



Transport Scotland

A9 Keir Roundabout to West of Broxden Roundabout Corridor Study

DMRB Stage 1 Bridging Report

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1. Introduction

1.1 Study Background

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

The STPR acknowledged that many of the collisions on the A9 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 reduced journey times, improved journey time 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; and
- Grade Separation of Broxden Roundabout and Inveralmond Roundabout at Perth.

Following the inclusion of Intervention 16 within STPR, the Scottish Government's Infrastructure Investment Plan (IIP), published in December 2011, reiterated the commitment to improve the A9 between Dunblane and Inverness. Consultants AECOM has subsequently undertaken a study of the A9 trunk road between Keir Roundabout and Luncarty and drafted a Design Manual for Roads and Bridges (DMRB) Stage 1 Assessment report for the section between Keir Roundabout and west of Broxden Roundabout.

1.2 Study Deliverables

The DMRB Stage 1 Assessment was carried out in accordance with DMRB TD37/93, however prior to moving forward to DMRB Stage 2 Assessment, Transport Scotland has commissioned Jacobs to produce this 'Bridging Report' in order to identify potential sections within the route that would assist in the process when undertaking the route option assessments.

2. DMRB Stage 1 Assessment

2.1 Introduction

The work undertaken in the DMRB Stage 1 Assessment forms the main basis upon which this bridging document is produced. The study followed a standard methodology of identifying study specific objectives, reviewing existing conditions on the corridor, consideration of route strategies and options and assessment of those options from an engineering, environmental and traffic and economic perspective.

2.2 Objectives

The objectives identified in the DMRB Stage 1 Assessment were derived from a review of the National Transport Strategy objectives and the STPR objectives for this corridor. These were classed as the Study Objectives and are:

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

Although high level objectives have been identified for the overall route, in splitting the route into sections, this presents a chance to review more specific problems and opportunities for each section, thus enabling section specific objectives to evolve and potentially be more relevant to each section. No review of objectives has been undertaken as part of this commission, but could be undertaken based on a more detailed review of the sections in the DMRB Stage 2 Assessment.

2.3 Potential Strategies

The DMRB Stage 1 Assessment considered the grade separation of Keir Roundabout, along with two strategies for the section between Keir Roundabout and west of Broxden Roundabout. The two strategies were:

- Option 1 is referred to as Do-Minimum: Closure of all central reserve gaps, with only left in/left out junctions remaining. This strategy is considered, in order to remove the main safety issue on the route (right turning vehicles), however it is recognised that it would result in significant additional distance travelled for those who currently have direct access to the A9.
- Option 2 is the Grade Separation of Junctions along the route (includes the Do-Minimum of closure of central reserve gaps). This strategy is considered necessary, so as to reduce the excessive additional distance travelled by some vehicles, due to closures in the central reserve gaps. The assessment of the grade separated junction strategy indicated that a minimum of 3 junctions would be required over the whole route.

2.4 Conclusions / Recommendations from DMRB Stage 1 Assessment

The DMRB Stage 1 Assessment report concludes that the grade separation of Keir Roundabout should remain part of any strategy going forward. In addition, it is recommended that a number of grade separated junctions are constructed along the corridor, enabling the closure of all gaps in the central reserve, however giving consideration to the excessive distance travelled by those whose access is affected. The study recognises that further traffic and economic analysis is required to establish the number and location of the grade separated junctions, however states that an economically viable solution could be developed to grade separate the route.

3. Moving Forward to DMRB Stage 2

3.1 Need for Bridging Report

The DMRB Stage 1 Assessment specified certain locations where grade-separated junctions may be considered when moving forward to DMRB Stages 2 and 3. Although it is possible that the junction locations specified in the DMRB Stage 1 report will ultimately be the preferred locations at Stage 3, it is considered that at Stage 1 narrowing the options to such locations may not provide the best route to identifying the optimum solution for the route as a whole.

The Bridging Report is intended to identify sections, rather than specific locations, where grade separated junctions may be considered to provide flexibility when further developing options. It is considered that this presents a number of potential benefits relating to:

- Funding (available funds may require a phased implementation);
- Procurement/Delivery (Constructability);
- Flexibility (prioritise sections with worst safety record, manage constraints); and
- Co-ordination with development aspirations / Developer Contributions.

