A9 Dualling Programme: Pass of Birnam to Tay Crossing

DMRB Stage 2 Scheme Assessment Report, Report Summary

A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-ZZ-0020 | C03

October 2023

Transport Scotland

TS/MTRIPS/SER/2013/03

A9 Dualling Programme: Pass of Birnam to Tay Crossing

Project No:	A9P02
Document Title:	DMRB Stage 2 Scheme Assessment Report, Report Summary
Document No.:	A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-ZZ-0020
Revision:	C03
Document Status:	A
Date:	October 2023
Client Name:	Transport Scotland
Client No:	TS/MTRIPS/SER/2013/03
Project Manager:	E.McMILLAN
Author:	C.KERR
File Name:	A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-ZZ-0020.docx

Jacobs U.K. Limited

95 Bothwell Street
Glasgow, Scotland G2 7HX
United Kingdom
T +44 (0)141 243 8000
F +44 (0)141 226 3109
www.jacobs.com

DMRB Stage 2 Assessment

The purpose of the Design Manual for Roads and Bridges (DMRB) Scheme Assessment Report is to identify route options within the Preferred Route Corridor, taking account of constraints, potential environmental, engineering and traffic and economic effects and considering feedback from the public and other stakeholders. These options are assessed, identifying the environmental, engineering, traffic and economic advantages, disadvantages and constraints associated with each route option. The Preferred Route Option is selected taking account of these assessments and taken forward for further development and refinement as part of the DMRB Stage 3 assessment.

In accordance with the DMRB (TD 37/93: Scheme Assessment Reporting), the DMRB Stage 2 Scheme Assessment Report is presented in the following volumes:

- Volume 1: Main Report and Appendices
  - Part 1 - The Scheme
  - Part 2 - Engineering Assessment
  - Part 3 - Environmental Assessment
  - Part 4 - Transport and Economic Assessment
  - Part 5 - Assessment Summary
  - Part 6 - Appendices
- Volume 2: Engineering Drawings
- Volume 3: Environmental Figures

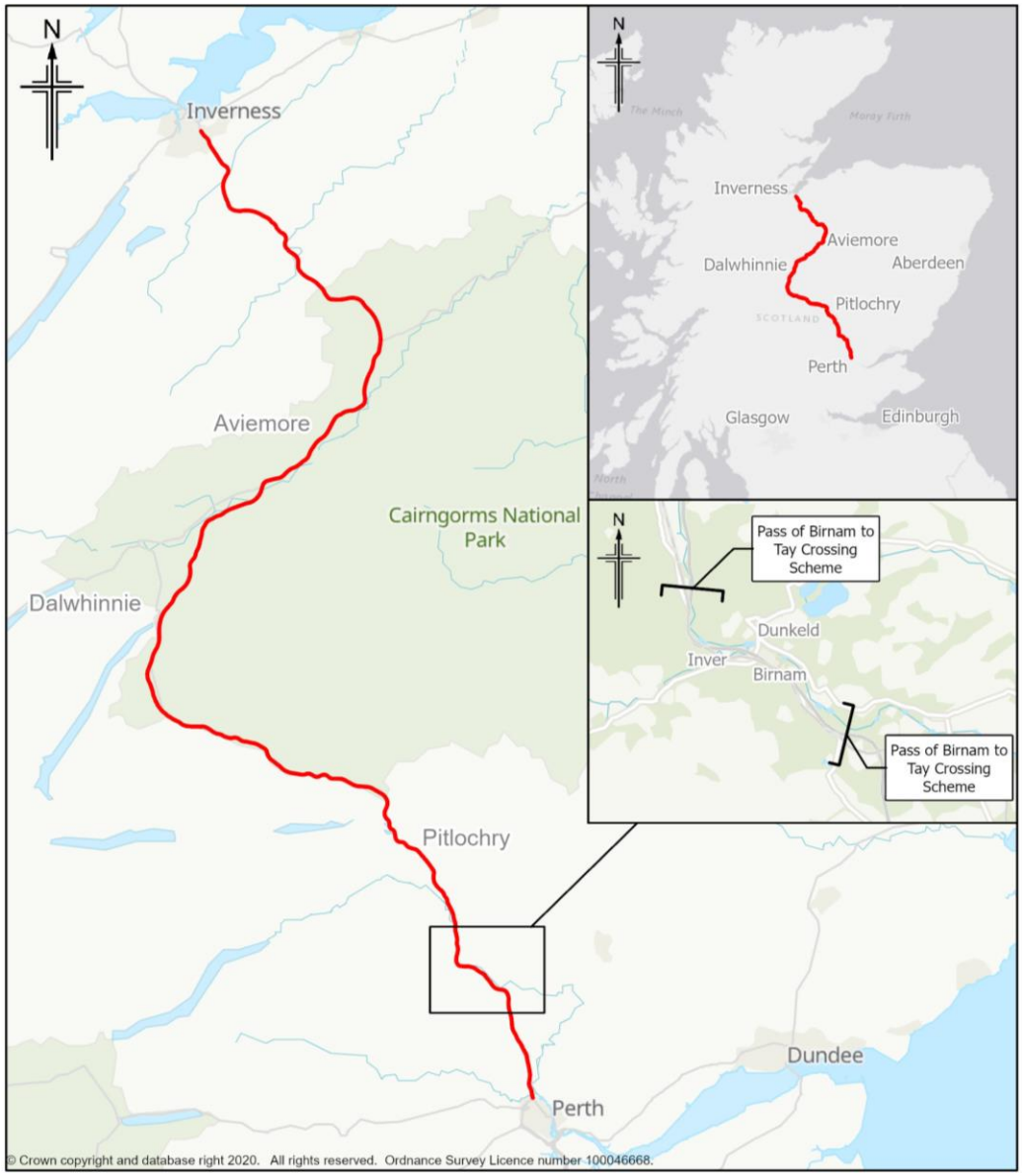
Part 1 - The Scheme

Background to Dualling the A9

The A9 corridor forms a strategic link between Central Scotland and the Scottish Highlands and is shown in Figure A.1. The 177 kilometre route between Perth and Inverness consists of seven single carriageway sections interspersed between eight existing dual carriageway sections. Approximately 129 kilometres of these single carriageway sections are proposed to be dualled in order to complete the overall dualling of the A9.

The Pass of Birnam to Tay Crossing project commences at the northern extent of the current section of existing dual carriageway that extends from Perth to the Pass of Birnam. It extends approximately 8.4 kilometres bypassing the towns of Birnam, Little Dunkeld and Dunkeld to the east and Inver and The Hermitage, which is a National Trust for Scotland (NTS) protected site, to the west. The tie-in point with the following scheme, Tay Crossing to Ballinluig, is approximately 0.75 kilometres north of the current River Tay crossing.

Figure A.1: A9 Perth to Inverness Location



Project 2: Pass of Birnam to Tay Crossing

Design and assessment work has been ongoing for the Pass of Birnam to Tay Crossing section of A9 dualling since 2004, with DMRB Stage 2 design and assessment beginning in 2009. Following public consultation in 2016, the local community requested more detailed consultation be undertaken to review options and investigate if other suitable alternative options, that address community concerns, were available. As a result, Transport Scotland agreed to the A9 Co-Creative Process, which was developed in collaboration with the Birnam to Ballinluig A9 Community Group and undertaken in 2018.

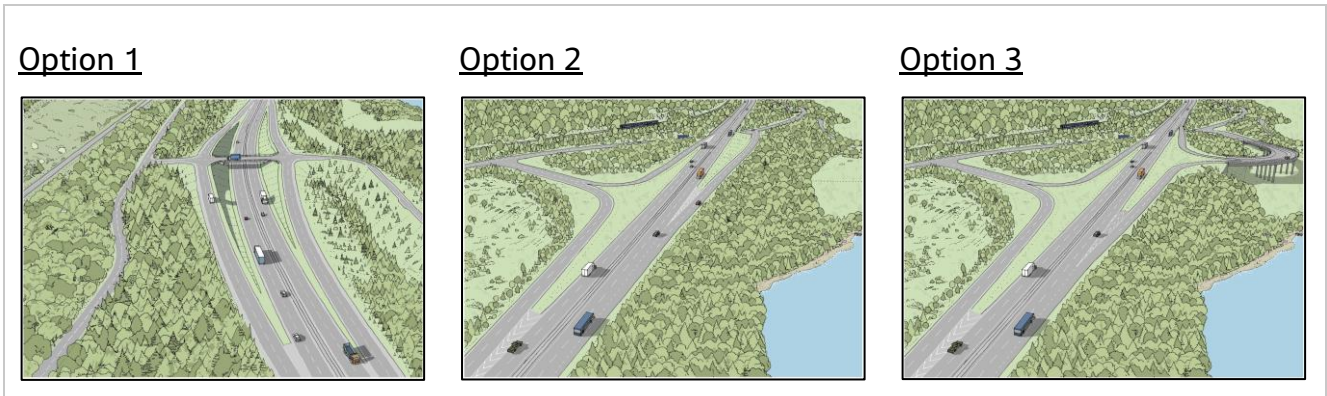
The outcome of the innovative A9 Co-Creative Process was the Community's Preferred Route, which was voted by the public. The Community's Preferred Route Option includes a 1.5 kilometre cut and cover tunnel in the locality of Dunkeld & Birnam Station. The option also includes an at-grade roundabout in the locality of the existing junction at Dunkeld.

