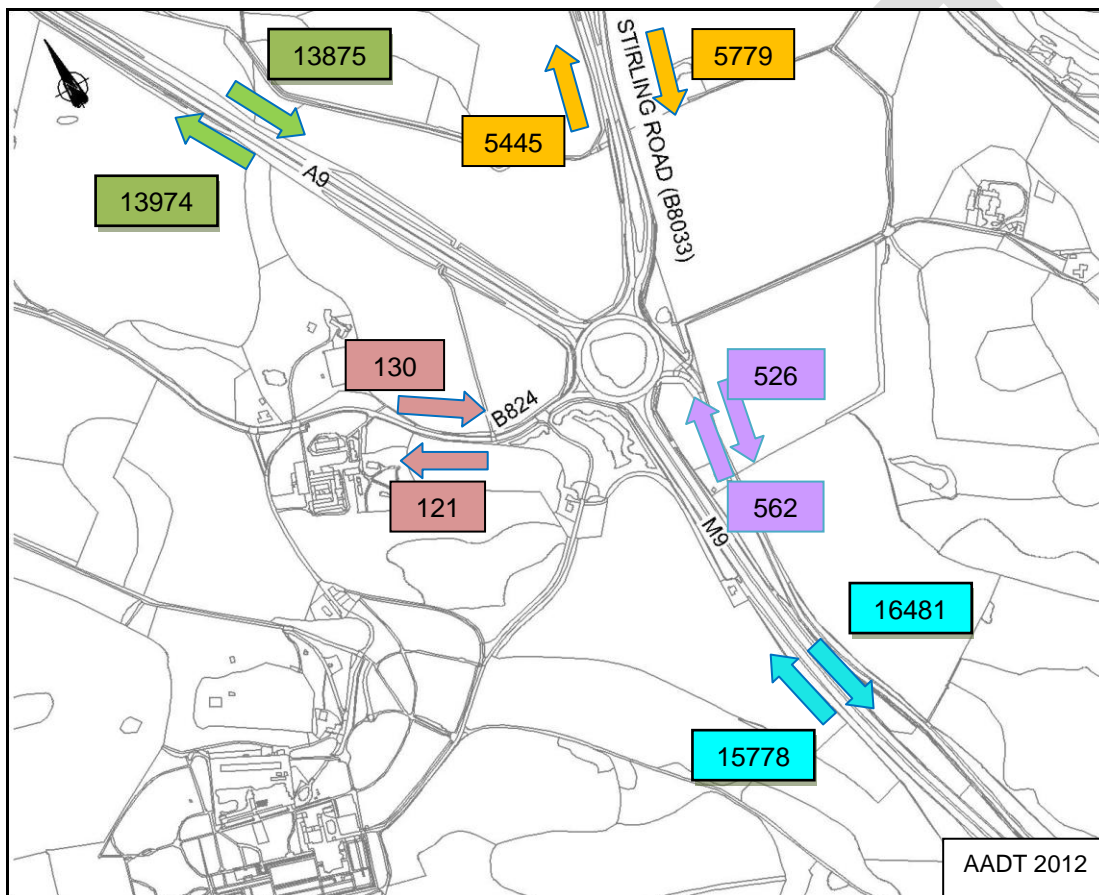


Figure 13 - Existing Road Layout at Keir Roundabout

There are no structures in the immediate vicinity of the roundabout with the exception of an agricultural underpass crossing the A9 dual carriageway approximately 250 metres to the north. An at-grade non-motorised user (NMU) crossing of the A9 dual carriageway at the roundabout connects the B8033 and B824 for pedestrians.

The area surrounding Keir Roundabout is predominately agricultural farmland interspersed with pockets of woodland and interconnecting laneways provide access to the adjacent land and properties. Generally, the land around Keir Roundabout slopes in a north to south direction. The A9 dual carriageway to the north ascends at a relatively steep incline away from the roundabout for just over a kilometre before reaching the top of the hill and subsequently falling back down to the west of Dunblane.

Capabilities on project:  
Transportation

#### 4.3.2 Topography and Land Use

The primary topographical and land use features within the Keir Roundabout study area are as follows:

- The junction consists of a roundabout with 5 entry/exit roads;
- The M9 is located to the south and the A9 to the north. Other roads off the roundabout are the A9 junction to/from Bridge of Allan (south-east of the M9), the B824 towards Doune to the north-west, and the B8033 towards Dunblane (Stirling Road) to the north east;
- The approach roads at the roundabout junction comprise the following construction features;
- The M9 consists of low cut on the east side and a low embankment on the west side;
- The A9 to the north consists of a low embankment on the east side and a medium height cut on the west side tapering down to the north;
- The A9 on the south side appears generally at grade/low embankment;
- The B824 on the west side of the roundabout consists of low embankment on the south side, and a medium height cut on the north side;
- The B8033 on the north east side of the roundabout is formed on low embankment;
- The local topography comprises low lying rolling ground with shallow gradients. To the south the ground descends to form the northern flank of the Forth Valley;
- The site is situated in a rural environment with the surrounding land appearing to be used for agricultural purposes. This appears to mainly consist of grazing; and
- Individual houses are also located locally to the roundabout.

#### 4.3.3 Geomorphology

British Geological Survey (BGS) geological maps show the predominant superficial deposits at the junction to comprise Glacial Till. A localised band of alluvium aligned to the north-west is also shown as being located at the junction. This is indicated as comprising silt, sand and gravel.

A geological plan showing superficial deposits is included in Appendix 8.

#### 4.3.4 Existing Ground Investigation

A review of the BGS geo-index shows several boreholes relating to the road schemes (and earlier investigations) to have been carried out. Information from selected records indicate ground conditions to be glacial till, described as firm to stiff, becoming very stiff, sandy CLAY with gravel and pockets of sand. Thicknesses of between 4m to 6m or more are indicated overlying SANDSTONE bedrock.

Groundwater level was encountered at around 1.2m below ground level.

#### 4.3.5 Other Features

- The Allan Water is present around 700m to the east of the junction flowing to the south;
- Galloway Quarry (disused) is present around 300m to the south east of the junction; and
- A small watercourse is present within the Dunblane show-field north of the roundabout.

Capabilities on project:  
Transportation

## 4.4 Greenloaning

### 4.4.1 Site Description

Greenloaning, located approximately 5 miles north of Dunblane, is a small village that sits between the A9 dual carriageway to the south and the Perth to Dunblane railway line to the north.

The A822 forms the main road in to the village from the A9 and continues north passing through the villages of Braco and Muthill, terminating at Crieff approximately 11 miles north of Greenloaning. The existing layout of the A822 junction to the south west of Greenloaning comprises of a northbound merge lane entering the village and a southbound merge lane via a one way overbridge for vehicles leaving Greenloaning. The Greenloaning study area is shown in below.

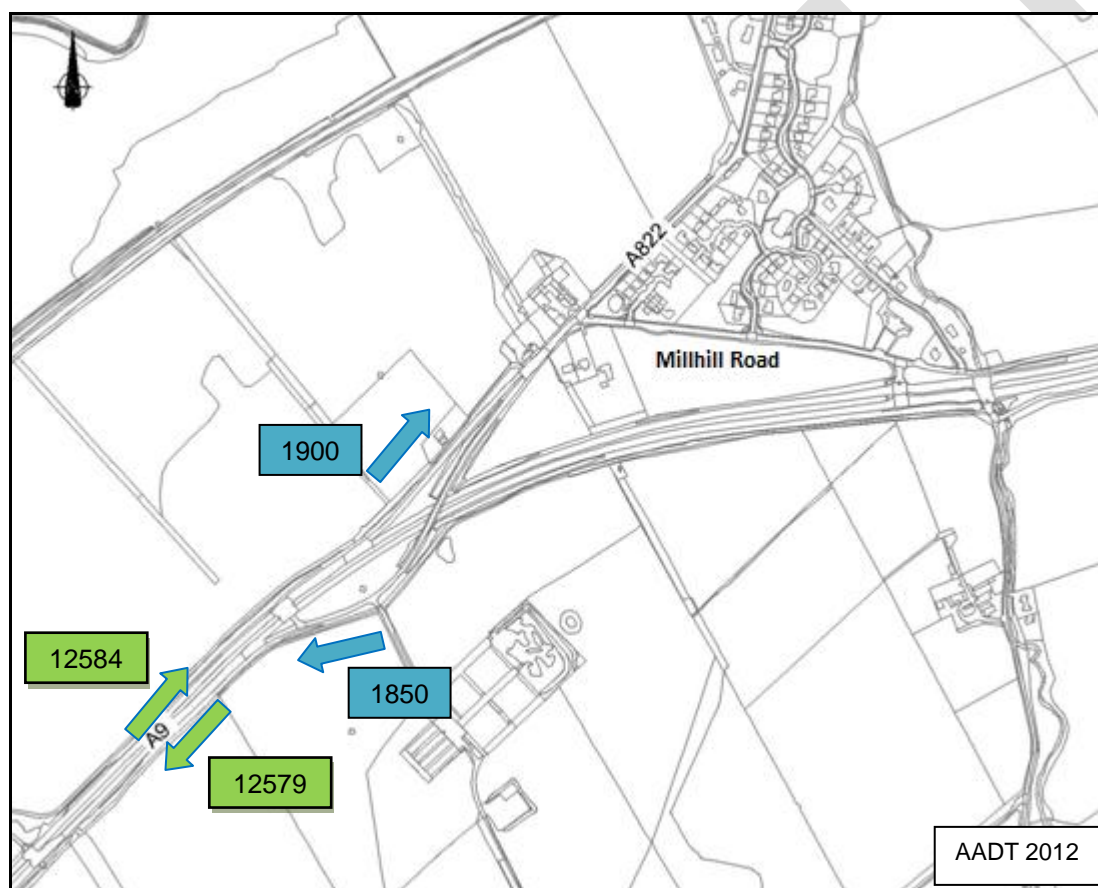


Figure 14 - Existing Road Layout at Greenloaning

The Millhill Road junction to the east provides additional access to and from the village which also links to the A822. Access to and from the south is provided through a short nearside diverge lane. A merge lane is not provided at this junction. A gap in the central median facilitates right turn manoeuvres and a right turning lane is provided within the central reserve. An at-grade NMU crossing is also provided.

Capabilities on project:  
Transportation

The junction to the east of Greenloaning and on the southbound carriageway provides access to properties and agricultural land south of the A9. A short diverge and merge lane are included within the layout of the junction. Right turning vehicles gain access through an offside diverge lane within the central median and a gap in the central reserve.

The rural land that surrounds Greenloaning is largely pastures for grazing animals and to a lesser extent fields for arable farming. On the whole, the land tends to slope across the carriageway from the south east toward Allan Water in the north. Millstone Burn, the only significant watercourse that crosses the A9 near the village, is located to the east of Greenloaning and is culverted under the road.

#### 4.4.2 Topography and Land Use

The primary topographical and land use features within the Greenloaning study area are as follows:

- The junction off the northbound A9 carriageway consists of a diverge slip road directly on to the A822. The slip road construction consists of low embankment and at grade sections;
- From the A822 the southbound slip road approach consists of a 2 span single lane overbridge carrying the A822 across the A9 and on to the merge to the A9. The overbridge approaches are constructed using embankments. The bridge has a heavy skew, and the central pier is located in the central reserve;
- The south bound slip road has been constructed within a cutting on the south side. A junction for a minor road leading to Townhead Farm (Quoiggs Beef Lot) is also present off the south bound slip road – access is only available on to the southbound A9 carriageway from here;
- To the west of the overbridge where both slip roads to the A9 are located, the A9 has been constructed on low embankment;
- East of the overbridge, the A9 itself enters an area of low cutting;
- The site is situated in a rural environment with much of the surrounding land appearing to mainly comprise agricultural grazing land and some rough pasture;
- Greenloaning village is situated around 500m north-east from the overbridge;
- Townhead Farm is located just to the south of the junction;
- The local topography typically comprises rolling ground with shallow gradients, which fall to the north-west. To the north the ground falls away towards a relatively level floodplain area containing the Allan Water;
- An overhead electricity line crosses the junction aligned south to north. A supporting pylon is located on the south bound verge on the north side of the overbridge slip road; and
- The A822 crosses the Glasgow/Perth railway and the Allan Water just north of the village which may constrain junction options.

