4 Iterative Design Development

4.1 Introduction

4.1.1 The DMRB Stage 3 design of the proposed scheme as assessed and reported in this ES is the result of approximately 15 months of design development to the preferred route option that was identified at DMRB Stage 2 (refer to Chapter 3: Alternatives Considered).

4.1.2 Environmental considerations have influenced the design, with knowledge of these gained through the EIA process, and from the engineering teams, consultees and Transport Scotland. Through this process, the design has been iteratively updated and improved to reach the final DMRB Stage 3 design.

4.1.3 DMRB Stage 3 is a vital part of the EIA process for major roads infrastructure, as it presents an opportunity to avoid or mitigate potential effects through changes to aspects such as road alignment, land requirements, or the type and form of major structures. Changes incorporated into the DMRB Stage 3 design during the design process that have 'already' avoided or reduced potential environmental impacts are often referred to as embedded mitigation.

4.1.4 The potential impacts and proposed mitigation as reported in this ES are those identified following assessment of the final DMRB Stage 3 design of the proposed scheme. As such, the potential effects of earlier design iterations are not described in the EIA chapters. This chapter (Chapter 4) therefore provides an overview of the iterative design process, and sets out the key environmental constraints and considerations that informed the final DMRB Stage 3 design.

4.2 Iterative Design Process

Constraints Review

4.2.1 One of the key project tools used to help consider environmental constraints was the Jacobs geographical information systems (GIS) based ProjectMapper®. All relevant environmental datasets, including those provided by statutory consultees and other environmental bodies (refer to Chapter 7: Consultation and Scoping) and those gathered through desk-based research and field surveys, were loaded onto an interactive database as 'layers'. Each environmental GIS dataset layer can be switched on or off to show its extents in relation to emerging proposed scheme design.

4.2.2 The ProjectMapper® tool was accessible to all those working on the project, enabling engineers to undertake preliminary siting prior to review and input by the environmental team (e.g. locating Sustainable Drainage Systems (SuDS) outside of designated sites). The datasets were used extensively through the design process to enable quick identification of potential issues to inform design development. Photograph 4.1 (see section 4.3) provides an example of how the proposed scheme interacts with environmental constraints at specific locations using the datasets. Figure 5.1 provides an overview of the proposed scheme in context with the environmental constraints.

Design Assessment

4.2.3 As part of the design process, the engineering design is subject to constant development and refinement. Examples of design refinement include revisions made to reflect landowner consultation, modelling or survey results (e.g. traffic movements, flood levels, geotechnical surveys), or adding further technical design detail.

4.2.4 To enable informed and timely input to the design, a programme of 'interim design fixes' was therefore established. These snapshots of the draft design enabled all environmental specialists to review the same proposals, and provide feedback to the engineers to inform the ongoing proposed scheme development.

4.2.5 A total of seven interim design fixes were issued, each having been informed by environmental, engineering/technical and consultation input.

4.2.6 Design fixes typically included refinements to:

- vertical alignment (i.e. altering the road height relative to existing ground);
- horizontal alignment (i.e. altering the precise route of the road);
- structures design (e.g. overbridge design including earthworks, side roads, and culvert positioning);
- routeing of side roads, access roads and NMU provision;
- positioning of SuDS; and
- gradients of earthworks slopes (embankments and cuttings).

Mitigation Workshops

4.2.7 Following assessment of each of the interim design fixes, a schedule of proposed design changes was prepared by the environmental teams. The schedules typically included changes such as modifications to road alignment, suggestions regarding siting of drainage features, proposals for grading out of side slopes, or identification of environmentally sensitive areas to be avoided if possible.

4.2.8 Mitigation workshops were then held by the project team to enable the environmental specialists, EIA Coordinators and engineering design teams to discuss proposals and influence the ongoing design development. These workshops were key to ensuring mitigation to avoid and minimise impacts were incorporated into the proposed scheme design as further described in Section 4.3 (Embedded Mitigation) of this chapter.

4.2.9 A specific example of the effectiveness of mitigation workshops combined with the use of the ProjectMapper® tool is the incorporation of earthworks slopes and retaining wall structures to limit the loss of native woodland and ancient woodland habitat within the proposed scheme. For example, the design of the Dunkeld - Rotmell (C502) Road Junction at ch3200 and the use of two retaining walls has ensured that the tie-in to the existing C502 is optimised and the earthworks encroaching into native woodland and ancient woodland habitat is limited.