Following completion of the A9 Co-Creative Process, further assessment work was undertaken on the Community's Preferred Route Option, which included consultation with key stakeholders and local residents. This assessment identified a number of challenges, which largely focussed on the construction complexity of the option, environmental impacts on local watercourses and capital and maintenance costs. As a result, and as good practice dictates that a range of options should be considered, three Additional Whole Route Options were developed. These options included ideas submitted by the public as part of the A9 Co-Creative Process and considered Transport Scotland and the local community's objectives.

Murthly/Birnam Junction DMRB Stage 2 Assessment

Three junction options were considered at Murthly/Birnam for the Additional Whole Route Options, as shown in Figure A.2. The initial focus of the DMRB Stage 2 assessment was on the Murthly/Birnam Junction options to determine a preferred junction option, which would be taken forward into the Additional Whole Route Options. Based on the outcome of the assessment undertaken, it is recommended that **Option 2**, a grade separated junction in the locality of the existing Birnam Junction, with merge/diverge slip roads in the northbound direction and a merge slip road in the southbound direction, be utilised for the Additional Whole Route Options. This option limits construction within the River Tay floodplain, has the lowest overall effects on the landscape resource and lowest anticipated costs.

Figure A.2: Murthly/Birnam Junction Options



Description of Route Options

Key features of the Community's Preferred Route Option (Option ST2A) and the three Additional Whole Route Options (Options ST2B, ST2C and ST2D) are summarised below.

Community's Preferred Route Option (Option ST2A)

- On-line route, largely following the horizontal alignment of the existing A9 single carriageway.
- A9 dual carriageway in a cut and cover tunnel for approximately 1.5 kilometres, commencing at the southern extent in the locality of the existing Birnam Junction and terminating approximately 300 metres south of the existing Dunkeld Junction.
- Dunkeld & Birnam Station retained in its current position with Station Road reconnected to the station. Parking on top of the cut and cover tunnel.
- Access road proposed to properties on Birnam Glen to the west of the station (in close proximity to Ladywell Landfill site).
- Speed limit of 50 miles per hour (mph) required between the southern extent of the scheme and the proposed Dunkeld Junction to maintain safety within the tunnel section. 70mph speed limit for the remainder of the scheme.
- Murthly/Birnam Junction:
  - Grade separated junction in the locality of the existing private access to Murthly Castle.
  - Diamond layout, facilitating all vehicle movements. Overbridge provided across the A9, connecting to the B867 to the west.
  - Requires a connection of the B867 and Perth Road in the locality of the existing Birnam Junction, crossing the A9 at the southern extent of the cut and cover tunnel.
- Dunkeld Junction:
  - At-grade roundabout in the locality of the existing junction at Dunkeld, including a segregated left lane between the A923 and A9 south.
  - Provides connections to the A9 (north and south), A923, A822 and road to Inver.
- The Hermitage:
  - Left-in left-out junction on the northbound carriageway.
- Dalguise Junction:
  - Grade separated junction south of the existing junction with the B898.
  - Loops in the northbound direction and slip roads in the southbound direction, facilitating all vehicle movements.
  - Realigned B898 crosses the A9 on an underbridge, connecting to a roundabout on the east of the A9, which also connects to the southbound slip roads.

Additional Whole Route Option 1 (Option ST2B)

- On-line route, largely following the horizontal alignment of the existing A9 single carriageway.
- A9 dual carriageway lowered into a 150 metre long underpass structure in the locality of Dunkeld & Birnam Station.
- Dunkeld & Birnam Station retained in its current position with Station Road reconnected to the station. Parking on top of the underpass.
- Access road proposed to properties on Birnam Glen to the west of the station (in close proximity to Ladywell Landfill site).

- Speed limit of 70mph throughout.
- Murthly/Birnam Junction:
  - Grade separated junction in the locality of the existing Birnam Junction.
  - Loops in the northbound direction and a merge slip road in the southbound direction, with no southbound diverge slip road.
  - B867 and Perth Road connected, crossing the A9 via an underbridge.
  - Includes an underbridge to connect the existing private access to Murthly Castle to the B867.
- Dunkeld Junction:
  - At-grade roundabout in the locality of the existing junction at Dunkeld, including a segregated left lane between the A923 and A9 south, facilitating all vehicle movements.
  - Provides connections to the A9 (north and south), A923, A822 and road to Inver.
- The Hermitage:
  - Left-in left-out junction on the northbound carriageway.
- Dalguise Junction:
  - Grade separated junction south of the existing junction with the B898.
  - Loops in the northbound direction and slip roads in the southbound direction, facilitating all vehicle movements.
  - Realigned B898 crosses the A9 on an underbridge, connecting to a roundabout on the east of the A9, which also connects to the southbound slip roads.

<u>Additional Whole Route Option 2 (Option ST2C)</u>

- On-line route, largely following the horizontal and vertical alignment of the existing A9 single carriageway.
- Generally, the same level as the existing A9 throughout, raised in the locality of Dunkeld Junction.
- Dunkeld & Birnam Station retained in its current position.
- Birnam Industrial Estate acquired, and the land used to construct a car parking facility accessed from Station Road, incorporating approximately fifty spaces.
- A new pedestrian underpass structure, incorporating lifts, constructed below the proposed A9 dual carriageway, linking the new car park to the station.
- Left-in left-out junction on the northbound carriageway to provide maintenance access to the station building. No public vehicular access available to the station building.
- Speed limit of 70mph throughout.
- Murthly/Birnam Junction:
  - Grade separated junction in the locality of the existing Birnam Junction.
  - Loops in the northbound direction and a merge slip road in the southbound direction, with no southbound diverge slip road.
  - B867 and Perth Road connected, crossing the A9 via an underbridge.
  - Includes an underbridge to connect the existing private access to Murthly Castle to the B867.
- Dunkeld Junction:
  - Grade separated junction in the locality of the existing Dunkeld Junction.
  - Variation of a diamond layout, facilitating all vehicle movements, with northbound and southbound slip roads.

- A822 and A923 connected, crossing the A9 via an underbridge.

- The Hermitage:
  - Left-in left-out junction on the northbound carriageway.
- Dalguise Junction:
  - Grade separated junction south of the existing junction with the B898.
  - Loops in the northbound direction and slip roads in the southbound direction, facilitating all vehicle movements.
  - Realigned B898 crosses the A9 on an underbridge, connecting to a roundabout on the east of the A9, which also connects to the southbound slip roads.

<u>Additional Whole Route Option 3 (Option ST2D)</u>

- On-line route, largely following the horizontal and vertical alignment of the existing A9 single carriageway.
- Generally, the same level as the existing A9 throughout.
- Dunkeld & Birnam Station retained in its current position.
- Birnam Industrial Estate acquired, and the land used to construct a car parking facility accessed from Station Road, incorporating approximately fifty spaces.
- A new pedestrian underpass structure, incorporating lifts, constructed below the proposed A9 dual carriageway, linking the new car park to the station.
- Left-in left-out junction on the northbound carriageway to provide maintenance access to the station building. No public vehicular access available to the station building.
- Speed limit of 70mph throughout.
- Murthly/Birnam Junction:
  - Grade separated junction in the locality of the existing Birnam Junction.
  - Loops in the northbound direction and a merge slip road in the southbound direction, with no southbound diverge slip road.
  - B867 and Perth Road connected, crossing the A9 via an underbridge.
  - Includes an underbridge to connect the existing private access to Murthly Castle to the B867.
- Dunkeld Junction:
  - At-grade roundabout in the locality of the existing junction at Dunkeld, including a segregated left lane between the A923 and A9 south, facilitating all vehicle movements.
  - Provides connections to the A9 (north and south), A923, A822 and road to Inver.
- The Hermitage:
  - Left-in left-out junction on the northbound carriageway.
- Dalguise Junction:
  - Grade separated junction south of the existing junction with the B898.
  - Loops in the northbound direction and slip roads in the southbound direction, facilitating all vehicle movements.
  - Realigned B898 crosses the A9 on an underbridge, connecting to a roundabout on the east of the A9, which also connects to the southbound slip roads.

Cost Estimates

Initial scheme cost estimate ranges have been prepared for each route option under consideration, which are shown in Table A.1. The total outturn cost estimate includes pre-construction phase costs, construction phase costs, risk, opportunity and uncertainty, and inflation through to the end of the construction phase. Optimism Bias is also included, which is a factor applied to the estimated total cost of the work to overcome the tendency for designers to be overly optimistic in their forecasts of the costs and time required to construct a trunk road scheme. Operation and maintenance costs are not included in the total outturn cost estimates.

Table A.1: Cost Estimates

Route Option	Scheme Cost Estimate (Minimum) (Excluding VAT)	Scheme Cost Estimate (Most Likely) (Excluding VAT)	Scheme Cost Estimate (Maximum) (Excluding VAT)
Option ST2A	£1,008 million	£1,266 million	£1,626 million
Option ST2B	£420 million	£495 million	£629 million
Option ST2C	£405 million	£478 million	£546 million
Option ST2D	£303 million	£362 million	£420 million

Part 2 - Engineering Assessment

Introduction

The engineering assessment considers the engineering advantages, disadvantages, opportunities and constraints associated with the route options under the key engineering features listed below.

- Walkers, Cyclists and Horse-riders (WCH);
- Lay-bys and Rest Areas;
- Relaxations and Departures from Requirements;
- Geotechnics and Earthworks;
- Hydrology, Hydrogeology and Drainage;
- Structures;
- Public Utilities; and
- Constructability.