#### 4.4.3 Geomorphology

BGS geological maps show the predominant superficial deposits at the junction to comprise Glacial Fluvial Ice Contact Deposits; gravel, sand and silt. To the immediate south, glacial till deposits are present towards the higher ground beyond. To the north alluvial deposits are present as part of the Allan Water flood plain – these form a feature along the margin of Strathallan. A narrow band of alluvial deposits are indicated crossing the A9 to the east of the overbridge, linked to the presence of a watercourse culverted under the A9. The watercourse drains the higher land in the south to the Allan Water north of the A9.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.4.4 Existing Ground Investigation

A review of the BGS geo-index shows several boreholes relating to the road schemes (and earlier investigations) to be available in the area. From selected records ground conditions are described as well graded sand, gravel and cobbles to around 4m overlying glacial till. Groundwater level was encountered at around 4m below ground level.

#### 4.4.5 Other Features

- The Allan Water is present around 900m to the north of the overbridge;
- Watercourses cross the A9 on both sides of the overbridge; and
- 2 localised water features were noted to be present to the east of the A9.

Capabilities on project:  
Transportation

## 4.5 Blackford

### 4.5.1 Site Description

Blackford is a small village located five miles south west of Auchterarder just north of the A9. It is home to Highland Spring's main site as well as the Tullibardine whisky distillery. It lies between the A9 dual carriageway in the south and the Perth to Dunblane rail line in the north.

The B8081, Moray Street, forms the main road running through the village of Blackford and connects to the A9 at the south west end of the village and again north of the village via a northbound merge taper. The Blackford study area is shown below.

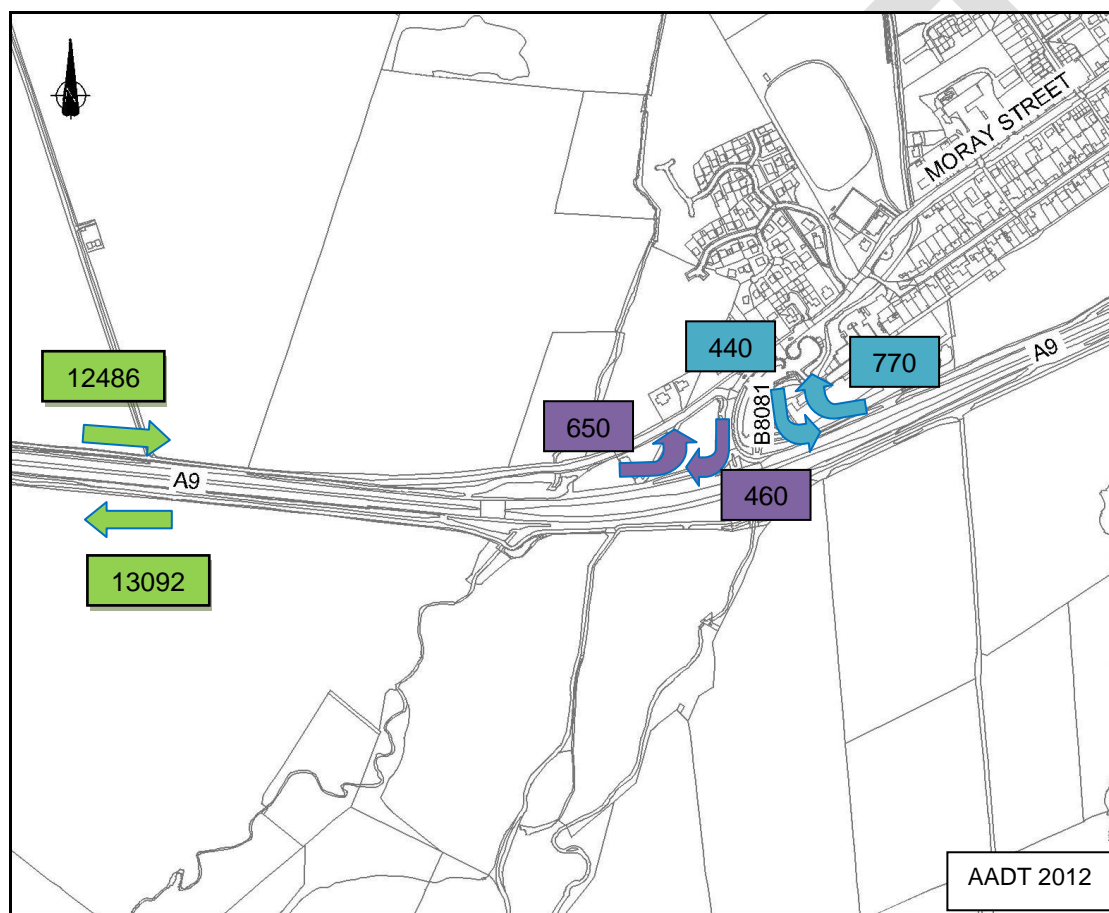


Figure 15 - Existing Road Layout at Blackford

Access from the south onto the B8081 at the south eastern end of Blackford is provided through a nearside diverge lane; while a gap in the central reserve and a right turn lane provides access for vehicles travelling from the north. The gap also allows right turning traffic from Blackford to turn out onto the A9 southbound carriageway. There is a merge lane on the nearside of the northbound carriageway to accommodate vehicles turning north onto the A9 from Blackford.

Capabilities on project:  
Transportation

Directly opposite the B8081 junction, there is a priority junction which provides direct access to a small number of residential properties, farm holdings and agricultural land on the south side of the A9. Whilst there is no diverge or merge lane, it does provide for right turn manoeuvres through a gap in the central median and a right turn lane.

The Burn of Ogilvie crosses the A9 dual carriageway just to the west of Blackford through a culvert. A localised depression in the land surrounding the river results in the A9 being at an elevated position however this begins to flatten out on the approach to Blackford.

#### 4.5.2 Topography and Land Use

The primary topographical and land use features within the Blackford study area are as follows:

- The junction on the north side of the A9 to Blackford consists of a slip road off, and a T-junction on to the A9. Construction of this side of the junction consists of low embankment;
- The minor access on the south side of the A9 consists of a T-junction on to the A9;
- The Danny Burn flows below the A9 at the junction in culvert;
- The site is situated in a rural environment with much of the surrounding land appearing to be used for agricultural purposes; this comprises mainly grazing;
- Blackford village is situated around 300m north-east from the junction; and
- The local topography typically comprises relatively flat rolling ground with shallow gradients, which falls from south to north. To the north the ground falls away towards a relatively level floodplain of the Allan Water.

#### 4.5.3 Geomorphology

BGS geological maps show the predominant superficial deposits at the junction to comprise glacial sand and gravel deposits; gravel, sand and silt. To the north of the junction alluvial deposits are present as part of the Allan Water flood plain. Two bands of alluvial deposits are indicated crossing the A9 in the region of the junction. One of these may be linked with the presence of the Danny Burn below the junction. A localised area of Glacial Till is present on the south side of the A9 and to the west of the junction.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.5.4 Existing Ground Investigation

A review of the BGS geo-index shows several boreholes relating to the road schemes (and earlier investigations) to have been carried out. From selected records glacial sand and gravel are described as clayey gravelly sand with some silt. Depths of around 4.5m were recorded.

Groundwater level was encountered at around 6m below ground level.

#### 4.5.5 Other Features

- The Danny Burn flows below the A9 at the junction; and
- Smaller streams flow below the A9 around 280m to the west of the junction and around 500m to the east.



Capabilities on project:  
Transportation

## 4.6 Aberuthven

### 4.6.1 Site Description

The village of Aberuthven, approximately 2.5 miles north east of Auchterarder, lies between the A9 dual carriageway and Ruthven Water. The A824, the main road passing through the village, forms a junction to the A9 at its north eastern edge. Access to Aberuthven from the south is provided for by a nearside diverge followed by a tight left hand bend. A gap in the central reserve and a right hand turning lane permits right turn manoeuvres and access to the village for vehicles travelling from the north. A northbound merge lane is also accommodated in to the layout of the junction. The Aberuthven study area is shown below.

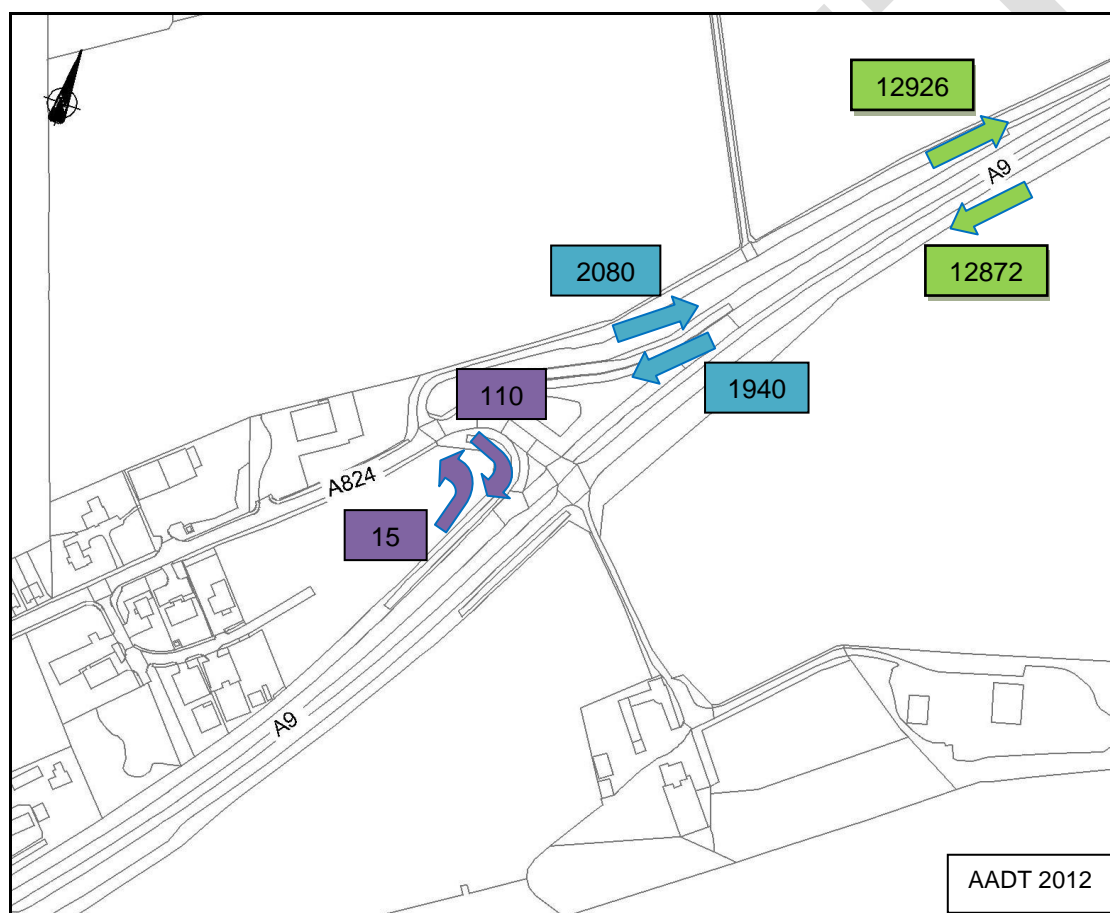


Figure 16 - Existing Road Layout at Aberuthven

Sitting opposite the A824 junction and on the southbound carriageway of the A9 is a priority junction that connects a private laneway to Maidenplain Farmhouse and Woodlands Farm. A right turning lane and a gap in the central reserve provide access to the property from the northbound carriageway.