3.2 Methodology

In packaging the route into sections, consideration of shared characteristics, locations relative to demand areas (towns/villages) and existing junction provision provides a starting point. Reference to the work undertaken in the DMRB Stage 1 Assessment provides the basis for this task.

A number of tasks were required to support the identification of sections to be taken forward to DMRB Stage 2 assessment:

- Review characteristics of route to help identify potential sections based on existing provision along the route;
- Review traffic levels and behaviour to determine key interchanges/junctions along the route;
- Analyse existing safety issues to determine whether there are common issues within sections that steer towards a common solution; and
- Review suitability of junctions to accommodate additional traffic, should it be required, following any gap closures.

4. Identification of Sections

4.1 Introduction

At DMRB Stage 2, further work is required to determine the exact locations of junctions and which additional link roads to connect to grade separated junctions, however at this stage it is considered that a logical approach relating to road characteristics and traffic behaviour would provide a basis for determining suitable sections for taking the overall route improvement forward.

4.2 Route Characteristics

The A9 between Keir Roundabout and Broxden Roundabout is approximately 40km of all-purpose dual carriageway road, with a design speed of 120kph. This section of the A9 provides access to settlements in Dunblane, Greenloaning, Blackford, Auchterarder and Aberuthven, carries over 20,000 vehicles a day and the national speed limits applies along its length. Junction standard along the route is variable with a mixture of grade separated and at-grade provision 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.

There are 90 junctions between Keir Roundabout and Broxden Roundabout; these are made up of 4 grade separated junctions, 7 at-grade junctions accessing A & B class roads, 28 junctions accessing C class roads and 51 private accesses to services, private property, agriculture or woodland.

The grade separated junctions are located at:

- 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; and
- Loaninghead Interchange (Gleneagles) which connects the A823 to the A9.



Figure 4-1 View from Loaninghead Junction Overbridge (Gleneagles)

At-grade junctions providing access to A & B roads are located at:

- Keir Roundabout;
- 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.

The majority of remaining junctions and accesses are simple priority junctions with right turn provision through gaps in the central reservation.



Figure 4-2 Typical Priority Junction with Central Reserve Gap (B9141 Dunning / Findo Gask)

Potential sections have been determined based on shared characteristics, locations relative to demand areas (towns/villages) and existing junction provision.

Section 1 – Keir Roundabout

Junction Characteristics

Keir Roundabout is a large at-grade 5 arm roundabout joining the A9 (Bridge of Allan), M9 (Central Belt), B824 (Doune) and B8033 (Dunblane) and as such suffers from congestion at peak periods. The roundabout has 2 circulatory lanes and is fully lit.

Problems and Opportunities

Initial analysis of the most recent studies on the route; including the DMRB Stage 1 report (AECOM, 2013), indicate that improvements to Keir Roundabout in the form of an upgrade to a grade separated layout should be included within the overall development of improvements within this section of the A9. Delays are known to occur at this junction, which provides a connection between the A9 and M9 and also traffic feeding into the north of Bridge of Allan and Stirling. The DMRB Stage 1 report makes reference to a recent BEAR Scotland report which investigated queuing on the A9 approach to the roundabout and indicated that when flows exceed 1,500 vehicles per hour, queues can extend up to 2.5km from the junction. Significant queuing occurs on Sunday, Monday and Friday evenings and continues over a three hour period from 3pm onwards.



Figure 4-3 Queued Traffic at Keir Roundabout (Northern Approach)

During significant queuing periods at Keir Roundabout journey time can be impacted. The BEAR Scotland report noted that the maximum time recorded for a single vehicle waiting in a queue to reach the roundabout was 16 minutes.

Queuing at Keir Roundabout is also a significant factor in collisions at the junction, with 70% of collisions involving queuing vehicles. Collisions at Keir Roundabout accounted for 31% of accidents at all junctions on this section of the A9, although it is noted that the majority of these were categorised as 'slight'.