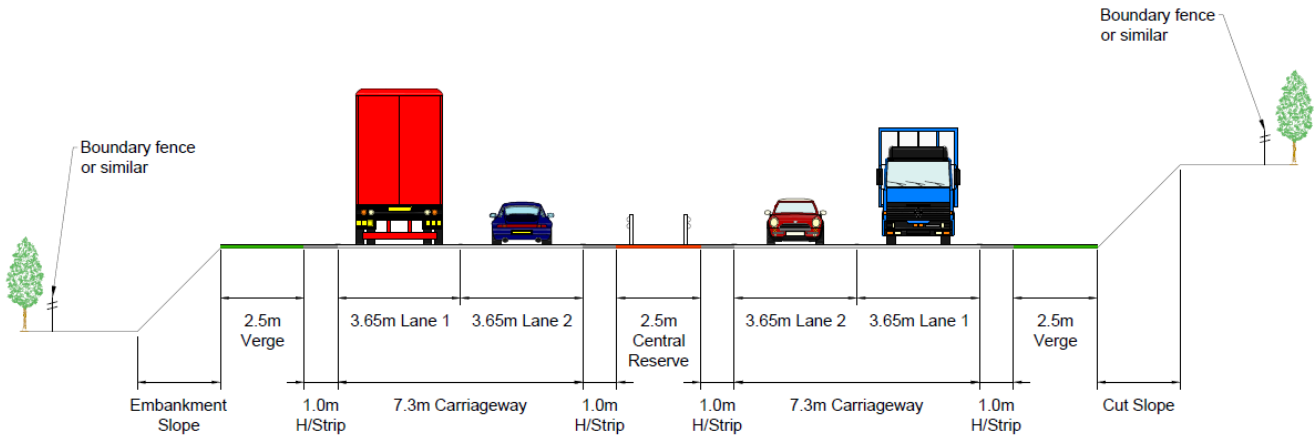
General Scheme Information

The proposed A9 will be a Dual 2-lane All-Purpose (D2AP) Road (sub-category c) (formerly known as Category 7A), as defined in the DMRB (CD109: Highway link design), which means it will have no gaps in the central reserve and no at-grade minor junctions. It is also recommended that only grade separated junctions are provided on the route for safe access and egress to the A9. Isolated left-in left-out accesses may be provided in exceptional circumstances. Compact grade separated junctions and at-grade roundabouts are not recommended for D2AP (sub-category c) dual carriageways.

The proposed A9 will have a Design Speed of 120 kilometres per hour (kph) (70 mph) over its entire length. However, the Community's Preferred Route Option (Option ST2A) includes a section that has a Design Speed of 85kph (50mph) due to forward visibility constraints within the 1.5 kilometre cut and cover tunnel.

The cross-section for the proposed A9 is shown in Figure A.3. Where necessary the central reserve and verges have been widened to ensure the necessary Stopping Sight Distance (SSD) is achieved. It is noted that the cross-section varies within the cut and cover tunnel for the Community's Preferred Route Option (Option ST2A).

Figure A.3: Proposed A9 Dual Carriageway Cross-section



The proposed A9 is a designated high load route. As a result, the headroom clearance for new structures over the dual carriageway will be a minimum of 6.45 metres, in accordance with the DMRB (CD127: Cross-sections and headrooms). The headroom clearance for structures under the proposed A9 and at side roads will be 5.3 metres.

It is noted that, for safety reasons, pedestrians, cyclists, motorbikes (with engines less than 50cc), animals and animal drawn vehicles are not permitted to use the cut and cover tunnel (Option ST2A).

Engineering Assessment Summary

The engineering assessment is summarised below.

WCH

There is a significant network of WCH routes within the Pass of Birnam to Tay Crossing section of the A9 Dualling Programme, comprising Core Paths, Rights of Way, National Cycle Network (NCN) Routes and Regional Cycle Network (RCN) Routes. The route options impact WCH routes at various locations and suitable mitigation to maintain connectivity is necessary.

One of the most significantly impacted routes is NCN Route 77, which is currently segregated from vehicular traffic between the existing left/right staggered priority junction with the B867 and Perth Road at Birnam and Dunkeld & Birnam Station. The route will be diverted onto the realigned B867/Perth Road for all options, however with Option ST2A there is an opportunity that the route can be placed on top of the cut and cover tunnel.

All options improve accessibility to the station, compared to the existing condition. Options ST2A and ST2B provide a direct connection from Station Road by lowering the proposed A9 dual carriageway. Options ST2C and ST2D incorporate a pedestrian underpass structure, with associated lifts and stairs. There is potential to provide Equality Act 2010 compliant access between station platforms, which will be investigated as part of the DMRB Stage 3 assessment, in conjunction with Network Rail and Transport Scotland.

All options impact existing WCH routes in the locality of the River Braan, albeit this impact is heightened for Option ST2C due to the larger land-take associated with the grade separated junction at Dunkeld. The impacts in the locality of the River Tay crossing are common to all options.

The variation between route options is not considered to be a significant differentiator.

Lay-bys and Rest Areas

The options under consideration include junctions at Murthly/Birnam, Dunkeld, The Hermitage and Dalguise. In addition, Options ST2C and ST2D include a left-in left-out junction at Dunkeld & Birnam Station, to provide maintenance access to the station and Highland Main Line railway. As a result of the frequency of junctions within the 8.4 kilometre scheme and considering the required weaving length (distance between junctions) to lay-bys and other geometrical parameters for the design of lay-bys, it is not proposed to provide any parking lay-bys. However, as part of the DMRB Stage 3 assessment, consideration will be given to upgrading the existing lay-bys to the immediate south of the scheme.

Relaxations and Departures from Requirements

In accordance with the DMRB (CD109: Highway link design) Relaxations and Departures from requirements have been considered in the design. This is predominantly to reduce impacts on adjacent environmental and physical constraints and to lessen construction complexity and costs.

Reductions in design standards are assessed as either being Departures from requirements, Relaxations or Deviations from recommendations, as detailed in the DMRB (GG101: Introduction to the Design Manual for Roads and Bridges) and summarised below.

- Departures from requirements - Where the requirements set out in the DMRB are not met, a departure application shall be submitted before the design is finalised. Departures should be submitted where it can be justified, it would not have unintended adverse consequences, innovative methods or materials are proposed, or a requirement not detailed in the DMRB is proposed.

  All Departures must be approved by the Overseeing Organisation prior to being incorporated into the works.

- Relaxations - Relaxations shall be applied where they are permitted within the appropriate section of the DMRB, with suitable justification for its inclusion recorded.

- Deviations from recommendations - A Deviation is where recommendations contained within the DMRB are not followed. Suitable justification for the use of Deviations should be documented and include a comparison of costs and time of the proposed solution, compared to the approach recommended in the DMRB.

  A safety risk assessment should be undertaken where a Deviation is proposed.

Where Departures from requirements, Relaxations and Deviations from recommendations are applied, careful consideration must be given to the safety implications and any requirements for mitigation measures, such as additional signage or road markings, to reduce or eliminate potential hazards.

As part of the DMRB Stage 2 assessment, only Departures from requirements and Relaxations have been considered. Deviations from recommendations will be fully considered as part of the DMRB Stage 3 assessment for the Preferred Route Option. It is noted that the most evident Deviation from recommendations within the DMRB Stage 2 assessment is the inclusion of an at-grade roundabout at Dunkeld Junction for Options ST2A, ST2B and ST2D.

The combined total of Relaxations and Departures from requirements for the Whole Route Options are listed below.

- Option ST2A: 13 Relaxations and 30 Departures;
- Option ST2B: 21 Relaxations and 28 Departures;
- Option ST2C: 16 Relaxations and 17 Departures; and
- Option ST2D: 20 Relaxations and 28 Departures.

The variation between route options is considered to be a differentiator, with Option ST2C the most favourable and Option ST2A the least favourable. Option ST2A is considered the least favourable due to its reduced speed limit, as it includes an at-grade roundabout and as it prohibits certain usage.

<u>Geotechnics and Earthworks</u>

Option ST2A requires significant excavation to form the 1.5 kilometre cut and cover tunnel (approximately 535,000m^3). Option ST2B also requires excavation to form the underpass structure at Dunkeld & Birnam Station. While not as significant as Option ST2A, the excavated volume (approximately 168,000m^3) is still extensive.

Options ST2A and ST2B also impact the Ladywell Landfill site, located to the west of the Highland Main Line railway, north of Inchewan Burn, as a result of the access road to properties on Birnam Glen, west of Dunkeld & Birnam Station. While the works are largely outwith the known boundary of the site, there is potential for contaminated ground to be encountered in this area, which may require treatment.

Option ST2C is raised above existing carriageway levels north of Dunkeld & Birnam Station to facilitate a grade separated junction at Dunkeld. This requires imported fill material (approximately 287,000m^3). Option ST2D is largely at-grade and on-line, therefore there are no significant excavations or embankments.

A summary of the total volume of material required for import and export for each route option is given in Table A.2.

Table A.2: Earthwork Volume Summary

Route Option	Total Import (m^3)	Total Disposal (m^3)
Option ST2A	0	698,000
Option ST2B	0	356,000
Option ST2C	287,000	146,000
Option ST2D	0	163,000

Option ST2A requires structural walls, formed with bored piles, to form the cut and cover tunnel. Similarly, Option ST2B also requires structural walls, formed with bored piles, to form the underpass structure at Dunkeld & Birnam Station. These walls will be up to approximately 8 metres maximum height. Option ST2C requires three short lengths of low height retaining walls to avoid encroachment towards residential properties adjacent to the southbound merge slip road that forms part of Dunkeld Junction. More significantly however, Option ST2C includes a retaining wall up to 14 metres high alongside Dunkeld & Birnam Recreation Club.