The farmland neighbouring the A824 junction at Aberuthven is generally quite flat, sloping only slightly away from the road on either side.

Capabilities on project:  
Transportation

#### 4.6.2 Topography and Land Use

The primary topographical and land use features within the Aberuthven study area are as follows:

- The junction on the west side of the A9 consists of a slip road off, and a T-junction on to the northbound carriageway of the A9;
- On the south bound carriageway, a central slip road is positioned leading to an opening in the central reservation allowing turning from the southbound carriageway;
- Road construction of the A9 over the junction area consists of low cut. The site is situated in a rural environment with the surrounding land appearing to be used for agricultural purposes; this comprises crops and grazing;
- Aberuthven Village is situated around 200m to the south-west of the junction;
- Some local areas of scrub and woodland are also present along the west verge of the A9; and
- The topography typically comprises low lying level ground.

#### 4.6.3 Geomorphology

BGS geological maps show the predominant superficial deposits at the junction to comprise fluvio-glacial sheet deposits; gravel, sand and silt. A band of alluvium aligned roughly north-south is also shown as being located just to the east of the junction. This is indicated as comprising silt, sand and gravel.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.6.4 Existing Ground Investigation

A review of the BGS geo-index shows several boreholes relating to the road schemes (and earlier investigations) to have been carried out. Information from three historical boreholes was obtained for the site. A summary of these are as follows;

- Upper horizons of sandy clay/loose clayey sand with some boulders;
- Compact very clayey SAND with some gravel and boulders; and
- Glacial sand and gravel deposits to 4.5m or more.

No groundwater was encountered in the boreholes at depths up to 4m below ground level.

#### 4.6.5 Other Features

- The Ruthven Water is located around 700m to the north west of the junction and flows to the north.

Capabilities on project:  
Transportation

## 4.7 Findo Gask

### 4.7.1 Site Description

The Broom of Dalreoch is a small hamlet that lies just to the south east of the River Earn Bridge, approximately 2 miles north east of Aberuthven and a similar distance north of Dunning.

The B9141 and an unclassified road leading north to Findo Gask form a right left staggered crossroad junction to the A9 dual carriageway. Vehicles from the north gain access to the B9141 through a nearside diverge lane and a give way arrangement at the junction. A similar layout is used for vehicles from the south exiting the A9 and headed north toward Findo Gask. There are no merge lanes at either junction. Gaps in the central reserve allow right turn manoeuvres and right turning lanes provide access to either junction for vehicles on the opposing carriageway. The Findo Gask study area is shown below.

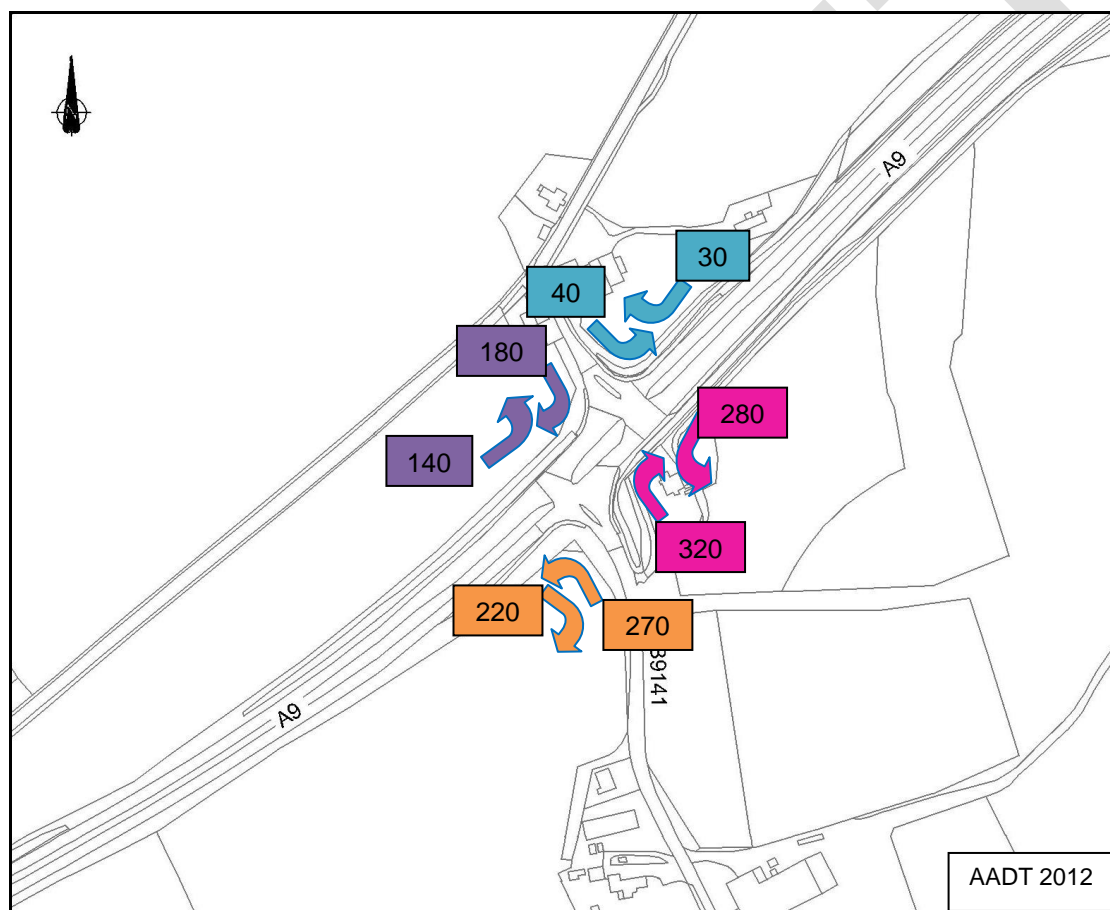


Figure 17 - Existing Road Layout at Findo Gask/Dunning Junction

Bus stops are present immediately after both junctions and a formal at-grade NMU crossing has been provided to allow pedestrians to cross the A9.

The Broom of Dalreoch has a low elevation at 16m above ordnance datum and slopes only slightly toward the nearby River Earn to the north east. The majority of the surrounding area is used as arable farmland to grow crops.

Capabilities on project:  
Transportation

#### 4.7.2 Topography and Land Use

The primary topographical and land use features within the Findo Gask study area are as follows:

- The junction on the north side of the A9 to Findo Gask consists of a slip road off, and a T-junction on to the A9;
- The junction on the south side of the A9 consists of a slip road off and a T-junction on to the A9;
- Construction of the A9 over the area of the junctions consists of low embankment;
- A flood relief culvert on a former channel of River Earn lies east of the junction;
- The site is situated in a rural environment with the surrounding land appearing to be used for agricultural purposes; this comprises mainly grazing;
- Several farms and houses are present locally particularly adjacent to the north junction;
- The local topography typically comprises low lying level ground with some shallow gradients; and
- The floodplain of the River Earn lies east of the junctions.

#### 4.7.3 Geomorphology

BGS geological maps show the superficial deposits at the junction to comprise the following:

- River Terrace Deposits locally at the junction, containing gravel, sand and silt;
- A flood plain of alluvium running west-east associated with the River Earn;
- At the south edge of the A9, Glaciofluvial sheet deposits are present, containing gravel, sand and silt; and
- The junction lies just west of the terrace of the River Earn flood plain, which forms the buried valley, former river course and associated deep deposits of late glacial clays.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.7.4 Existing Ground Investigation

A review of the BGS geo-index shows a series of boreholes associated with the existing road scheme. Information from the road scheme in this area shows its location within the buried valley of the River Earn. This has been infilled at depth with late glacial lake deposits, with sand and gravel deposits closer to the surface. Local alluvial sands are also present.

#### 4.7.5 Other Features

- The River Earn is located around 450m north of the junction, and is aligned east west;
- Associated flood plain and former river channels are indicated between the junction and the river to the east; and
- The area overlies the buried valley of the River Earn, with relatively thin granular subsoils overlying deep deposits of laminated silty clays.

Capabilities on project:  
Transportation

## 4.8 Forteviot

### 4.8.1 Site Description

The site is located on the A9 around 1.5km north of Forteviot. The B934 on the south side of the A9 is essentially a T junction and road construction of the A9 over the area of the junction's consists of low embankment. The main A9 route climbs the Cairnie Braes heading north-east out of the Earn valley on a sidelong embankment and the B934 runs steeply down the valley side between the A9 towards the River Earn below.