Grade separation of Keir Roundabout is considered to have a significant improvement on both journey times and the number of collisions and is therefore proposed in any improvement strategy for this section of the A9. Based on the potential journey time savings from grade separating Keir Roundabout, this would meet the study objective relating to tackling congestion and supporting the promotion of journey time reductions. It is possible that improvements at Keir Roundabout will be the only opportunity to meet this objective, as journey times are not an issue elsewhere for strategic trips, and therefore other improvements will be geared towards collision reduction.

In line with the DMRB Stage 1 Assessment report, it is therefore recommended that grade separation of Keir Roundabout be taken forward for further consideration at subsequent stages of assessment. Due to the strategic importance of the Keir Roundabout and relatively high traffic movements through it, potential options are likely to be on a larger scale to the remaining junction improvements along the route, therefore this could effectively form a stand-alone package within the corridor improvements.

Specific Packaging Benefits/Issues

The potential costs associated with grade separation of Keir Roundabout would likely be greater than any of the other proposed improvements on the route; therefore by considering it as a stand-alone package this may be beneficial in both procurement and delivery of the scheme.

Summary of Key Issues

- Junction type – At-grade roundabout leads to queuing and delays
- Safety – High proportion of slight accidents involve queuing vehicles

Section 2 – Keir Roundabout to Queen Victoria Slips

Section Characteristics

This is a 4.5km section of the route that bypasses Dunblane to its west and has no at-grade junctions or direct access onto it. In addition to Keir Roundabout and the Queen Victoria slips, there is an additional grade separated junction on the A820 at Stockbridge.

Problems and Opportunities

Given the relatively high standard of this section, there are few existing problems with it, other than the merge and diverge tapers at Queen Victoria Slips would not satisfy the standards set in DMRB. Any closure of central reserve gaps to the north of this section would likely result in increased turning movements at this junction; therefore consideration should be given to bringing this junction up to DMRB standard. The aspiration is for the remainder of the A9 dualling to be designed to Category 7A standard; therefore this junction would require improvements in order to provide consistent standards throughout the route.



Figure 4-4 Queen Victoria Slips

Specific Packaging Benefits/Issues

This section of the A9 is already grade separated and therefore would potentially present the least expensive and most straightforward construction of all sections to improve. Improvements could be carried out with minimal disruption to traffic flow, although there may be a requirement for temporary closures and potential diversions via Stockbridge 2km south.

Summary of Key Issues

- Junction type / Safety – Below standard diverges at Queen Victoria Junction results in deceleration on A9

Section 3 - Queen Victoria Slips to Loaninghead

Section Characteristics

This 15km section of the route has a number of at-grade junctions and accesses including Balhaldie services, a grade separated overpass joining the A822 at Greenloaning (South access only) and the grade separated junction at Loaninghead. A large at-grade junction also provides access to the B8081 at Blackford. A pedestrian walkway is located on the near side of the northbound carriageway extending from the B8033 grade separated junction to the Balhaldie Services.

The main settlements served by this section of the A9 are Blackford (which houses a population of 740, Highland Spring & Tullibardine distillery) and Greenloaning (population 330). Between Greenloaning and Blackford, the road passes through areas of arable and pasture farming 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 it passes under the A823 Loaninghead Interchange.

Problems and Opportunities

Due to the high frequency of at-grade junctions and crossings of the A9 and large amounts of farming around it, conflict with agricultural vehicles is particularly prevalent. An Accident Analysis Report prepared by BEAR Scotland 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 recommended remedial measures to highlight the potential presence of agricultural vehicles.



Figure 4-5 Farm Access and Central Reserve Gap (Between Queen Victoria Junction and Balhaldie Services)

At Greenloaning, collisions (both slight and serious) are dispersed along the route and show no particular clustering along the corridor, although 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 within a 1km section.



Figure 4-6 B8081 Blackford Junction

The spread of accidents throughout this section, rather than clustering at specific locations, suggests that the closure of all central gaps would have a significant impact on the reduction of accidents. There are a number of

minor parallel service roads that tie into the existing junctions on the A9, therefore upgrading the link roads and connections to any proposed grade separated junctions would be required in order to mitigate against additional distance travelled by those affected by gap closures.