The variation between route options is considered to be a differentiator, with Option ST2D the most favourable and Options ST2A and ST2B the least favourable.

Hydrology, Hydrogeology and Drainage

Road drainage for the proposed cut and cover tunnel included in Option ST2A is complex, primarily due to the lowered road alignment, existing topography and narrow corridor. Within the tunnel section, sump tanks will be required, which will need to be emptied via a manhole within the tunnel. As such, one direction of the tunnel would need to be closed for this operation, utilising bi-directional traffic in the other half of the tunnel. Bi-directional traffic in a tunnel is not desirable due to the risk of head-on collisions, and reduced speed limits would likely be employed.

At the northern cut and over tunnel portal within Option ST2A, further complications exist, which requires surface run-off, collected outwith the tunnel, to be passed through the tunnel to reach Inchewan Burn. To limit the potential impact on the tunnel during flood events, an additional sump tank with pump is required.

Option ST2B incorporates an underpass in the locality of Dunkeld & Birnam Station. Filter drains on the A9 dual carriageway would continue through the underpass structure with a Hydrodynamic Vortex Separator (HVS) included beneath carriageway level to treat run-off. A geocellular/modular system is also required below the carriageway, which extends the depth of excavation and introduces a requirement for maintenance, albeit this is infrequent.

Options ST2C and ST2D are generally at-grade throughout, albeit Option ST2C is raised at Dunkeld Junction. Both options include filter drains and detention basins throughout, however Option ST2C includes a geocellular/modular system at Dunkeld Junction, to attenuate surface run-off.

The variation between route options is considered to be a differentiator, with Options ST2C and ST2D the most favourable and Options ST2A and ST2B the least favourable.

Structures

Option ST2A includes a 1.5 kilometre cut and cover tunnel that will be a two span structure, constructed using 1.2 metre diameter bored piles. Option ST2B incorporates a 150 metre long underpass structure that, given the site constraints, would also be formed utilising 1.2 metre diameter bored piles. Both options include a drop structure and culvert at Inchewan Burn. As a result of the A9 dual carriageway lowering works, a further structure is necessary for Options ST2A and ST2B across Birnam Glen and Inchewan Burn to the west of Dunkeld & Birnam Station to provide access to properties on Birnam Glen.

The grade separated junctions at Murthly/Birnam and Dalguise for all options include structures and the grade separated junction included in Option ST2C at Dunkeld requires an additional structure. All options include structural works to lengthen the existing Inver and Inch Rail Underbridges and a new structure alongside the existing River Tay crossing.

The total number of structures for each route option is summarised below.

- Option ST2A: 10;
- Option ST2B: 11;
- Option ST2C: 11; and
- Option ST2D: 10.

The variation between route options is considered to be a significant differentiator, with Option ST2D the most favourable and Option ST2A the least favourable.

Public Utilities

The route options interact with underground and overground public utility apparatus owned by BT Openreach, Scottish Gas Networks (SGN) Scottish and Southern Energy (SSE) and Scottish Water. The total number of interfaces with utility apparatus is summarised below.

- Option ST2A: 98;
- Option ST2B: 98;
- Option ST2C: 87; and
- Option ST2D: 85.

The impacts between route options are broadly comparable. Options ST2A and ST2B include lowering works in the locality of Dunkeld & Birnam Station, which will add complexity to diversion works. However, it is envisaged that post construction, measures can be employed to divert the utility apparatus.

The variation between route options is not considered to be a significant differentiator.

Constructability

Construction of the 1.5 kilometre cut and cover tunnel for Option ST2A, and the underpass for Option ST2B, in such a constrained and sensitive corridor, will be complex. As insufficient space exists for an open excavation, the walls that form part of the cut and cover tunnel, and the underpass, would be constructed using large diameter bored piles (1.2 metre diameter) to retain a height of approximately 10 metres. Installation will require heavy plant in close proximity to residential properties, Dunkeld & Birnam Station, the Highland Main Line railway and the Category A Listed station building. Construction will generate noise and vibration, with the potential to affect residential properties immediately adjacent to the proposed A9 as bored piles are formed over a significant length. Maintaining bi-directional traffic flows on the A9 throughout construction will be challenging, and reduced speed limits and narrow lane widths will be required.

For Options ST2A and ST2B, construction works will be undertaken approximately 2.5 metres from the Category A Listed station building, with potential risk of accidental damage. It is not anticipated that the works will have a structural impact on residential properties. However, before commencement of piling works, Pre-Construction Condition Surveys may be undertaken

Works to lower Inchewan Burn for Options ST2A and ST2B are complex and will require permanent and temporary bored and sheet piling works, as well as the erection of a temporary A9 bridge, to allow the existing A9 structure to be demolished. The burn itself would be diverted through a temporary culvert while the permanent drop structure and box culvert are constructed.

As Option ST2C is above existing carriageway levels, it requires retaining walls of less than 2 metres high for short lengths on the east side adjacent to residential properties. These walls will likely be simple in-situ concrete or pre-cast L-shaped gravity walls, which are relatively simple to construct. No retaining wall solutions are required on the west side alongside the Highland Main Line railway as a natural earthwork slope can be accommodated, subject to the existing railway bund being removed.

Option ST2D is largely at-grade and while there will be some construction challenges, they are not as significant as the other options.

Anticipated construction durations for the route options are shown below. This assumes a 6-day working week (Monday to Friday, 7am to 7pm, Saturday 8am to 1pm, with no night-time, Sunday and Bank Holiday working).

- Option ST2A: 4 ½ to 5 years;
- Option ST2B: 4 to 4 ½ years;
- Option ST2C: 2 ½ to 3 years; and
- Option ST2D: 2 ½ to 3 years.

The variation between route options is considered to be a significant differentiator, with Option ST2D the most favourable and Options ST2A and ST2B the least favourable.

Part 3 - Environmental Assessment

Introduction

The DMRB sets out UK wide guidance on the development of trunk road schemes. The DMRB specifically provides guidance on environmental assessment and describes the level of assessment required at each of the key stages of development of a trunk road scheme.

The primary aim of DMRB Stage 2 assessment is to comparatively assess route options (which may vary, for example by vertical or horizontal alignment or junction layout) and identify a Preferred Route Option. Once the Preferred Route Option is selected, the design is then further developed and assessed at DMRB Stage 3, and the Preferred Route Option is the subject of an Environmental Impact Assessment (EIA) under the relevant legislation.

Taking into account DMRB guidance, the following environmental factors have been subject to environmental assessment as part of the DMRB Stage 2 assessment.

- Chapter 8: Population - Land Use;
- Chapter 9: Geology, Soils and Groundwater;
- Chapter 10: Road Drainage and the Water Environment;
- Chapter 11: Biodiversity;
- Chapter 12: Landscape;
- Chapter 13: Visual;
- Chapter 14: Cultural Heritage;
- Chapter 15: Air Quality;
- Chapter 16: Noise and Vibration;
- Chapter 17: Population - Accessibility;
- Chapter 18: Material Assets and Waste;
- Chapter 19: Climate;
- Chapter 20: Human Health; and
- Chapter 21: Policies and Plans.

The assessment of potential impacts and effects on each environmental factor listed above is undertaken in comparison to baseline conditions, which were determined through field survey, desk-based review and consultation. Baseline conditions describe the existing environmental conditions in the defined study area and in the wider area as pertinent to the particular environmental factor.

The general approach to assessment is based on determining the potential for significant effects assessed from a combination of the sensitivity or importance of the environmental receptors and the magnitude of potential impacts. It should be noted that the magnitude and significance reported has been considered assuming embedded mitigation (design measures which are integrated into a project for the purpose of minimising environmental effects) but in the absence of essential mitigation (mitigation critical for the delivery of a project that can be acquired through statutory powers).

For the purposes of the DMRB Stage 2 assessment, construction impacts are considered to be temporary.

Environmental Assessment Summary

Throughout the DMRB Stage 2 Assessment, two aspects are considered:

1) Whether any potential effects would be considered significant; and
2) Whether any of the potential effects identified differ sufficiently between proposed route options that they need to be considered as part of the overall identification of a Preferred Route Option (which considers environmental, engineering and traffic and economic considerations).

The DMRB Stage 2 environmental assessment is summarised in the following paragraphs. Unless otherwise stated, it is assumed that all potential impacts and effects are adverse, therefore the option with the lowest overall effect for each environmental factor would be considered the most favourable and the option with the highest overall effect would be considered the least favourable.

Chapter 8: Population - Land Use

The assessment considers the impacts and effects on land use receptors, including private property and housing, community assets, community land, development land, businesses and agricultural land holdings. The assessment also includes consideration of the potential impacts and effects of land-take, including the need for demolitions, and change in accessibility, including introduction or removal of severance. Commentary is also provided on likely direct/indirect socio-economic impacts.

During construction, it is considered that Option ST2A would have the highest overall effect on Population - Land Use. This is largely as a result of the duration and complexity of construction, and the number and groupings of housing and business properties affected, with potential for direct and indirect impacts on businesses and community assets. Option ST2B is expected to have an intermediate overall effect due to the second longest construction period, with similar consequential effects on Population - Land Use as Option ST2A. Options ST2C and ST2D are anticipated to have the lowest overall effect during construction.