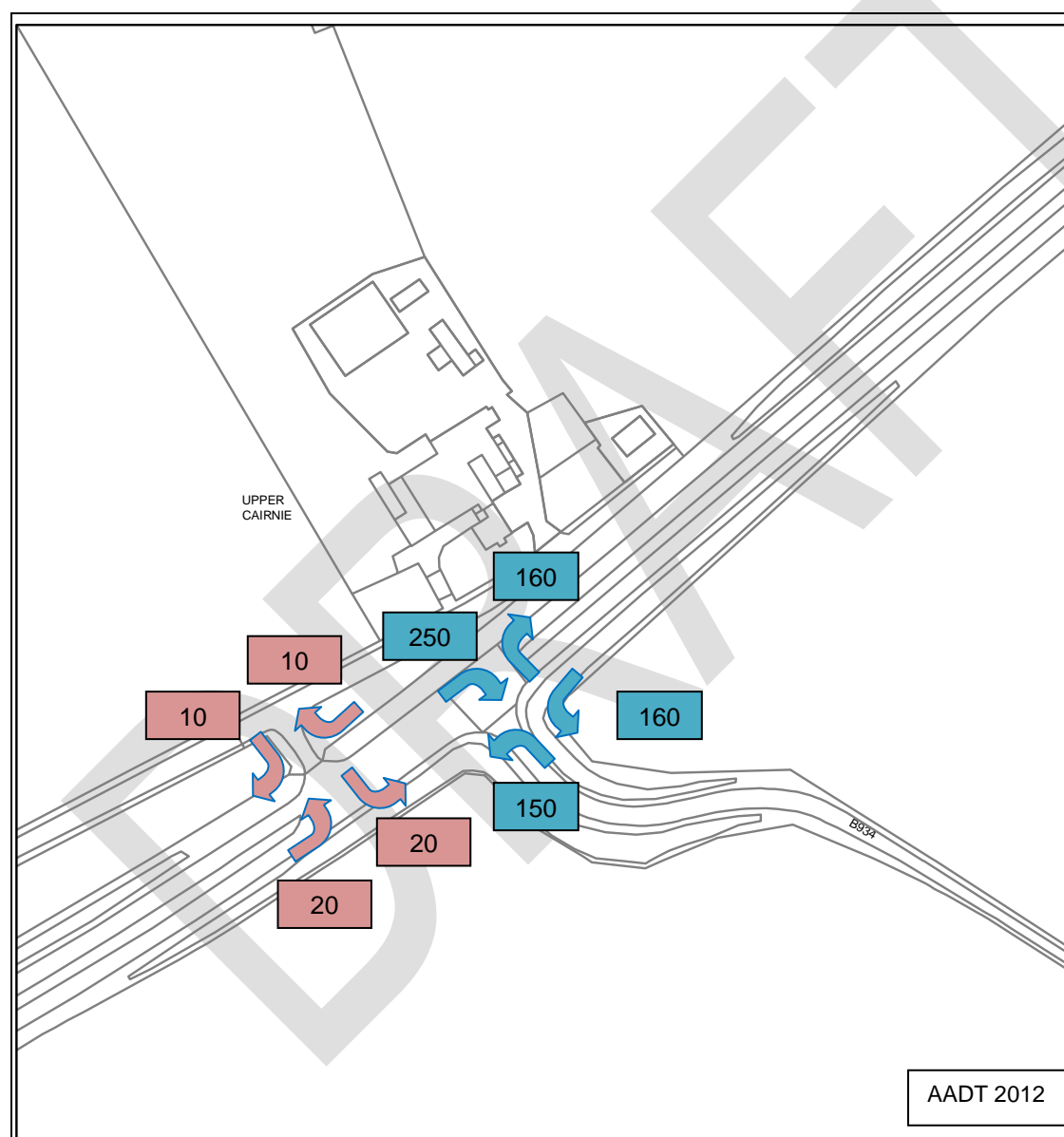


Figure 18 - Existing Road Layout at Findo Gask/Dunning Junction

Capabilities on project:  
Transportation

#### 4.8.2 Topography and land use

- The site is situated in a rural environment with the surrounding land appearing to be used for agricultural purposes; this appears to mainly comprise grazing.
- Farms and some houses are present locally.
- The local topography forms part of the upper valley side and is relatively flat. To the north the surface comprises rolling ground forming the northern valley side of the Cairnie Braes.
- Westwards down the Cairnie Braes, the A9 is formed in deep soil/rock cuttings comprising glacial till over sandstone (Old Red Sandstone Strata)

#### 4.8.3 Geomorphology

BGS geological maps show the predominant superficial deposits at the junction to comprise Glacial Till.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.8.4 Existing Ground Investigation

A review of the BGS Geo-Index shows a series of boreholes associated with the existing road scheme with indicate that soil/rock cuts occur to the west on the A9.

Capabilities on project:  
Transportation

## 4.9 Windyedge Cottages

### 4.9.1 Site Description

Windyedge Cottages lie less than two miles south east of Broxden Roundabout. The private laneway to the south of the A9 leads to a single farm holding and agricultural land. The road leading north passes through the village of Tibbermore, 1.5 miles away, and subsequently meets up with the A85 Perth to Crieff road. The Windyedge Cottages study area is shown below

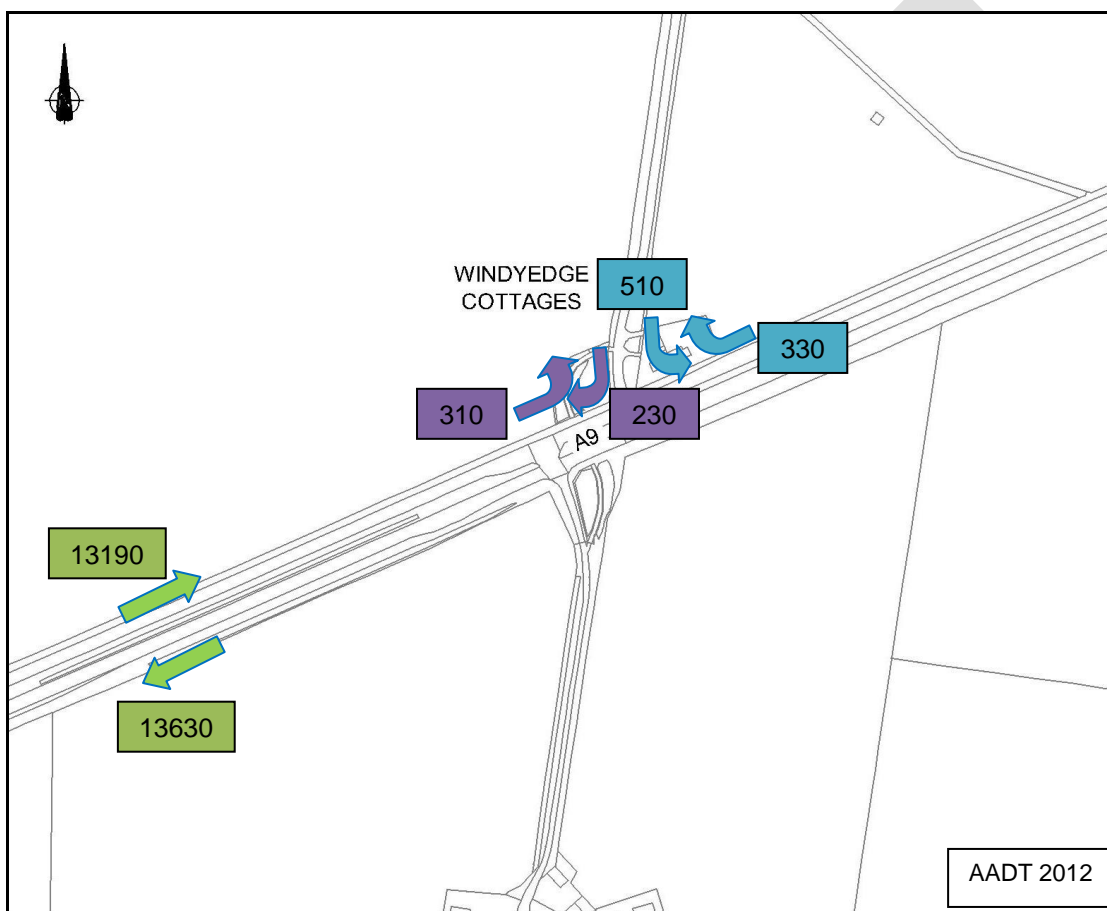


Figure 19 - Existing Road Layout at Windyedge Cottages

The two roads form a right left staggered crossroad junction to the A9 neither of which include a merge nor diverge lane. There is however gaps in the central median and right turning lanes accommodated within the central reserve to permit right turning manoeuvres.

A bus stop either side of the carriageway is located immediately after each junction and an at-grade NMU crossing permits the crossing of pedestrians. An agricultural underpass crosses the A9 at this location and allows agricultural vehicles access to the lands north of the dual carriageway.

Capabilities on project:  
Transportation

The area surrounding Windyedge Cottages is relatively flat land with only a slight decline on the approach to the junction from the south west. In the locality of the junction the land is mainly used for farming crops however further to the north east, the arable farmland makes way for large areas of woodland on either side of the carriageway.

#### 4.9.2 Topography and Land Use

The primary topographical and land use features within the Windyedge Cottages study area are as follows:

- The junction on the north side of the A9 to Tibbermore consists of a dual lane T-junction from a minor road – The Tibbermore Road on to the A9;
- The south side of the A9 has an access to Windyedge;
- A subway passes beneath the A9 under the footprint of the junction. This is presumed to be accommodation works for a farm underpass;
- Road construction of the A9 over the area of Windyedge junction consists of low embankment;
- The site is situated in a rural environment with the surrounding land appearing to be used for agricultural purposes; this appears to comprise mainly crop growing;
- Woodland and forestry are present to the north and south of the junction;
- A farm and some houses are present locally on the south and north sides respectively; and
- The local topography typically comprises level ground with any gradients being shallow.

#### 4.9.3 Geomorphology

BGS geological maps show the predominant superficial deposits at the junction to comprise glacial till. Maps indicate instances of rock (sandstone) at or near surface in the area.

A geological plan extract showing superficial deposits is included in Appendix 8.

#### 4.9.4 Existing Ground Investigation

A review of the BGS Geo-Index shows a series of boreholes associated with the existing road scheme.

#### 4.9.5 Other Features

West of the junction, at Crossgates, the A9 traverses deep rock cuttings with relatively thin soil cover.

The sandstones are understood to be aquifers, as indicated by a number of wells in the area.



Capabilities on project:  
Transportation

#### 4.10 Minor Road and Access Treatment

Under the proposed strategy set out in Chapter 3, major junctions on the A9 would be fully grade separated, and all median gaps closed. This is in line with the recommendations in TD9 for a Category 7A Dual Carriageway.

For a 7A Dual Carriageway, TD9 also recommends that minor side roads shall be stopped up, provided with left in/left out connections, or grade separated without connection. Isolated existing accesses are permitted, again operating as left in/left out only.

There is currently a high level of direct access to the A9 with 76 C Class, Unclassified Roads, Agricultural and Private Accesses over the 40km section. Once any proposed locations for grade separation have been established, consideration can be given to reducing the number of junctions and accesses to the A9.

This can be achieved in a number of ways:

- tying minor roads and accesses into nearby junctions.
- rationalising side roads and accesses to reduce the overall number on the A9
- closing up minor roads and accesses where suitable alternative routes/accesses exist.

Parallel access lanes may be required to collect and connect minor accesses where they are situated in relatively close proximity to existing or proposed grade separated junctions.

There may be instances where it will not be feasible to gain access via the local road network, provide connection to a Grade Separated Junction, or collect with other minor accesses into a Left in Left out (LILO) junction. In these instances, it may be appropriate for the existing access to remain as a single isolated LILO access.

The proposed treatment of minor roads and accesses will be dependent upon identifying those junctions where it is appropriate to provide grade separation, and therefore specific treatments have not been considered at this stage of assessment.

#### 4.11 Laybys

The standards for laybys are contained in TD69 of the DMRB which, for a dual carriageway recommends that Type A laybys be provided at 2.5km spacing. TD69 also recommends laybys be located a minimum of 1km before and beyond any grade separated junctions.

There are currently a total of 28 laybys on the A9, of which only two are Type A, the remainder being the lower standard Type B layby.

It is recommended that a review of laybys be undertaken following identification of junctions for grade separation, and consideration be given to upgrading existing Type B lay-bys to Type A, or constructing new Type A lay-bys along the route.