Specific Packaging Benefits/Issues

This section of the A9 has direct access to the towns of Greenloaning and Blackford, and also provides the primary link from the A9 towards Crieff, therefore there may be potential for links to development aspirations.

Construction impacts could potentially be high depending on the scale of the proposals taken forward within this section. Upgrading existing junctions may provide the most cost effective proposal, however consideration to rationalising existing accesses and links to upgraded or new grade separated junctions would need to be considered in the DMRB Stage 2 Assessment, to ensure the appropriate number and location of junctions are identified. This may be particularly relevant on this section due to the number of accesses and higher than average number of collisions involving agricultural vehicles.

Summary of Key Issues

- Junction type / Safety – Large number of accesses and central reserve gaps in this section resulting in conflict between local and strategic trips

Section 4 - Loaninghead to West of Broxden

Section Characteristics

This is a 20km section of the route with primarily at-grade junctions providing access to the settlements at Auchterarder, Aberuthven and many minor accesses. As such this section has similar problems to the section to the south (Queen Victoria Slips to Loaninghead). There are no grade separated junctions on this section.

Problems and Opportunities

The section between the A823 Loaninghead Interchange and the A824 Auchterarder has the worst collision rate of the sections between Keir Roundabout and Broxden Roundabout. Between the Loaninghead Interchange and Aberuthven (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 were 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.



Figure 4-7 Right Turning Provision (North of Crossgates)

In order to improve this section of the route, closing the central gaps alone would not be feasible due to the excessive diversion distance that would be required to either Loaninghead or Broxden Roundabout. Provision of additional junctions or junction upgrades would therefore need to be considered.

To the southern end of this route there are roads running parallel to the A9, including the A824 as well as unclassified roads that could potentially be improved to form a link between grade separated junction on the A9. The A824 access to the south of the Auchterarder onto the A9 could be considered for closure with an alternative route option via Muirton and the Loaninghead grade separated junction.

Specific Packaging Benefits/Issues

Opportunities may exist within the southern part of this section in particular, to link any proposed junction improvements to developments. This could provide the most cost effective solution to locating the proposed grade separated junction. It is understood that there are existing proposals at Shinafoot to provide a grade separated junction, which may be linked to current development plans. Any junction with the A9 at this location would require improvements to the side road (B8062) to connect to the town of Auchterarder. In addition, work is currently ongoing on the west of Broxden Roundabout to Luncarty section, which may also include a proposed grade separated junction to the west of Broxden Roundabout. These two proposals may impact on identifying the optimum location for any grade separated junction within this section.

Due to the collision rate being the worst on the route if this section is progressed separately from the rest of the route it provides an opportunity to prioritise it, if required.

Summary of Key Issues

- Safety – Highest accident rate on the route
- Junction type / Safety – Accident clusters at a number of at-grade priority junctions north of Aberuthven

5. Summary and Recommendations

5.1 Summary

A DMRB Stage 1 Assessment has been undertaken on the A9 between Keir Roundabout and west of Broxden Roundabout, with a view to grade separating the existing dual carriageway route.

The purpose of this bridging report is to use the information developed in the DMRB Stage 1 assessment and split the route into sections, which would assist in the process of taking forward potential improvements to a DMRB Stage 2 Assessment.

Potential sections have been identified based on shared characteristics, locations relative to demand areas (towns/villages) and existing junction provision. In addition, consideration has been given to the potential benefits relating to procurement, constructability, safety and considering potential development plans.

5.2 Recommendations

It is recommended that by splitting the A9 between Keir Roundabout and west of Broxden Roundabout into smaller sections, there will be benefits when moving forward to identifying the preferred location and number of grade separated junctions at DMRB Stages 2 and 3. In addition, this method is considered to present the best option for procuring and constructing the options, allowing for phased implementation of the overall scheme. The following sections are therefore recommended:

- Keir Roundabout;
- Keir Roundabout to Queen Victoria Slips;
- Queen Victoria Slips to Loaninghead; and
- Loaninghead to west of Broxden Roundabout.