During operation, the differences in impacts and effects on community assets (including their accessibility) and agricultural holdings are not considered sufficient to be a differentiator between proposed route options. Differences in impacts and effects arising from land-take and demolitions on private property & housing and businesses and on development land are considered sufficient to be differentiators. Differences in impacts and effects on community land relating to loss/creation of open space and greenspace is also considered sufficient to be a differentiator. Options ST2C and ST2D are considered to have the highest overall effect on land use and Options ST2A and ST2B are assessed as having the lowest overall effect.

Chapter 9: Geology, Soils and Groundwater

The assessment considers the impacts and effects to superficial and bedrock geology, soils, land contamination and groundwater (including groundwater reliant receptors, such as private water supplies, ecological habitats and surface water features).

Although there are no differentiators identified in terms of significance of potential effects, with respect to land contamination, there is a significant difference in the procedure required for developing land within the curtilage of Ladywell Landfill site, due to the governance of the site Waste Management License. Options ST2A and ST2B both include infrastructure within the curtilage of Ladywell Landfill site and are considered to have the highest overall effect. Options ST2C and ST2D, which remain outside the curtilage of Ladywell Landfill site, are considered to have the lowest overall effect in relation to land contamination.

Chapter 10: Road Drainage and the Water Environment

The potential effects of each of the proposed route options on road drainage and the water environmental has been considered. The more extensive works on Inchewan Burn associated with Options ST2A and ST2B would result in the potential for significant effects on hydromorphology and surface water quality for this watercourse.

Options ST2C and ST2D have the potential for no significant effects and therefore are considered to have the lowest overall effect on road drainage and the water environment. Options ST2A and ST2B are assessed as having the highest overall effect.

Chapter 11: Biodiversity

The assessment has considered the potential impacts and effects on biodiversity resources. These resources comprise a range of species and habitats relating to terrestrial and freshwater ecosystems. Key habitats considered include, the internationally important River Tay Special Area of Conservation (SAC) and sites listed on the Ancient Woodland Inventory (AWI).

The differences in effects on fish species of conservation interest as a result of habitat fragmentation at Inchewan Burn and the loss of areas listed on the AWI are considered sufficient to differentiate between proposed route options. During construction and operation, Options ST2A and ST2B impact Inchewan Burn, with significant effects on fish species of conservation interest arising from permanent, irreversible habitat fragmentation. Option ST2D has the lowest loss of AWI (approximately 17 hectares) with Option ST2A resulting in the highest loss (approximately 21 hectares). Due to the permanent effects on Inchewan Burn, Options ST2A and ST2B are assessed to have the highest overall potential significant effect on biodiversity resources and Options ST2C and ST2D the lowest overall effect.

Chapter 12: Landscape

The assessment has taken account the potential effect of each of the proposed route options on the landscape resource, including the key aspects of the landscape designations through which the proposed route options would pass, including the River Tay (Dunkeld) National Scenic Area (NSA) and its Special Qualities and Murthly Castle, Dunkeld House and The Hermitage Gardens and Designed Landscapes (GDL).

Options ST2A and ST2D have the lowest overall effect on landscape resources, while Options ST2B and ST2C have the highest overall effect. However, it is noted that if the cut and cover tunnel could be developed to allow woodland planting on top of the structure, this would improve the fit with the character of the landscape for Option ST2A, potentially reducing effects on the Special Qualities of the River Tay (Dunkeld) NSA. If this were to be achieved, Option ST2A would be assessed as having the lowest overall effects.

Chapter 13: Visual

The visual assessment considers both the visual amenity and views experienced by people from publicly accessible viewpoints and nearby buildings, including nearby residential properties, and View from the Road, which addresses the predicted effects associated with each option on vehicle travellers.

In terms of views experienced by people from publicly accessible viewpoints, Options ST2A and ST2D are assessed as having the lowest overall effects. For Option ST2A this is largely due to the cut and cover tunnel and the potential landscaping on top of the tunnel section. For Option ST2D, this is largely due to the route being generally on-line and at-grade and therefore closest to the existing baseline condition. Option ST2C is assessed as having the highest overall effect, which is largely due to the inclusion of the raised grade separated Dunkeld Junction.

Option ST2D has the lowest overall effect for Views from the Road, largely as the proposed alignment is on-line and views from the road are not significantly different from the baseline. Option ST2A is assessed to have the highest overall effect as a result of the tunnelled section curtailing views of the surrounding environment.

Chapter 14: Cultural Heritage

The cultural heritage assessment considers the potential for impacts and effects on cultural heritage resources, including archaeological remains, historic buildings and the historic landscape, taking cognisance of relevant legislation and planning policy. The differences in potential for significant effects on historic buildings are

considered sufficient to differentiate between proposed route options, whereas the differences in potential effects on archaeological remains and historic landscape are not considered to be differentiators.

As a result of the potential for significant effects on the Category A Listed Dunkeld and Birnam Station including Footbridge, and the complexity and nature of maintaining access to the station during construction, temporary access options for pedestrians and cyclists were also assessed. A short summary of the temporary access options is given below.

- Access Option 1 - Extend station platforms to the north to form a temporary station, with vehicular access provided to Platform 2 (northbound), via a new access road from the A822 (Old Military Road) and the replacement of the Highland Main Line railway bridge over Inchewan Burn.
- Access Option 2 - Temporary pedestrian footbridge across the A9 construction site, from Birnam Industrial Estate to Dunkeld & Birnam Station, Platform 1 (southbound).
- Access Option 3 - Extend station platforms to the north to form a temporary station, with vehicular access provided to Platform 2 (northbound), via a new access road from the A822 (Old Military Road), the replacement of the Highland Main Line railway bridge over Inchewan Burn and a temporary pedestrian footbridge across the A9 construction site, from Birnam Industrial Estate to Dunkeld & Birnam Station, Platform 1 (southbound).
- Access Option 4 - Temporary pedestrian footbridge across Inchewan Burn, linking the existing Platform 2 (northbound) and the new access road from the A822 (Old Military Road).
- Access Option 5 - Temporary pedestrian footbridge across the A9 construction site, from Birnam Industrial Estate to Dunkeld & Birnam Station, Platform 1 (southbound) and a temporary pedestrian footbridge across Inchewan Burn, linking the existing Platform 2 (northbound) and the new access road from the A822 (Old Military Road).

It is noted that for Options ST2A and ST2B, any of the temporary access options noted above could be utilised to maintain access to the station. However, for Options ST2C and ST2D, Option 2, which can be erected quickly and cheaply, is considered the most appropriate solution. This is the access solution that has been assessed within the environmental assessment for these proposed route options.

Options ST2A and ST2B, incorporating temporary access Option 4, are assessed to have the lowest overall effect. Access Option 4 would necessitate a temporary pedestrian footbridge across the Inchewan Burn, linking the existing Platform 2 (northbound) and the new access road from the A822 (Old Military Road). Options ST2A and ST2B, incorporating temporary access Option 3, are assessed to have the highest overall effect. Access Option 3 would necessitate extending the station platforms to the north to form a temporary station with vehicular access provided to Platform 2 (northbound) via a new access road from the A822 (Old Military Road), the replacement of the Highland Main Line railway bridge over the Inchewan Burn, and a temporary pedestrian footbridge across the A9 construction site linking Birnam Industrial Estate to Platform 1 (southbound) of Dunkeld & Birnam Station.

Options ST2A and ST2B would have a significant beneficial effect on The Category A Listed Dunkeld and Birnam Station including Footbridge, as they re-establish the physical connection between the station and Birnam, via Station Road, potentially facilitating re-use of the station building. There is a lesser beneficial effect for Options ST2C and ST2D due to the improved physical connection to Birnam and the potential future use of the building due to the replacement car park, pedestrian underpass and vehicular access from the A9 for maintenance and emergency access only. However, there would be an adverse effect on the setting of the Category A Listed station building from the permanent loss of the forecourt (now car park) and the close interaction of the proposed route options during operation.

Taking into consideration the beneficial and adverse effects for all proposed route options (including temporary access options) Options ST2A and ST2B with temporary access Option 4 are assessed to have the lowest overall

effect. Options ST2C and ST2D with temporary access Option 2 are assessed to have an intermediate overall effect. Options ST2A and ST2B with temporary access Option 3 are assessed to have the highest overall effect.

Chapter 15: Air Quality

The DMRB Stage 2 assessment of air quality on human health and receptors and designated habitats considers air pollutants associated with combustion emissions typically arising from vehicle traffic, comprising oxides of nitrogen (NO_x), nitrogen dioxide (NO_2) and particulate matter (PM) (PM_{10} and $PM_{2.5}$). In relation to sensitive designated habitats, nitrogen (N) deposition is also considered. Dust deposition associated with deposition of PM generated from construction activities and traffic associated with construction works is also considered in the assessment.

The DMRB Stage 2 assessment has determined that the potential human health effects of the proposed route options are not significant as the pollutant concentrations at all assessed receptors are below the objective values set to protect human health. For designated habitats there would be potential for significant effects for all proposed route options. Although there are some differences between proposed route options in terms of number and extent of effects, these are not considered sufficient to be a differentiator between proposed route options.

Chapter 16: Noise and Vibration

The noise and vibration assessment has considered the potential effects on noise sensitive receptors (e.g., residential properties) of road traffic noise generated by the interaction of tyres on the road surface, from engines and exhausts, and from the aerodynamic noise caused by vehicles moving through the air. Vehicle acceleration and speed, road gradients, traffic composition (i.e., percentage of Heavy Good Vehicles in the total number of vehicles) and road surface type influences the noise generated. Additionally, potential effects on noise sensitive receptors arising from construction noise and vibration have also been assessed.