Capabilities on project:  
Transportation

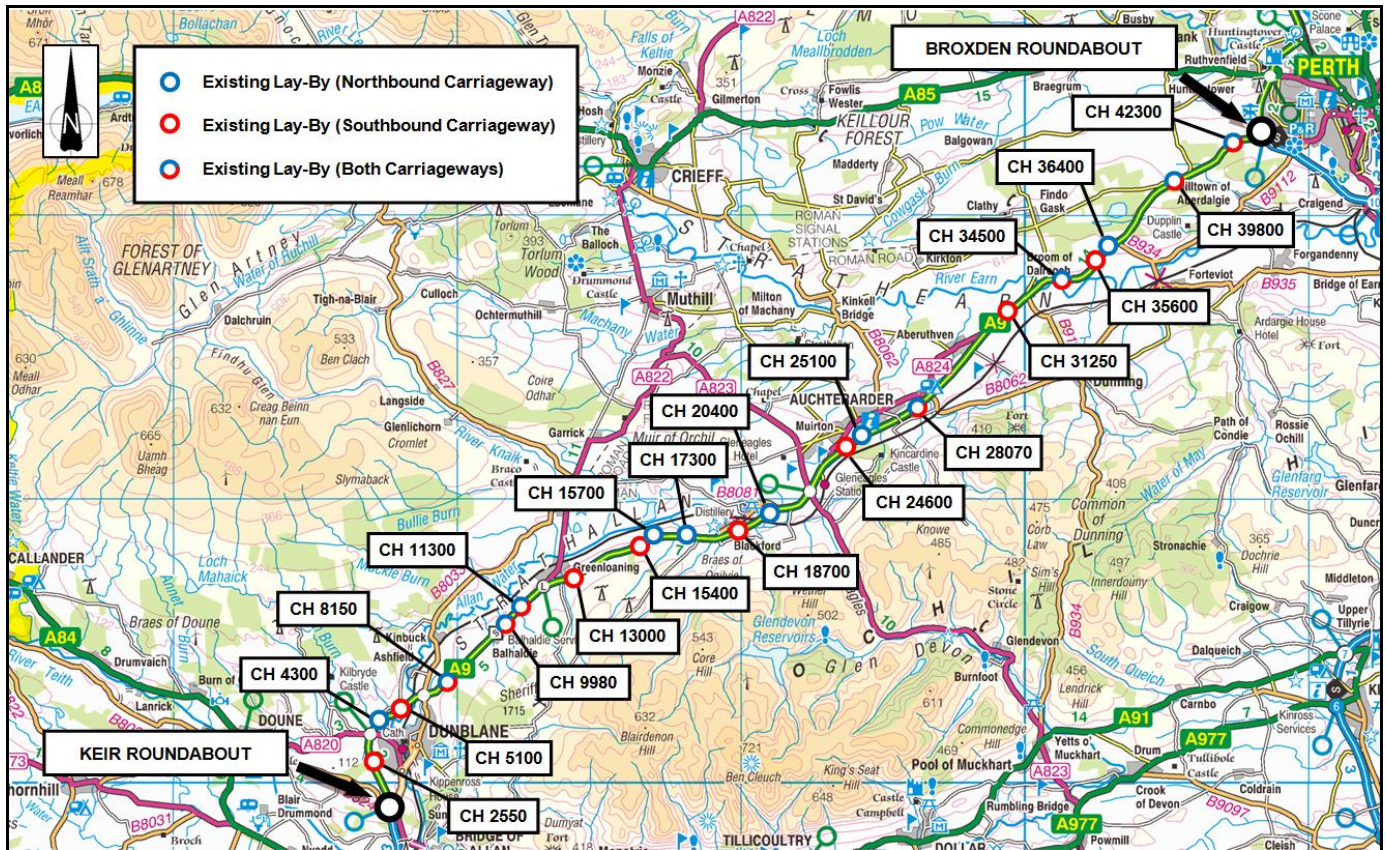


Figure 20 - Existing Layby Locations

#### 4.12 Use Of Existing Grade Separated Junctions And Any Other Planned Improvements

##### 4.12.1 Gleneagles Station Link Road

Gleneagles Railway Station is currently accessed via a priority junction on the southbound carriageway of the A9. The current junction arrangement facilitates left in and left out movements from the southbound carriageway; and a gap in the central median permits vehicles to turn right into the station access from the northbound carriageway. The median gap has been formed to restrict right turn movements from the access onto the northbound carriageway; instead vehicles are directed to turn left and access the northbound carriageway via the Loaninghead Interchange, just under a kilometre away.

Perth and Kinross Council (PKC) are currently promoting a scheme to close the existing access and median gap on the A9 and provide a direct link from the rail station to the Loaninghead Interchange via a new road running parallel with, and to the south of the A9. This scheme will also include the closure of a nearby farm access and median gap on the A9.

It is anticipated that this scheme will be delivered by the summer of 2014 and as such the access from the railway station onto the A9 has not been considered as part of this assessment. Nevertheless, based on the proximity of the junction to the Loaninghead Interchange, the nature of the access, and volume of traffic using it, the PKC scheme corresponds with the anticipated measures when assessed in relation to the A9 Junction Strategy.

Capabilities on project:  
Transportation

#### 4.12.2 Loaninghead Interchange and A824 Junction

The proximity of the A824/A9 junction to the Loaninghead Interchange would mean that the provision of a grade separated junction here would result in limited weaving length between junctions, which would not be within standard. A Grade separation junction between the A9 and the A824 at Auchterarder has not be considered as part of the assessment in Chapter 3.

However, any future assessment should give consideration to an additional link connecting the A824 at Auchterarder with the Loaninghead Interchange via an overbridge to the A9. This would tie into the new link from Gleneagles Railway Station to the Loaninghead Interchange. It would offer wider benefits particularly with respect to public transport improving integration by taking buses directly past the railway station.

#### 4.12.3 Shinafoot Junction

The B8062 passes under the A9 midway between the towns of Auchterarder and Aberuthven via the Shinafoot Underpass. The Auchterarder Development Framework published by PKC in 2012 establishes a series of trunk road interventions to be provided based on the construction of new houses. Over 200 houses have been constructed to date, and the next intervention is required on the construction of the 500th house. This will consist of the provision of merge and diverge slips on the southbound carriageway only, allied with minor alignment improvements to the B8062.

The analysis undertaken to ascertain the need for grade separation (described in Chapter 3) included testing of a junction at Shinafoot and found that it offered similar, if slightly less benefits to a junction at Aberuthven. The spacing would not preclude the grade separation of both, however it is recommended that further analysis be undertaken to establish the most suitable location for grade separation which will deliver best value for money.

#### 4.12.4 Proposals to the West of Broxden Roundabout

The scope of this DMRB Route Study covers the section of the A9 between Keir Roundabout and Broxden Roundabout. A Part 1 STAG Appraisal is being undertaken concurrently considering the road issues around Perth, and some of the options generated as part of this process have the potential to impact upon any proposals on the A9 to the west of Broxden Roundabout. Furthermore, it is understood that the development of the land to the north-west of Broxden Roundabout for housing may include the provision of a new Grade Separated Junction to the A9 at a location between Broxden Roundabout and Windyedge Cottages.

Therefore, whilst this DMRB Route Study considers the provision of a new Grade Separated Junction at the Windyedge junction, this should be kept under review taking account of any further developments in relation to the STAG 1 Appraisal, and the development of land to the north-west of Broxden Roundabout.

### 4.13 Other Potential Route Improvements

The more significant potential interventions for this section of the A9 between Keir Roundabout and west of Broxden Roundabout are outlined above. There are a number of other improvements which fall under the remit of this study and these are outlined below.

It should be noted that BEAR Scotland is currently acting as operator for this section of the route and is responsible for maintenance on this part of the A9. Furthermore, as operator, BEAR has and continue to monitor the safety record on the A9, identifying locations or sections with a significantly poor record by way of the Moving Cursor Programme, and implementing specific collision mitigation measures as appropriate. This report does not consider maintenance issues or minor improvement schemes.

#### 4.13.1 Provision of Hard Strips

As noted before, the existing hard strip provision varies along the length of the route. A 1m wide hard strip to both the near and offside of each carriageway would be the minimum requirement for a Category 7A dual carriageway. However, there are significant lengths of the A9 where the existing hard strip is significantly narrower, in the order of around 200mm to 300mm.

Capabilities on project:  
Transportation

The introduction of hard strips in line with current standards should have a significant positive impact on driver stress along the route and it is recommended that further consideration be given to this as part of any wider improvement scheme.

#### 4.13.2 Improvements to Existing Merge/Diverge

Of the existing grade separated junctions, the merge and diverge tapers at Queen Victoria Slips would not satisfy the DMRB standards of new construction. To maintain consistency along the route it is proposed to upgrade the merge and diverge tapers at existing junctions to bring into line with the DMRB.

#### 4.13.3 Opportunities to facilitate NMUs

Opportunities to provide enhanced facilities for non-motorised users should be considered as part of any wider route improvement scheme. NMU facilities should be incorporated into any new grade separated junction and improvements elsewhere on the network should be enhanced where there is a demonstrable need.

#### 4.13.4 Improvements to Access/Egress at Services

The existing services northbound and southbound at Balhaldie, and at Loaninghead are all served by what would be considered substandard access and egress provision based on the likely existing or potential daily traffic movements into and out of each site.

None of the site provides any merge provision on egress, and the diverge provision at Balhaldie Northbound and Loaninghead is significantly less than the desirable length set out in TD42 of the DMRB. The diverge taper length at Balhaldie Southbound would satisfy the desirable length set out in the DMRB, but the proximity of a private access immediately preceding it is likely to result in conflicts between decelerating and accelerating vehicles.

A proliferation of accesses on both sides of the carriageway at Balhaldie adds further to driver confusion and increase the potential for collisions, and any improvements should seek to rationalise accesses into a single junction on each carriageway.

Similarly the exit from Loaninghead Services is directly before the off-slip at Loaninghead Interchange, which again leads to conflicts between vehicles turning onto and off the A9. The presence of a stone wall at this exit reduces visibility and the radii on exit would appear to be inadequate for the HGV movements, evidenced by the extensive kerb damage at this location.

The costs of the improvements to the access/egress to existing services would be comparatively low in nature compared to other interventions along the route, and again these improvements could be considered as part of any future scheme.

### 4.14 Public Utilities

Consultations show that there are several utility companies that may be affected by the proposed improvement works within the A9 study corridor. Up to date drawings showing the locations of any services and equipment were acquired from seven utility companies who were found to operate in the area.

The utility companies and statutory authorities include; British Telecom, Cable & Wireless, National Grid, Scotia Gas Networks, Scottish and Southern Energy, Scottish Water and Virgin Media.

#### 4.14.1 British Telecom

Within the study corridor, underground British Telecom (BT) services generally run in the verge of the northbound carriageway between the Queen Victoria Slip Roads and Broxden Roundabout. There are however sections of the road where it crosses over and runs in the southbound carriageway verge. This occurs for about 2km just east of Blackford and again near Loaninghead Interchange. There is also a 4.5km section of road where the service runs in the southbound carriageway verge between Burnside Cottage and Broxden.

Underground services do not run along either verge of the mainline carriageway from Keir Roundabout to the B8033 overbridge north of Dunblane.

Capabilities on project:  
Transportation

Underground service road crossings of the mainline carriageway occur frequently at minor road junctions and accesses, serving commercial and residential buildings.

There are approximately 52 locations where underground services cross the A9 mainline with additional crossings at existing and proposed grade separated junction locations. Overhead services are also present within the study corridor.

A more in depth assessment of the type and location of these BT services will be undertaken during the Stage 2 assessment phase. It will be necessary to establish the impact, if any, of the proposed improvement works on BT services in the area in order to establish and put in place protective and diversionary measures.

#### 4.14.2 Cable & Wireless

After discussion with Cable & Wireless, it was found that they have no apparatus within the study corridor between Keir Roundabout and Broxden. However, records show that Cable & Wireless have leased network within the study area but do not have as built records of this information shown on any drawings..

#### 4.14.3 National Grid

National Grid's gas utilities should not be affected by the proposed A9 improvement works from Keir Roundabout to just south of Broxden. At their closest point, the gas mains pass approximately 120 metres east of the proposed works boundary at the Doune Road overbridge near Dunblane. It also comes within 250 metres of the proposed boundary approximately 500 metres north of the Doune Road overbridge.

North of Dunblane, the mains generally follow a north easterly direction on route to Aberdeen passing a safe distance from the A9 study corridor. It crosses the A9 just North of Luncarty, however, this is out with the proposed works boundary.

#### 4.14.4 Scotia Gas Networks

Scotia Gas Network services are encountered in the study area of the A9. There are four occasions where the gas main crosses the mainline carriageway.

A medium pressure gas main crosses the A9 over a central median gap near Dunning Road, Aberuthven. The gas main may potentially be affected due to the proposed closure of central median gaps and the provision of safety barriers at this location.

Another medium pressure gas main crosses the junction of the A9 dual carriageway at Keir Roundabout and goes on to cross the B824 and the B8033 roads on either side of the A9. Disruption is likely at this location due to the proposed grade separation of Keir Roundabout connecting the M9 motorway and the A9 dual carriageway.