In terms of construction, Option ST2A would have the highest overall effect arising from noise and vibration, due to the requirement for bored piles to construct the 1.5 kilometre cut and cover tunnel and the longest construction duration. Option ST2B is expected to have an intermediate overall effect since it has the second longest construction period and will also require bored piles to construct the 150 metre long underpass. Options ST2C and ST2D are considered to have the lowest overall effect as they have a shorter construction period and require less piling.

During operation of the dual carriageway, Option ST2A is assessed to have the lowest overall noise effect due to the 1.5 kilometre cut and cover tunnel reducing noise effects at noise sensitive receptors as the road passes Birnam. Option ST2B is expected to have an intermediate overall effect due to the lowered carriageway and 150 metre long underpass reducing noise effects at noise sensitive receptors as it passes Dunkeld & Birnam Station. Options ST2C and ST2D are considered to have the highest overall effects, as the proposed carriageway passes noise sensitive receptors at Birnam either at, or above, existing road levels.

Chapter 17: Population - Accessibility

The assessment considers the potential impacts and effects on the journeys made by WCH. This includes consideration of journeys using footpaths, cycle routes and informal access routes to land. While all the proposed route options will affect WCH routes during construction and operation, the differences in effects are not considered sufficient to be a differentiator between proposed route options.

Chapter 18: Material Assets and Waste

The potential environmental impacts and effects related to the use and consumption of material assets and the production and management of waste that can reasonably be anticipated with the construction of the proposed route options have been assessed. It should be noted that operational impacts and effects have been scoped out of the DMRB Stage 2 assessment as they were considered to be not significant (by quantity) in the context of the proposed route options.

The differences in potential impacts and effects between proposed route options during construction on material assets and waste are considered sufficient to be a differentiator. Option ST2A is assessed to have the highest overall effect during construction on material assets and waste, largely due to the significant construction activity involved with the 1.5 kilometre cut and cover tunnel. Options ST2B and ST2C are assessed to have an intermediate overall effect largely due to the 150 metre long underpass and raised at-grade Dunkeld Junction respectively. Option ST2D is anticipated to have the lowest overall effect.

Chapter 19: Climate

The climate assessment considers:

- The potential effects of the proposed route options on climate, in particular the magnitude of and opportunities to reduce greenhouse gas (GHG) emissions during construction and operation; and
- The vulnerability of the proposed route options to climate change, in particular, whether anticipated changes to climatic conditions and/or the frequency of extreme events are likely to have significant adverse effects on the project (or elements of the project) during construction and/or operation.

At DMRB Stage 2, due to limited data being available to inform the climate assessment (e.g., material quantities, which are not typically available at this stage), a full assessment of the GHG emissions likely to arise as a result of the construction and operation of each of the proposed route options has not been undertaken. The assessment has therefore focussed on those elements of the construction phase for which data is currently available, namely earthworks, aggregates and soils, whilst also comparing estimated changes in road use GHG emissions associated with each proposed route option.

An assessment of the vulnerability of each of the proposed route options to climate change has not been completed at this stage, as potential climate related impacts are likely to be similar for each of the proposed route options. An element of climate change vulnerability is, however, considered in Chapter 10: Road Drainage and the Water Environment, which considers flood risk.

The differences between potential impacts and effects on climate change during construction are considered to be a differentiator. Option ST2A is assessed to have the highest overall effect during construction, predominantly due to emissions associated with the construction of the 1.5 kilometre cut and cover tunnel. Options ST2B and ST2C would have an intermediate effect largely due to the 150 metre long underpass and raised at-grade Dunkeld Junction respectively. Option ST2D is assessed to have the lowest overall effect on climate.

Chapter 20: Human Health

The World Health Organisation (WHO) defines human health as '*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*'. For the purposes of the assessment, human health is considered to encompass both physical and mental health. Although there is no requirement in the DMRB guidance for wellbeing to be assessed, this element has been included in the assessment in response to concerns raised by the local community during the A9 Co-Creative Process.

All proposed route options have the potential for an overall likely negative health and wellbeing outcome during construction. Option ST2A would likely have the highest overall negative outcome on health and wellbeing due to the nature and duration of the required construction activities, which would include extensive piling and excavation. Potential for adverse amenity effects in relation to noise and vibration, landscape amenity and accessibility for a longer duration when compared to the other options were considered to be differentiators. Additionally, Option ST2C was also considered to have a similarly high overall likely negative outcome on health and wellbeing due to severance/separation from healthcare (Craigvinean Surgery) and recreation facilities (Dunkeld and Birnam Recreation Club and Riverside Land) during construction, which may have a disproportionate effect on the young and the elderly who are more likely to use these facilities.

As Option ST2D has the least intrusive construction activities and the shortest construction duration, it is anticipated to have the lowest overall likely negative effect on community health and wellbeing. Option ST2B is

anticipated to have an intermediate overall likely negative health and wellbeing outcome owing to it having the second longest anticipated construction duration and the associated noise effects, as well as having adverse visual effects.

During operation Option ST2A is assessed to have an overall likely positive outcome on health and wellbeing due to the potential opportunities for additional green space and landscape amenity, as well as improved amenity for NCN Route 77, which are considered to be differentiators. Options ST2B, ST2C and ST2D are assessed to have an overall likely neutral outcome on health and wellbeing during operation when considering a combination of positive and negative effects across the health and wellbeing determinants.

Option ST2A is therefore considered to have the lowest overall effect for health and wellbeing and Options ST2B, ST2C and ST2D would have intermediate effects.

Chapter 21: Policies and Plans

Whilst the majority of policy compliance assessments are consistent across the proposed route options, it is assessed in policy compliance terms that the main differences between the proposed route options are in relation to road drainage and the water environment and biodiversity assessments. These differences are considered sufficient to be differentiators. Options ST2C and ST2D are considered to adhere greater with policy objectives than Options ST2A and ST2B due to differential hydromorphology and surface water quality impacts upon Inchewan Burn and impacts upon fish species of conservation interest.

Policy non-compliance in relation to Population – Land Use and Cultural Heritage are consistent across the proposed route options and the differences are not considered sufficient to be a differentiator.

Part 4 - Transport and Economic Assessment

Transport Modelling Approach

The traffic and economic assessments have been undertaken using the Paramics A9 Dualling Traffic Model (A9DTM). The model years used in the assessment are 2026 and 2041, representing the first year of full programme operation and 15 years thereafter. The forecasting of traffic was undertaken by the Lead Traffic and Economic Advisor (LTEA) (Aecom).

The Paramics model has been used to compare the route options in terms of performance indicators, such as changes in travel behaviour and route choice due to the introduction of each route option to the future year models. The outputs from these models have been used as the basis for an economic assessment using Transport Users Benefit Appraisal (TUBA, v1.9.9) software to determine the economic benefits of each option compared to the Do-Minimum scenario (the conditions as they were in 2015).

It is noted that from a traffic modelling perspective, the proposed route options are similar, aside from the variations in layout at Murthly/Birnam Junction and Dunkeld Junction, and the differences in proposed speed limit on the proposed A9 dual carriageway. All options have the same junction layout at Dalguise Junction and The Hermitage, and all options provide access to Dunkeld & Birnam Station via Station Road in Birnam. The differences in proposed A9 geometry, including changes to the vertical alignment to accommodate a cut and cover tunnel or underpass (Options ST2A and ST2B) is not anticipated to have an impact on traffic flows or journey times on the A9.

Effects of Route Options

Differences in the design of the proposed route options influence journey times for strategic and local traffic, as well as traffic flows on the local transport network on Perth Road through Birnam. Table A.3 shows modelled journey times for the A9 between the project extents in the base year (2015) and forecast values for 2026 and 2041 under the Do-Minimum and Do-Something options. It should be noted that for traffic assessment purposes, Options ST2B and ST2D are considered the same.

Table A.3: A9 Journey Times Between Project Extents (minutes:seconds)

Scenario	Existing	Do-Minimum		Do-Something Option ST2A		Do-Something Options ST2B & ST2D		Do-Something Option ST2C	
Year	**2015**	**2026**	**2041**	**2026**	**2041**	**2026**	**2041**	**2026**	**2041**
Northbound Journey Time	05:57	06:03	06:07	05:48	05:51	05:11	05:16	04:56	04:59
Southbound Journey Time	06:15	06:21	06:24	05:47	05:50	05:11	05:15	04:54	04:59

Table A.4 shows the existing Annual Average Daily Traffic (AADT) flows at four locations along Perth Road in Birnam that have been taken from the A9DTM. The table also shows the forecast AADT on Perth Road in 2026 and 2041 in the Do-Minimum scenario. The following tables, Tables A.5, A.6 and A.7 show the forecast AADT flows on Perth Road for the route options for 2026 and 2041under the Do-Something scenario.