It is envisaged that the remaining two crossings, a medium pressure gas main crossing south of Old Doune Road footbridge and a low pressure gas main crossing on the B8033 overbridge north of Dunblane, would not be affected by the proposed works.

#### 4.14.5 Scottish and Southern Energy

An extensive network of Scottish and Southern Energy utilities exist in the study area consisting of low, high and extra high voltage cables/lines.

Plans indicate there are 37 buried low and high voltage cables which cross the A9 mainline. Within the road boundary, there are small sections of road where buried cables run in the verge parallel to the carriageway. Some of these utilities will likely be affected by the proposed improvement works on the A9 and plans should be put in place for protective and diversionary measures. However, the extent of disruption will depend on the final location and layout of the proposed compact grade separated junctions, the provision of alternative access lanes and any additional works to the existing carriageway.

Five extra high voltage (EHV) overhead lines cross the A9 carriageway at various locations along the scheme, however it is not thought at this stage that the lines will be affected by the proposed improvement works.

#### 4.14.6 Scottish Water

Records from Scottish Water show that there is existing apparatus present in the A9 study corridor. Water mains were found to cross the A9 mainline at 22 locations along the route and further crossings of side roads connecting the A9 were also identified.

Capabilities on project:  
Transportation

In addition to these crossings, water mains were found to run parallel and close to the mainline carriageway on several sections of the route, including areas where compact grade separated junctions are proposed.

A large diameter water main crosses the mainline at the junction to the A9 dual carriageway at Keir Roundabout. This water main may potentially be affected by the proposed flyover of Keir Roundabout and it is likely that plans to mitigate this disruption will need to be considered.

It is noted that a water works is located just east of Roman Road junction however it should not be affected by the improvement works.

Scottish Waters sewage network briefly runs alongside a layby adjacent to the mainline carriageway just south of Auchterarder. There are no road crossings for foul or storm sewage systems and it is thought minimal disruption will be encountered.

#### 4.14.7 Virgin Media

After consultation with Virgin Media it was determined that none of their services cross or come close to the study corridor between Keir Roundabout and Broxden.

### 4.15 Existing Road Pavement and Structures

The condition of the existing road pavement on the trunk road network is measured every two years and entered onto the Scottish Executive Road Information System (SERIS). The skid resistance and structural strength of the pavement is measured and recorded on the SERIS database. Sections that do not exhibit satisfactory performance levels are identified for further site investigation to ascertain what improvements may be required.

BEAR Scotland, as operator of this section of the A9, are responsible for the management and ongoing maintenance of pavements and structures along the route. BEAR's duties include carriageway and bridge inspections; routine carriageway and bridge repairs; and carriageway reconstruction and resurfacing.

Due to the nature and objectives of this route study, and BEAR's responsibility for pavement and structure inspection and repair, this report does not consider these aspects unless it directly affects the specific route interventions discussed further in this chapter.

### 4.16 Flooding

Scottish Environment Protection Agency Flood Maps has been reviewed to identify areas that may be affected by flooding. SEPA advises that the scale of a flood can depend on a variety of things including:

- the amount of rain and how quickly it has fallen;
- the conditions in the area around the river, known as the catchment, such as how hilly or vegetated an area is and how dry or wet the ground is, can affect how much rain soaks into the ground and how much water runs directly into the river;
- if there is a particularly high tide; and
- if there is a tidal surge or waves caused by strong winds and currents.

The Flood Map provides an estimate of the areas of Scotland with a 1 in 200 or greater chance of being flooded in any given year.

Drawings indicating the potential flood mapping along the route are contained in Appendix 9.



## 5 Environmental Assessment

### 5.1 Introduction

In accordance with the DMRB, AECOM have undertaken an initial assessment within the environmental impact assessment (EIA) process to decide which environmental topics are to be examined in statutory and non-statutory EIAs and to determine the data, survey needs and level of effort required. The findings of this scoping exercise are summarised in this chapter.

The scoping exercise has considered the route corridor as a whole, but where appropriate makes reference to the specific locations where grade separation may be considered.

### 5.2 Air Quality

The proposed junction improvements have the potential to cause temporary localised dust nuisance during construction. This deposition would hold particular significance for any residential properties located close to the proposed junction upgrade sites. Other than these residential areas, nuisance is unlikely to have significant impact due to the rural nature of the study area. Exhaust emissions from construction vehicles will also impact on local air quality during the construction phase. However, the total number of construction vehicles using the local network is anticipated to be small compared with normal traffic flows. Both potential impacts are likely to be mitigable through best practice.

During operation, the closure of a number of minor T-Junctions/median crossovers on A9 between Keir roundabout and Broxden roundabout could result in a slight increase in traffic flows if vehicles have to travel further. However, any increase is expected to be very small. The creation of six grade separated junctions is likely to result in less queuing at those junctions as the grade separation should result in free flowing traffic. This should be beneficial to local air quality due to the reduced congestion but the effect is expected to be very small. Widening of the existing grade separated junction at Greenloaning should provide greater capacity which would be beneficial to reducing congestion and local air quality. However, the effect is expected to be very small.

There is not expected to be any change in air quality in the Perth AQMA as a result of the scheme. However, traffic data is required to quantitatively assess the change in local air quality and greenhouse gas emissions. A DMRB simple level assessment will be carried out using the DMRB screening method for local and regional effects.

### 5.3 Cultural Heritage

Data was collected from The Perth and Heritage Trust Historic Environment Record (HER) and the Royal Commission on Ancient and Historic Monuments Scotland (RCAHMS) online sources in order to carry out a scoping study for proposed junction developments on the A9 between Dunblane and Perth.

The results of the study show that there are 198 recorded heritage assets within 500m of the eight junction locations. This includes 14 Scheduled Monuments and 22 listed buildings. There is the potential for unrecorded archaeological features to survive, particularly in the area surrounding the proposed junction to the south of Auchterarder.

It is recommended that a simple assessment following DMRB guidance should be undertaken.

### 5.4 Landscape Effects

The landscape of the study area is considered to be of a relatively high quality due to the intactness of its features and presence of designated landscapes and features such as Areas of Great Landscape Value (AGLV), Gardens and Designed Landscapes (GDL) and Ancient Woodland. The area, with its rolling hills and valleys, is scenically attractive, with few detractors.

Despite this, the proposals are not anticipated to introduce any significant effects on landscape character, due to the relatively localised nature of the proposals within an existing road corridor. Where the proposals occur within or in close proximity to designated landscape, care will need to be taken to ensure that important landscape features and views of the designated landscapes are preserved.

Capabilities on project:  
Transportation

Visual effects are likely to occur where high sensitivity residential receptors are in close proximity to the proposals, where new structures become apparent in views or close off existing views. Potentially significant effects may occur, although in the long term mitigation measures may reduce these to non-significant levels.

Cumulative effects in specific locations and visual effects on individual or specific groups of receptors would be considered as part of the Stage 2 Assessment.

### **5.5 Ecology & Nature Conservation**

The proposed A9 upgrade development has the potential to adversely affect a number of habitats that appear to be mainly of low conservation interest. Road improvements do however have the potential to adversely affect hedgerows and trees along the route of the A9 in addition to indirect impacts upon statutorily designated sites. A final objective assessment of the conservation value of the area will be made at Stage 2 once detailed surveys as outlined above have been undertaken. Measures need to be taken to prevent sediment run-off into watercourses, in particular the River Teith, and drainage ditches within the Study Area during road improvements.

A number of protected species are considered likely to be present within the Study Area, surveys will be required to establish their presence and any potential direct and indirect impacts from the proposed junction improvements.

At this stage, it is not possible to objectively discuss the likely effects of the proposed scheme. However, preliminary desk based information reviewed would indicate that the conservation and ecology of the habitats adjoining the existing road are of low to medium quality and providing that best practice is followed with regards to construction activities then the impact of the proposed scheme should be not significant.

### **5.6 Geology & Soils**

This preliminary assessment of the baseline geo-environmental conditions has identified that potential adverse impacts may occur during the construction and operational phases of the proposed scheme. At this stage, it is considered that the risk of encountering contamination in the study area is low. However, once a preliminary design is provided, a further desk study and potentially intrusive ground investigation should be undertaken to more fully characterise ground conditions, determine the severity of potential adverse impacts and identify mitigation measures.

### **5.7 Materials**

Due to the size of the Development and the expected works that will be required to be undertaken, there are potential impacts as a result of the materials to be used during the construction, where material use will be greatest, and the operational phases of the Development.

Materials that are of greatest concern are aggregates, concrete and the production and management of waste material produced from construction. A Simple Assessment is required to determine the significance of the impacts from these materials on the surrounding environment, with particular consideration of the various water bodies and ecological designated sites within the study area. The likelihood of these potential impacts is expected to be decreased significantly by the production and undertaking of several site-based management plans, therefore reducing the significance of these impacts.

From initial desk-based survey work carried out on the study area, there are a number of sensitive receptors with the potential to be affected as a result of the use and storage of materials on the Development construction site. Further to these potential impacts, the project exceeds the £300,000 threshold set within the DMRB Interim Advice Note 153/11 that requires the project to be subject to at least a Simple Assessment.



Capabilities on project:  
Transportation

Additional information required in order to complete the Simple Assessment, as per DMRB Interim Advice Note 153/11, includes site preparation and construction works, quantities of materials required for the project, estimate quantities of waste material anticipated and the source or origin of the materials used.

## 5.8 Noise & Vibration

A qualitative assessment of the noise and vibration impact from the proposed improvements at seven locations along the A9 Keir Roundabout to Broxden Roundabout where grade separated junctions are proposed was undertaken. This assessment concluded that at the majority of the sites it is unlikely that noise levels will increase at noise sensitive receptors within the study area, which exceed the short term day time noise threshold levels or the long term day and night noise thresholds. This conclusion assumes that traffic flows using the proposed junctions will be a magnitude lower than traffic flows on the A9 (i.e. less than 10%) and so for the following proposed grade separated junctions a Simple Assessment need only to be carried out at this stage:

- Greenloaning
- Blackford
- Auchterarder
- Aberuthven
- Findo Gask
- Windyedge Cottage

At the Keir Roundabout, where the proposal includes moving the whole carriageway closer to noise sensitive receptors that are located on the northbound carriageway, noise threshold levels in the short and long term are likely to be exceeded and a Detailed Assessment needs to be carried out.

It is not expected that any of the noise sensitive receptors in the vicinity of any of the proposed road improvements will be affected by vibration effects from traffic, either ground borne or from low frequency noise, providing there are no road surface irregularities or the gradients of the overbridges are such as to cause HGV's to change down in gear.

At this stage only noise and vibration impacts relating to the operational use of the proposed development is considered. Noise and vibration impacts relating to the construction of the proposed road improvements will be dealt with at later stages of the assessment.

## 5.9 Effects on All Travellers

The A9 between Keir Roundabout and Broxden Roundabout is a long established corridor and does not sever any of the communities along the route in of themselves. Communities located to the north of the A9 do however experience a degree of severance with the rural countryside to the south. Recreational walkers, cyclists and equestrians also experience a degree of severance, although, it should be noted that rivers and the railway also contribute to severance.

The effects on all travellers are minimal because the A9 is long established and the proposals do not include any sections of new alignment.

The proposals to grade separate junctions will provide additional amenity for pedestrians, cyclists and equestrians by providing a safe manner in which to cross the A9 without interacting with it. However, journey lengths, depending on the location and design, may increase slightly.

The proposal to grade separate Keir Roundabout will increase amenity for pedestrians and cyclists, from Bridge of Allan especially, by removing the interaction with the A9.