Table A.4: Existing and Forecast Traffic Flows on Perth Road

	Existing Traffic Flows 2015				Do-Minimum 2026 (2041)			
	Section 1	Section 2	Section 3	Section 4	Section 1	Section 2	Section 3	Section 4
Perth Road Traffic Flows (2-way AADT)	1,800	1,300	1,800	2,600	2,200 (2,400)	1,600 (1,700)	1,900 (1,800)	2,800 (2,800)

Table A.5: Forecast Traffic Flows on Perth Road, Option ST2A

	Option ST2A Do-Something 2026 (2041)			
	Section 1	Section 2	Section 3	Section 4
Perth Road Traffic Flows (2-way AADT)	1,400 (1,600)	1,500 (1,600)	2,800 (2,900)	3,800 (4,000)

Table A.6: Forecast Traffic Flows on Perth Road, Options ST2B & ST2D

	Options ST2B & ST2D Do-Something 2026 (2041)			
	Section 1	Section 2	Section 3	Section 4
Perth Road Traffic Flows (2-way AADT)	2,000 (2,200)	2,000 (2,100)	3,000 (3,100)	4,000 (4,100)

Table A.7: Forecast Traffic Flows on Perth Road, Options ST2C

	Option ST2C Do-Something 2026 (2041)			
	Section 1	Section 2	Section 3	Section 4
Perth Road Traffic Flows (2-way AADT)	2,400 (2,700)	2,400 (2,600)	2,600 (2,600)	3,600 (3,600)

Table Notes:

1) Section 1 refers to Perth Road between A9 Murthly/Birnam Junction and Woodville.
2) Section 2 refers to Perth Road between Woodville and Station Road.
3) Section 3 refers to Perth Road between Station Road and Stell Park Road.
4) Section 4 refers to Perth Road between Stell Park Road and the A923.

Accidents

The impact on accidents has been assessed for the various options using default rates/costs from the DMRB (Volume 15: Economic Assessment of Road Schemes in Scotland, Section 1 (The NESA Manual)) in both the Do-Something and Do-Minimum scenarios. NESA recommends that, where possible, accident rates derived from local data should be used, however, this data must be taken from periods when conditions on the road have been broadly unchanged. Average Speed Cameras were introduced on the A9 in October 2014 to improve safety. Construction work on the Kincraig to Dalraddy section of the A9 began in autumn 2015 and the section opened to traffic in 2017. Construction work on the Luncarty to Birnam section of A9 dualling began in autumn 2018 and opened to traffic in summer 2021. In addition, various on-line Ground Investigation (GI) contracts for other A9 dualling projects have also resulted in constantly changing travel conditions on the A9. As such, conditions have not been broadly unchanged in recent years. Guidance states that for the derivation of local accident rates, data should cover the five years prior to the NESA assessment, and for local severity splits, data within a minimum of

five years must be supplied. Since the A9 has been evolving over the last five years, the assessment has used national default rates.

Table A.8 shows the expected accident savings for each route option. The table indicates that the average number of accidents forecast per year would be expected to reduce under all options, compared to the Do-Minimum scenario. All options are expected to result in a reduction in the number of personal injury accidents. This is expected due to the upgrade of 8.4 kilometres of single carriageway to dual carriageway standards, which prevents right-turn manoeuvres across the carriageway, along with the provision of improved junctions. It is noted that within Table A.8, slight accidents for Option ST2A will nominally increase. This is a result of the Murthly Junction, which is further south that the existing junction and results in an increased volume of traffic utilising the B867, which is to a lesser standard than the A9.

Table A.8: Average Number of Accidents Saved per Year (2041)

Accident Severity	Accidents Saved per year Option ST2A	Accidents Saved per year Option ST2B	Accidents Saved per year Option ST2C	Accidents Saved per year Option ST2D
Fatal	0.2	0.2	0.2	0.2
Serious	0.9	0.9	1.0	0.9
Slight	-0.1	0.0	1.0	0.0

Option ST2C would provide a fully compliant D2AP Road (sub-category c) with grade separated junctions at Birnam, Dunkeld and Dalguise to access/egress the A9 and connect to the existing road network. This would provide a safety benefit over the existing layout. Options ST2A, ST2B and ST2D incorporate an at-grade roundabout at Little Dunkeld, which is a Deviation from recommendations, and presents a greater risk of an accident occurring at this location, primarily as traffic decelerates and accelerates to navigate the roundabout. Accidents at the proposed at-grade roundabout are most likely to be either rear-end shunts on the A9 approaches, or sideswipe type incidents as traffic enters the circulatory carriageway. Many of these accidents are anticipated to result in only vehicle damage, and therefore are not included in the personal injury accident reductions. However, it should be noted that if an accident occurs at the at-grade roundabout for Options ST2A, ST2B and ST2D, there is potential for northbound traffic to queue on approach. For Option ST2A, this may result in traffic queuing within the cut and cover tunnel, introducing a potential safety issue.

Economic Performance of Route Options

The purpose of the economics section of the DMRB Stage 2 Scheme Assessment Report is to identify the differences between the options in terms of economic performance and in doing so identify the option(s) that are anticipated to present the best value for money. It is noted that the level of benefits from individual sections of the route will be less than for the entire A9 Dualling Programme (Perth to Inverness). The accrued benefits, for the entire A9 Dualling Programme, are not presented.

To assist with identification of the option(s) likely to produce the greatest value for money, the costs and benefits have been indexed such that the lowest cost option has an index value of 100 and the option with the greatest benefits has an index value of 100. The costs and benefits of the other options are presented relative to this index value. This means that the cost index for all options is greater than or equal to 100 and the benefits for all options is less than or equal to 100.

A comparison of the Economic Performance for each option is shown in Table A.9. The cost of each route option is shown in Table A.1.

Table A.9: Indexed Economic Performance

Option	Option ST2A	Option ST2B	Option ST2C	Option ST2D
Indexed Total Present Value of Benefits (PVB)	32	78	100	78
Indexed Present Value of Costs (PVC)	374	135	133	100
Indexed Net Present Value (NPV)	21	68	74	100
Indexed Benefit to Cost Ratio (BCR)	11	74	96	100

Table A.9 indicates that Option ST2C would provide the greatest benefits for road users, as it includes grade separated throughout. The economic benefits of Options ST2B and ST2D would be broadly similar, but less than for Option ST2C, largely due to the reduction in vehicle speeds that would be necessary to negotiate the proposed at-grade roundabout at Dunkeld Junction. However, the travel time benefits of Option ST2A would be appreciably less than the other options, due to the 50mph speed limit on the A9 between the southern tie-in and the proposed Dunkeld Junction. This speed restriction, which is less than the posted speed limit on the existing A9, would result in increased journey times on this section of the A9, compared to other options.

As Option ST2A would provide the lowest level of economic benefits at the highest cost, this is clearly the worst performing option in economic terms. Options ST2B and ST2D would provide comparable benefits, but Option ST2D would produce these benefits at significantly lower cost and would therefore perform better than Option ST2B in economic terms. While Option ST2C would likely generate greater travel time benefits and accident savings that Option ST2D, the significantly higher capital cost of Option ST2C means that the NPV and BCR of Option ST2D is likely to be greater.

Consequently, in economic terms, Option ST2D is likely to be the best option.

Part 5 - Assessment Summary

Introduction

The DMRB Stage 2 assessment has assessed the options, taking account of constraints, potential environmental (including community and individual human impacts), engineering and traffic and economic effects to identify an Emerging Preferred Route Option. Transport Scotland's and the community's objectives have also been considered, as well as feedback from the public and other stakeholders, including that obtained through the A9 Co-Creative Process.

As agreed, as part of the A9 Co-Creative Process, the Emerging Preferred Route Option from the DMRB Stage 2 assessment will be presented to Scottish Ministers for consideration. Should the assessment identify an Emerging Preferred Route Option that is different to the Community's Preferred Route Option (Option ST2A), both options will be presented to Scottish Ministers for consideration. Scottish Ministers will then confirm a Preferred Route Option for the Pass of Birnam to Tay Crossing section of the A9 Dualling Programme.

Preferred Route Option Assessment

A summary of the key findings of the DMRB Stage 2 assessment is given below for each route option.

<u>Option ST2A</u>

- Key Benefits:
  - Reduced traffic flows on Perth Road (between Murthly Junction and Station Road) compared to the Do-Minimum scenario;
  - The joint lowest overall adverse effect on cultural heritage and includes a significant beneficial effect on the setting of the Category A Listed Dunkeld & Birnam Station from re-establishing the physical connection between the station and Birnam via Station Road;
  - Direct vehicular and pedestrian connection provides opportunities for the sustainable reuse of the station building. Potential for providing Equality Act 2010 compliant access between station platforms can be investigated in conjunction with Network Rail and Transport Scotland (Rail);
  - Provides the potential for creation of additional undesignated open space on top of the cut and cover tunnel, which could provide amenity space for the community;
  - Results in the fewest significant adverse effects and greatest number of significant beneficial effects in relation to operational noise, particularly for noise sensitive receptors in Birnam, when compared with the at-grade options (Options ST2C and ST2D); and
  - Combination of the provision of additional open space and the beneficial effects in relation to noise results in the lowest overall effect on human health and wellbeing.
- Key Disbenefits:
  - Speed limit of 50mph proposed for safety between the southern extent of the scheme and the proposed Dunkeld Junction, resulting in reduced travel time benefits;
  - Requires significant excavation to form the 1.5 kilometres cut and cover tunnel, with significant disposal and lorry movements;
  - Complex road drainage required, particularly due to the lowered road alignment, existing corridor topography and narrow corridor;
  - Construction of the 1.5 kilometre cut and cover tunnel in such a constrained and sensitive corridor will be complex, with tunnel walls constructed using 3,700 large diameter bored piles. Installation will require heavy plant in close proximity to residential properties, Dunkeld & Birnam Station and the Highland Main Line railway;

- Includes an at-grade roundabout at Dunkeld, which is a Deviation from recommendations for a D2AP (sub-category c) standard. Possibility of queuing within the cut and cover tunnel in the event of an accident occurring on the roundabout;
- Lowest level of economic benefits at the highest cost;
- Construction duration and requirement for extensive piling results in the greatest overall effect on noise and vibration and human health during construction;
- Scale and nature of construction results in the highest overall effect on material assets and waste, and climate;
- Inchewan Burn would require to be lowered by approximately 8 metres, resulting in significant changes to its form and function, impacting fish passage and fragmenting habitat;
- Potential for direct and indirect impacts on businesses and community assets during construction, given the 4 ½ to 5 years expected construction duration;
- Acquisition of Birnam Industrial Estate, which requires demolition of commercial properties;
- Significant effect on View from the Road and the Special Qualities of the NSA; and
- Although assessed as having the lowest overall effect on Cultural Heritage, there is a significant adverse effect on the setting of the Category A Listed Dunkeld & Birnam Station resulting from the loss of the station forecourt.

<u>Option ST2B</u>

- Key Benefits:
  - Includes a 70mph speed limit throughout, consistent with the overall A9 Dualling Programme;
  - The joint lowest overall adverse effect on cultural heritage and includes a significant beneficial effect on the setting of the Category A Listed Dunkeld & Birnam Station;
  - Direct vehicular and pedestrian connection provides opportunities for the sustainable reuse of the station building. Potential for providing Equality Act 2010 compliant access between station platforms can be investigated in conjunction with Network Rail and Transport Scotland (Rail);
  - Results in significant beneficial effects in relation to operational noise, particularly for noise sensitive receptors in Birnam with fewer significant adverse effects when compared with the at-grade options (Options ST2C and ST2D); and
  - Does not require the acquisition of Birnam Industrial Estate.
- Key Disbenefits:
  - Requires significant excavation to form the underpass structure, with significant disposal and lorry movements;
  - Complex road drainage required, particularly due to the lowered road alignment, existing corridor topography and narrow corridor;
  - Construction of the 150 metre long underpass in such a constrained and sensitive corridor will be complex, with walls constructed using 860 large diameter bored piles. Installation will require heavy plant in close proximity to residential properties, Dunkeld & Birnam Station and the Highland Main Line railway;
  - Increases traffic flows on Perth Road (north and south of Station Road) through the omission of a southbound diverge slip road at Birnam Junction;
  - Includes an at-grade roundabout at Dunkeld, which is a Deviation from recommendations for a D2AP (sub-category c) standard;
  - Scale and nature of construction results in an intermediate overall effect on material assets and waste, and climate;

- Inchewan Burn would require to be lowered by approximately 6 metres, resulting in significant changes to its form and function, impacting fish passage and fragmenting habitat;
- Potential for direct and indirect impacts on businesses and community assets during construction, given the 4 to 4 ½ years expected construction duration;
- Significant adverse effects on landscape as there is limited scope to integrate the underpass into the surrounding landscape; and
- Although assessed as having the lowest overall effect on Cultural Heritage, there is a significant adverse effect on the setting of the Category A Listed Dunkeld & Birnam Station resulting from the loss of the station forecourt.

Option ST2C

- Key Benefits:
  - Includes a 70mph speed limit throughout, consistent with the overall A9 Dualling Programme;
  - Incorporates grade separated junctions throughout, fully compliant with the D2AP (sub-category c) standard;
  - Provides the greatest travel time benefits for road users, due to the inclusion of grade separated junctions throughout;
  - No significant drainage issues anticipated;
  - Slight beneficial effect from the improved connection between the Category A Listed Dunkeld & Birnam Station and Birnam;
  - Replacement car park and pedestrian underpass would provide some opportunities for the sustainable re-use of the station building;
  - No direct impact on Inchewan Burn or fish passage;
  - Reduced direct and indirect impacts on businesses and community assets during construction;
  - Fewer significant adverse noise and vibration effects during construction than the lowered route options (Options ST2A and ST2B); and
  - Equality Act 2010 compliant access to Dunkeld & Birnam Station and southbound platform through provision of a new underpass structure, with potential for providing compliant access to the northbound platform.
- Key Disbenefits:
  - Requires import of acceptable fill material;
  - Requires construction of low-height retaining walls on the east side of the A9 to the immediate south of Dunkeld Junction. A further retaining wall (up to 14 metres in height) required in the locality of the River Braan crossing;
  - Increases traffic flows on Perth Road (north and south of Station Road) through the omission of a southbound diverge slip road at Birnam Junction;
  - No direct vehicular access to Dunkeld & Birnam Station, with parking provided on the site of Birnam Industrial Estate;
  - Scale and nature of construction results in an intermediate overall effect on material assets and waste, and climate;
  - Acquisition of Birnam Industrial Estate, which requires demolition of commercial properties;
  - Significant adverse impact on visual receptors and landscape character as a result of the raised vertical alignment and greater prominence of road infrastructure associated with the grade separated Dunkeld Junction;

- Significant adverse effect on the setting of the Category A Listed Dunkeld & Birnam Station from the permanent loss of the forecourt and the visible presence of the carriageway; and
- Results in a reduced number of beneficial operational noise effects and increased number of adverse effects when compared to the lowered route options (Options ST2A and ST2B).

Option ST2D

- Key Benefits:
  - Includes a 70mph speed limit throughout, consistent with the overall A9 Dualling Programme;
  - Provides comparable operational benefits to the other options but at a lower cost, therefore performing better in economic terms;
  - No significant structures required;
  - No significant drainage issues anticipated;
  - Largely at-grade, therefore no significant excavations or embankments necessary;
  - No substantial piling activity;
  - Scale and nature of construction results in the lowest overall effect on material assets and waste, and climate;
  - Slight beneficial effect from the improved connection between the Category A Listed Dunkeld & Birnam Station and Birnam;
  - Replacement car park and pedestrian underpass would provide some opportunities for the sustainable re-use of the station building;
  - No direct impact on Inchewan Burn or fish passage;
  - Reduced direct and indirect impacts on businesses and community assets during construction;
  - Fewer significant adverse noise and vibration effects during construction;
  - Equality Act 2010 compliant access to Dunkeld & Birnam Station and southbound platform through provision of a new underpass structure, with potential for providing compliant access to the northbound platform;
  - Lowest overall effect on the River Tay (Dunkeld) NSA and its Special Qualities; and
  - Lowest overall effect on visual amenity as much of the existing roadside vegetation would likely be maintained and views from adjacent visual receptors would be relatively unchanged.
- Key Disbenefits:
  - Increases traffic flows on Perth Road (north and south of Station Road) through the omission of a southbound diverge slip road at Birnam Junction;
  - Includes an at-grade roundabout at Dunkeld, which is a Deviation from recommendations for a D2AP (sub-category c) standard;
  - No direct vehicular access to Dunkeld & Birnam Station, with parking provided on the site of Birnam Industrial Estate;
  - Acquisition of Birnam Industrial Estate, which requires demolition of commercial properties;
  - Significant adverse effect on the setting of the Category A Listed Dunkeld & Birnam Station from the permanent loss of the forecourt and the visible presence of the carriageway; and
  - Results in a reduced number of beneficial operational noise effects and increased number of adverse effects, particularly in Birnam when compared to the lowered route options (Options ST2A and ST2B).

Consideration of Reduced Cut and Cover Tunnel Length

Following further consultation with the Birnam to Ballinluig A9 Community Group in late 2019, further consideration was given to an option that incorporated a 450 metre long cut and cover tunnel, which was originally developed through the A9 Co-Creative Process. It was concluded however, that although it had a reduced length of tunnel, the option would still have significant construction complexity, similar to the Community's Preferred Route Option (Option ST2A), with an estimated construction duration of between 4 and 4 ½ years. Furthermore, it would also impact local watercourses and not fully address concerns noted from some local residents and stakeholders.

Emerging Preferred Route Option

Based on the findings of the DMRB Stage 2 assessment, and considering feedback from the public and other stakeholders, the Emerging Preferred Route Option for the Pass of Birnam to Tay Crossing section of the A9 Dualling Programme is **Additional Whole Route Option 3 (Option ST2D)**.

It is noted that the Emerging Preferred Route Option (Option ST2D) includes the community's favoured options, as voted through the A9 Co-Creative Process, at Dunkeld, The Hermitage and Dalguise. In addition, the junction option at Birnam is based on the principle of the community's second preference for a junction, which was a grade separated junction, restricted movements junction with a northbound diverge slip road and a southbound merge slip road only. However, to partly address traffic increases on Perth Road with such an option, a northbound merge slip road has been added. The Emerging Preferred Route Option (Option ST2D) also incorporates improved access to the station, with the opportunity to enhance further, which was noted as important to the local community.

DMRB Stage 3 Assessment

The Preferred Route Option will be taken forward to undergo a DMRB Stage 3 assessment. As part of this assessment, the Preferred Route Option will be refined, developed and assessed, taking account of public and stakeholder feedback as necessary and appropriate. The DMRB Stage 3 assessment will focus on key areas for development to reduce risk and uncertainty.

Key issues that will be more fully considered as part of the assessment include:

- Design refinement (including consideration of Deviations from recommendations, Relaxations and Departures from requirements), particularly at junctions to ensure adherence to current standards and to reduce overall land-take where possible;
- More detailed design of major structures;
- Provision of private means of access;
- Consideration of constructability;
- Proposals for lay-bys;
- Refinement of proposals for WCH and consideration of accessibility throughout the scheme;
- The location and layout of road drainage infrastructure, including detention basins and treatment ponds;
- Impacts on watercourses, including the River Tay and River Braan and its tributaries and associated floodplain;
- Impacts on Dunkeld & Birnam Station and the Highland Main Line railway;
- Environmental mitigation, such as mammal underpasses, biodiversity and landscape planting including for AWI loss, and measures to reduce noise effects; and
- Additional community engagement and stakeholder consultation focused on those directly impacted by the Preferred Route Option.