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Proposals to close central reservations will have an effect on low numbers of pedestrians, cyclists and equestrians but if no alternative provision is made for these users then severance with the countryside and journey length will both be increased.

The view from the road for the majority of the route will remain unaffected by the proposals. The exceptions to this will be the introduction of a grade separated junction at Findo Gask which will have an adverse effect on the view from the road over short sections.

The levels of driver stress, for both drivers on the A9 and drivers joining the A9, will be reduced at localised sections as a result of the introduction of grade separated junctions and the closing of central reservations.

#### **5.10 Community & Private Assets**

The proposed closure of central reserves and installation of grade separated junctions on the A9 between Keir and Broxden roundabouts are likely to require land take from the surrounding areas of the new junctions. This land is predominantly going to be taken from agricultural land of moderate productivity, with additional areas of forestry, open space and private land (both residential and industrial) also required.

Where work is required at urban areas, there is also the potential for areas of community land to be taken and an indirect impact on users of the community facilities within the villages through reduced or altered access during periods of construction. However, these impacts are predicted to be minor and many of them will also be limited to periods of construction.

#### **5.11 Road Drainage and the Water Environment**

Along the study area of the A9 between Keir and Broxden roundabouts, there are several watercourses that cross or run parallel to the A9 route and are therefore subject to potential adverse impacts as a result of the Development. According to the DMRB, Volume 11, Section 3, Part 10 guidance, due to the developments potential to "affect several existing watercourses" and alter the type of junctions along the course of the route, the Development is subject to further assessment to determine the likelihood and potential significance of these impacts.

There are several particular aspects of the water environment within the study area that are likely to be sensitive receptor sites for adverse impacts from the Development, including the two SSSI, RSPB and RAMSAR designated sites, and the fresh water fish populations that are supported within the surrounding surface water bodies. There is also the potential for further intrusion in to the water environment from new or increased road sections that cross the various watercourses at Greenloaning and Blackford villages and the B8062 junction.

Before mitigation or any detailed design, it is likely that there will be a significant impact on the water environment within the study area as a result of the Development, in regards to the sensitivity of the receptors (supporting fresh water fish populations, and being of national and international importance for the support of other wildlife), the likely invasive requirement of building over or in proximity to watercourses, and the scale and nature of the Development in changing the type of junctions on the A9 trunk road. Therefore at least a simple assessment will be required following further design detail to determine the significance of the aforementioned impacts. However, it is considered likely that with appropriate mitigation the impacts will not be significant.

#### **5.12 Consideration of Cumulative Effects**

A full assessment of cumulative impacts will be undertaken at design stage 2. This will include a consideration of planning applications in the study area, as well as impacts to other roads works in the area.

## 6 Traffic & Economic Assessment

### 6.1 Introduction

This section describes an outline economic assessment of improvements to the A9 between Keir Roundabout and Broxden Roundabout. Existing traffic conditions are described in detail in Chapter 2, and an assessment of the traffic impact of various scenarios is dealt with in Chapter 3.

Whilst only very broad recommendations are put forward in this report with respect to proposed improvements to the A9, it was nevertheless deemed reasonable to undertake a preliminary economic assessment of a potential scenario comprising the interventions described in the previous chapters. The scenario tested was suitably conservative to ensure a robust assessment.

### 6.2 Economics

Guidance on the appraisal of road schemes in Scotland is set-out in DMRB Volume 5, "SH 1/97 - The Traffic and Economic Assessment of Road Schemes in Scotland". Economy is also one of Transport Scotland's five STAG (Scottish Transport Appraisal Guidance) criteria. The Economy criterion itself has three sub-criteria. Together, these provide a full assessment of the impacts of a scheme on the economy. The sub-criteria are:

- Transport Economic Efficiency (TEE) covers the benefits ordinarily captured by standard cost-benefit analysis – the transport impacts of an option;
- Wider Economic Benefits (WEBs) relate to the notion of potential transport impacts on agglomeration and the relationship between agglomeration and productivity. Further guidance can be found in the STAG Technical Database and practitioners should note that it is likely that appraisal of this sub-criterion should only be completed in Part 2 Appraisal; and
- Economic Activity and Location Impacts (EALIs) allow the impact of an option to be expressed in terms of the net effects of the option on the local and/or national economy.

This section focuses in particular on TEE, the economic assessment of a transport scheme based on a comparison of the total benefits generated by the scheme with its total associated costs. The following three elements have been considered in the assessment of the scheme:

- The impacts of the scheme on road collisions in the study area: estimated using NESAS 10 methodology and changes in traffic levels forecast by the traffic assignment model. Travel demand data has been appropriated from the Transport Model for Scotland (TMfS07);
- The impacts of the scheme on travel times and costs for trips affected by the scheme together with the associated impacts on revenue and indirect tax levels have been estimated using the NESAS program; and
- The capital costs associated with the scheme. An allowance has also been made for optimism bias and risk.

Forecast costs and calculated benefits have been combined to produce an overall estimate of the balance of the costs and benefits of the scheme over a 60-year appraisal period. 2025 has been selected as the opening year of the scheme as it is assumed that all proposed works in the corridor will be completed to coincide with completion of the A9 Dualling Project (Perth to Inverness).

#### 6.2.1 Elements of the Assessment

The following sections outline the approaches used to estimate the value of schemes costs and benefits.

##### 6.2.1.1 Assessment of Safety Impacts

The impact of the scheme on the number of collisions in the study area has been estimated using NESAS 10 methodology for calculating combined link and junction collision numbers and costs.

The estimated value of impacts for the forecast years has in turn been converted into an estimated Net Present Value (NPV) of collision savings in 2002 prices and values over a 60-year appraisal period (2025 – 2084).

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#### 6.2.1.2 Assessment of Travel Times and Costs

Within the NESA program, the benefits experienced by road users are split broadly into two categories:

- Consumer User Benefits: Benefits for those road users who are not travelling on the road for primarily business purposes (typically commuting or non-work purposes); and
- Business User Benefits: Benefits for those road users who are travelling on the road primarily for business purposes (e.g. to meetings or road haulage).

Within NESA, each user is assigned a 'value of time' whereby, when a highway improvement is provided, the user enjoys a 'consumer surplus', i.e. in this case they travel along a section of road in a shorter amount of time, and therefore save money. This surplus or benefit is summed for all of the respective road users over the whole period of assessment and the total benefits calculated. Typically 'value of time' is much higher for business users in comparison to consumer users, and therefore business users benefit most from any such improvement.

#### 6.2.1.3 Other Impacts Calculated

The other impacts calculated within the NESA program are detailed below:

- Private Sector Provider Impacts: Benefits for those in the private sector who operate on the road network (typically bus services);
- Collision Benefits: Benefits in terms of reduced number and severity of collisions in monetary terms (this will be one of the key sources of benefits with the anticipated savings from the reduction in the number and severity of collisions); and
- Change to Indirect Tax Revenues: Change in tax revenues to central government due to changes in fuel economy etc.

#### 6.2.1.4 Assessment of Capital Costs

The various route interventions included in the test scenario, and the corresponding estimated cost are set out in Table 24 below:

	TOTAL CONSTRUCTION COST (£'000's)	COMMENTS
TEST SCENARIO	£69,730	Construction of 6no new GSJ (inc Keir Roundabout), 14km of parallel side roads, 9 new LILO, 24 new Type A laybys etc. Includes allowance for land costs.

Table 24 - Estimated Costs (Q4, 2012 Prices) [excluding Optimism Bias]

#### 6.2.1.5 Allowance for Optimism Bias

Optimism Bias (OB) is defined as the systematic tendency for project appraisers to underestimate their scheme's cost (and therefore overestimate the strength of its economic case).

The NESA manual gives further guidance on the treatment of OB in a Scottish context. It states (Chapter 7: Part 6 Valuation of Costs and Benefits, Paragraph 7.18):

"For economic assessment of Scottish trunk road schemes, Scottish Executive advice with regard to Optimism Bias is that Total Scheme Costs (TSC) should generally have an Optimism Bias of +25% applied and Works Duration an Optimism Bias of +10% applied. These values accord with historic available to the Scottish Executive and are generally considered acceptable for trunk road schemes with TSCs of up to £50m. For trunk road schemes with estimated TSC greater than £50m further advice and agreement must be sought from Scottish Executive as to the appropriate levels of Optimism Bias which should be applied."

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As the overall total scheme cost at this stage of the project is greater than £50m then the guidance above has been deemed and agreed to not be applicable. Therefore in line with the guidance on appraisal and evaluation given in HM Treasury's Green Book, an allowance was also applied to costs to account for optimism bias. In line with this guidance, the cost estimate for the test scenario has been uplifted by 44% to allow for optimism bias. However, it is noted that whole scheme will not in all likelihood be implemented in a single phase and as such the various packages of work will be advanced on priorities and available funding. As these packages are brought forward, they are likely to be below the £50m threshold and so may attract the lower rate of OB.

#### 6.2.2 The NESA Analysis

The NESA (Network Evaluation from Survey and Assignment) program compares the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and collisions), and expresses the results in terms of a monetary valuation.

NESA 10 was used for the assessment. The essence of NESA is that the travel cost for each component (link and junction) of the network is calculated separately according to the flows and turning movements assigned to it. The individual link and junction costs that are time, vehicle operating costs and collisions are summarised to yield the total costs over the network.

The benefits are calculated for the assessment period of 60 years, which is in accordance with DMRB Volume 5, "SH 1/97 - The Traffic and Economic Assessment of Road Schemes in Scotland", and are balanced against the construction and maintenance costs over the same period.

Carrying out a road scheme normally results in a stream of costs, followed by a stream of benefits associated with the improved flow of traffic and a reduction in collisions. This information must be compared to arrive at an understanding of the overall worth of the scheme. However they cannot simply be added as if they occurred simultaneously. Cost and benefits arising in different years are therefore expressed in terms of their 'present value' i.e. their value in a given year. This is called the present value year and in the NESA programme this is taken to be 2010.

The Net Present Value (NPV) of any scheme can be calculated by subtracting the Present Value of Costs (PVC) from the Present Value of Benefits (PVB). This figure is expressed as a 2002 price discounted from the current year to 2002. A positive NPV indicates that the benefits of the proposed scheme outweigh the costs indicating that a scheme is potentially economically viable. The assessment period is 2025 to 2084, with 2025 assumed to be the full opening year and 2084 assumed to be the final assessment year. These assumptions result in a 60-year assessment period, in accordance with current STAG guidance.

Environmental effects such as noise, changes in air quality, visual intrusion and severance are not evaluated in the NESA assessment but are covered in the accompanying environmental report.

#### 6.2.3 NESA Inputs

The NESA assessment has utilised the following data and parameters:

- Typical 12 hour matrix of traffic movements between NESA model zones;
- Default collision data (with specific junction collision rates);
- Route based traffic composition; and
- Link and junction details for the Do-Minimum and Do-Something scenarios.

Construction and land costs have been input in multiples of £1,000 at 2012 Q4 prices. NESA calculates the equivalent costs in the present year value and allocates them to the correct year.

#### 6.2.4 Transport Economic Efficiency Results

The Net Present Value (NPV) for the test scenario is provided in Table 25. In this instance the 'Core' traffic growth scenario has been assumed.

It should be noted that the cost estimates used within the NESA assessments include 44% Optimism Bias however this percentage should reduce as the proposed scheme moves through the appraisal process.

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NESA ELEMENT	
Consumer User Benefits (£k)	55,160
Business User Benefits (£k)	48,920
Private Sector Provider Impacts (£k)	-230
Collision Benefits (£k)	62,940
Present Value of Benefits (PVB) (£k)	166,800
Present Value of Costs (PVC) (£k)	46,480
Net Present Value (NPV) (£k)	120,310
Benefit to Cost Ratio (BCR)	3.59

Table 25 - Detailed Transport Economic Efficiency (TEE) Results

#### 6.2.5 Impacts on Public Accounts

The NESA analysis for the test scenario reveals that the proposed scheme should provide a positive impact on the public accounts. Whilst the Present Value of Costs (PVC) of providing the scheme is £46,980k, this is compensated for by a Present Value of Benefits (PVB) value of £166,800k. The benefits being derived from a combination of journey time savings from grade-separation of Keir Roundabout and collision savings from removal of all at-grade junctions.

#### 6.2.6 Transport Economic Efficiency for Consumer Users

Consumer users are those who use a highway for reasons other than business, i.e. they could be commuters or those on leisure trips. Such users therefore typically have a lower value of time than business users and transport providers. The benefits identified for this scheme are £60,440k for the scenario tested.

#### 6.2.7 Transport Economic Efficiency for Business Users and Transport Providers

Business users and transport providers are a key beneficiary of any highway improvement as a reduction in congestion or improvement in safety helps to bring about savings or an increase in productivity for their businesses. As such, their value of time is higher than for consumer users and this is reflected in this instance by a benefit of £48,920k for the scenario tested.

#### 6.2.8 Reliability

This sub-objective summarises the proposal's impact on the objective to improve journey time reliability for transport users, including both passengers and freight.

For journeys by private road vehicles (including road goods vehicles), it is reasonable to expect travellers to be aware of the average journey time, including variations caused by factors such as different traffic conditions at different times of the day. Thus reliability should be measured in terms of the unpredictable variability in travel times about these averages, measured by the standard deviation of travel time.

At this early stage in the appraisal process, reliability is assessed on a qualitative rather than quantitative basis using measured and estimated journey times.

It is considered that for strategic traffic on the A9, journey time reliability will see an improvement as a result of the closure of the median crossovers which will eliminate queuing right turning traffic at junctions. The provision of a continuous central median barrier along the A9 between Keir and Broxden will reduce conflicts between emerging and strategic traffic which will improve driver confidence.

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### 6.2.9 Wider Economic Impacts

Transport is a key driver of economic development, whereby transport investments can, in particular, affect the location and pattern of economic activity.

The proposed improvements to the A9 between Keir and Broxden will collectively enhance the attractiveness of the A9 corridor. The scheme will improve traffic conditions on the A9 by maintaining journey time reliability and improving safety. The A9 is already a key transport corridor and the proposed improvements will further enhance the attractiveness of the route.

A significant part of the benefits delivered by transport improvements is normally in the form of time savings to travellers. This time has a 'value' to travellers and therefore any saving in travel time induces a 'consumer surplus' or benefit for the user. These benefits to transport users are sometimes transferred to others. In theory, the time savings to firms will lead them to reduce prices and increase output – passing benefits on to those who buy their products. Time savings for commuters and others in an area might make this area more attractive to live in – so benefits are passed on to homeowners and landowners.

In summary, the wider economic impacts of a road scheme are determined by the improved local and strategic accessibility it may provide. In terms of strategic accessibility, the proposed scheme will enhance existing links between Dunblane/Perth and the principal settlements located to the north of the A9 carriageway. The scheme will also enhance the attractiveness of the area in general. In terms of local accessibility, the scheme will improve access for those using the A9 by making turning movements safer, which may have the effect of making the local area more attractive to live or locate a business in.

One of the disbenefits of the scheme will be the length of detours required which would appear to have an immediate impact on the cost of journeys. However it is considered that road users will determine suitable alternative detours once the scheme has opened, with these journeys being viewed as acceptable in order to benefit from the use of a high standard dual carriageway. A further analysis of detours, to include consideration of the impacts upon side roads and the potential for collision migration, may be undertaken at Stage 2.

### 6.3 Summary of Economy for Test Scenario

The Economic Appraisal of example scenario tested is summarised in Table 26.

NESA ELEMENT	TEST SCENARIO
Benefit to Cost Ratio (BCR)	3.59
Net Present Value (NPV) (£k)	120,310
Reliability	Slight Beneficial
Wider Economic Impact	Slight Beneficial
Present Value of Costs (PVC) (£k)	46,480

Table 26 - Economic Appraisal of Test Scenario

### 6.4 Summary of Economic Assessment

This chapter has examined the traffic and economic impacts of providing upgrades to the junctions and intermediate sections of the A9 between the Keir Roundabout and Broxden Roundabout. There is an evident need for the scheme arising from the observed collision rate on this section of the A9 as well as the delays for turning traffic that occur at the side road junctions. Even with the impact of the current economic downturn, it is forecast that volumes on the A9 will continue to increase year on year which potentially could further increase both collisions and delays leading to deterioration in the attractiveness of the route and increasingly unreliable journey times.

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For the purposes of the economic assessment, the impact of closing the central median crossovers has been assumed as an "A9 Only" diversion scenario whereby traffic diverts using the A9 alone rather than via the minor road network. An economic assessment of the proposed scheme has been undertaken using the NESA software, within which the traffic forecast data has been utilised. It is considered that this has resulted in a robust assessment of the economic benefits of the scheme at Stage 1.

In this regard, the NESA assessment have shown that the example scheme (comprising the grade separation of 6 junctions including Keir Roundabout) generates a BCR of 3.59 and Net Present Value (NPV) of £120m (2002 prices) over the 60-year appraisal period.



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## 7 Conclusions & Recommendations

### 7.1 Summary

The A9 forms the main road link between the Central Belt of Scotland and Inverness. The section of the A9 from Keir Roundabout at Dunblane to the west of Broxden Roundabout at Perth is dual carriageway for its full length and experiences problems arising from congestion during peak traffic hours at Keir Roundabout resulting in unreliable journey times. It also has a poor collision record resulting from the proliferation of median gaps which allow right turn manoeuvres onto and off the route. This contributes to a higher than average number of serious and fatal collisions.

STPR16 acknowledged these issues and proposed grade separation of all junctions along this section of the route, as part of the wider planned improvements to the A9 from Dunblane to Inverness.

This DMRB Stage 1 Preliminary Assessment considered a number of strategies to address these specific issues and to meet the study objectives:

- Make improvements to tackle congestion and support the promotion of journey times reductions on this section of the A9, particularly through Keir Roundabout;
- Reduce collision severity and the number of collisions on the A9 between Keir Roundabout and west of Broxden Roundabout.

A recent survey by route operators BEAR highlighted a significant queuing issue at Keir Roundabout resulting in delays of up to 15 minutes through the junction. The queuing that occurs at this junction during peak periods is thought to contribute to the significant number of shunt type accidents on the approaches. This assessment concludes that grade separation of Keir Roundabout should remain part of any strategy for dealing with the route going forward.

An assessment of strategies to deal with the remainder of the route concluded that closure of the median gaps without the provision of any new grade separated junctions would have resulted in:

- a significant increase in vehicle kilometres travelled;
- a significant increase in turning movements at the existing grade separated junctions and roundabouts; and
- would have resulted in unreasonable diversion lengths for some travellers.

This was not considered a reasonable approach and was discounted.

The provision of roundabouts in lieu of new grade separated junctions at existing major junctions along the route was also dismissed on the basis that they would have introduced delay into the road network. This would not have supported the objective of promoting journey time reductions.

The third strategy to deal with the section of the A9 beyond Keir Roundabout considered the provision of a number of grade separated junctions at various locations along the route. This assessment tested numerous scenarios to find a solution which would:

- Minimise the additional trip lengths;
- Reduce additional vehicles at existing junctions; and
- Provide travel time and accident benefits.

Numerous scenarios were tested comprising individual grade separated junctions for major side roads along the route as well as multiple combinations of these junctions from two to five. The tests provided an estimate of the total economic benefits that each scenario may accrue, as well as an estimate of the additional daily movements at existing grade separated junctions.

The assessment concluded that a minimum of at least three new grade separated junctions would be required to return a positive economic benefit, however in this scenario the additional traffic on existing grade separated junctions was estimated to be in excess of 1000 vpd at each. The inclusion of an additional grade separated junction into the scenarios tested elicited a

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corresponding increase in the estimated overall total economic benefits. A greater number of new grade separated junction as a reduction in the additional vehicles at existing junctions.

The analysis undertaken confirmed that the closure of median gaps and the provision of new grade separated junctions along this section of the A9 could generate positive economic benefits. It is concluded that the third strategy considered in this report be taken forward for further consideration at subsequent stages of DMRB Scheme Assessment.

The work undertaken at this stage of the Scheme Assessment did not seek to confirm the specific number of locations of any new grade separated junctions. As a result, it has not been possible to determine the additional infrastructure (parallel side roads, minor road improvements etc.) that may be required for the scheme. Nevertheless, in the interest of assessing the economic viability of undertaking improvements to this section of the A9, a preliminary economic assessment was undertaken based on very broad and conservative assumptions regarding a potential scheme. The outcome of this assessment would suggest that an economically viable solution could be developed.

## 7.2 Recommendations

The assessment work undertaken at this stage has concluded that grade separation of Keir Roundabout, along with the grade separation of additional junctions between Keir Roundabout and Broxden Roundabout should be taken forward for further consideration as part of the Scheme Assessment process. A number of specific recommendations are made based on the outcomes of the work undertaken to date. These are as follows:

- Median closures would make a significant reduction on the severity of accidents by disallowing right turning traffic to and from this section of the A9. This should be taken forward as the basis of the scheme in a Stage 2 DMRB assessment;
- Construction of new grade separated junctions on the route will reduce the delays caused by banning right turns. Increasing the number of grade separated junctions on the route has an inverse exponential effect on the reduction of diversion kms. Further traffic and economic analysis is required to determine the number and location of these junctions;
- The only solution considered to address the STPRs aim of reducing journey times is to grade separate Keir Roundabout. This should be taken forward to the DMRB Stage 2 Assessment;
- Additional Topographical data should be obtained to allow a more detailed assessment of the existing road geometry, including the analysis of the vertical alignment and the visibility at junctions;

Once the optimum number and location of grade separated junctions has been determined, a strategy to rationalise the remaining existing junctions and accesses should be developed.

## Appendices

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## Appendix 1 – Existing Road Features

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## Appendix 2 – Plan indicating sections of sub-standard geometry

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## Appendix 3 – Junction Geometry Review Schedule

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#### Appendix 4 - List of Horse Crossing Points on the A9 between Keir Roundabout and Broxden Roundabout

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#### List of Horse Crossing Points on the A9 between Keir Roundabout and Broxden Roundabout

1. Cotton to the Peel.
2. Windyedge to Tibbermore
3. Crossgates to the Gask Roman Road
4. B934 – Upper Cairnie
5. Dalreoch crossing
6. Strathy to Haugh of Aberuthven
7. Shinafoot Underpass
8. Milton Flyover
9. Auchterarder Underpass Nr Woodend
10. A823 Crossing
11. Blackford Entrance
12. Netherton underpass
13. Greenloaning and the Harperstone road
14. Kinbuck Flyover
15. Lower Auchinlay
16. Moon Cottage crossing
17. Doune and Dunblane showfield underpass.

No crossing point is provided however an need for a crossing point has been identified for horse riders at Woodside of Balhaldie..



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## Appendix 5 – Letter from CTC Scotland regarding cycling on A9 between Keir Roundabout and Broxden Roundabout

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## Appendix 6 –Plan indicating Edge of Pavement Details

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## Appendix 7 – Junction Flow Diagram

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## Appendix 8 - Geological Plans

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## Appendix 9 – Indicative Flood Maps

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