Stakeholder Input

4.2.10 As explained in Chapter 7 (Consultation and Scoping), the A9 Dualling Environmental Steering Group (ESG) met on a regular (typically monthly) basis through DMRB Stages 2 and 3, covering all A9 dualling projects. In addition to input to environmental mitigation as described in the respective chapters of this ES, statutory consultees were able to advise and influence various aspects of the draft DMRB Stage 3 design. The ESG is a valuable consultation forum but it is not a decision making or approval mechanism. Statutory consultee input to draft designs for this project include, for example:

- gradient of sides slopes and earthworks along the route;
- location and type of SuDS;
- flood mitigation measures, including Compensatory Flood Storage Areas;
- guidance on the interaction of the proposed scheme with cultural heritage assets, particularly scheduled monuments and listed buildings; and
- landscape and ecology mitigation.

4.2.11 The DMRB Stage 3 design has also been informed by discussions with landowners and the owners of affected properties. These discussions have influenced:

- location of the proposed overbridge and associated side road junction (Kindallachan North vs. Guay South);
- refinement of side road access arrangements to residential properties and Dowally Church and to residential properties at Guay and Kindallachan;
- refinement of left-in left-out junction locations and side road arrangements at Haugh of Kilmorich, Haugh Cottages and Westhaugh of Tulliemet;

- design of the Kindallachan Burn Underpass; and
- design and location of the proposed landscape and ecology planting and replacement pond habitat.

4.3 Embedded Mitigation

4.3.1 Some of the key design considerations during DMRB Stage 3 design development that avoided or reduced potential impacts are described further below.

Reducing Loss of Designated Areas (River Tay SAC)

4.3.2 The River Tay SAC is designated as a Special Area of Conservation (SAC) under the EU Habitats Directive, providing protection in relation to otter, Atlantic salmon and lamprey (sea, brook and river).

4.3.3 The existing A9 runs parallel to the River Tay for most of the proposed scheme and is adjacent to the river between ch1400-1900 (refer to Photograph 4.1) and again between ch2900-3800. The River Tay SAC also includes habitat to each side of the river itself, and the distance between the designated area and the edge of the existing carriageway is less than 15m at some locations.

Photograph 4.1: Aerial imagery and the proximity of the River Tay SAC to the existing A9 south of Rotmell

ProjectMapper®, 2018

4.3.4 The River Tay SAC was identified as a key constraint during design development, with the aim of avoiding or reducing the potential impacts of construction and operation such as habitat loss, changes to the watercourse, and water quality.

4.3.5 Examples of specific design changes that have removed or reduced potential impacts of the proposed scheme on River Tay SAC habitat were:

- integration of a retaining wall into the design of Fishing Bothy 1 Access Track at ch1000; and
- replacement of a SuDS basin and associated access track at ch2100 with more compact geocellular storage and hydrodynamic vortex separator systems.

4.3.6 Baseline geomorphology surveys identified potential river bank erosion risks across the southern sections of the A9 Dualling Programme between Pass of Birnam and Glen Garry. A reach of the River

Tay, adjacent to Warren Lodge and Ledpetty Lodge (ch1600-1900 of the proposed scheme), was identified as a high risk site due to significant historical bank erosion exposing a highly susceptible section of river bank. Photograph 4.1 above and Photograph 4.2 below illustrate the reach of the River Tay at risk and an example of the extent of river bank erosion.

Photograph 4.2: River bank erosion of the River Tay SAC to the south of Rotmell at ch1800

4.3.7 Whilst it appeared that only the lower portion of the river bank had been subject to erosion and resulting instability, the close proximity of the existing A9 carriageway was considered to be a concern in this area.

4.3.8 Consideration was therefore given to potential solutions to mitigate the risk to the existing A9 and proposed scheme, such as: distancing the A9 from the river by moving the road alignment further to the east or by steepening the existing road embankment; protecting the river bank/river bed through either the use of rock armour, the installation of steel sheet or bored concrete piles close to the river edge or the installation of caissons within the river; ground improvement through compaction grouting of the existing river bank; and constructing the proposed A9 dualling on viaduct, supported by buried piers/columns to allow further natural erosion to occur. The preferred option has been assessed as a contiguous bored pile wall and this has been incorporated into the DMRB Stage 3 design.

4.3.9 Following design refinement to minimise the impact on the River Tay SAC, the DMRB Stage 3 design requires approximately 2.18ha of temporary loss and 0.17ha of permanent loss of terrestrial habitats of the River Tay SAC. The loss of terrestrial habitats of the River Tay SAC are considered to represent a practicable minimum, taking into account other constraints and technical/safety considerations such as protecting road infrastructure and safety.

Reducing Loss of Native and Ancient Woodland

4.3.10 The existing A9 passes through extensive areas of woodland, some of which is identified on SNH's Ancient Woodland Inventory (AWI) and/or identified as native woodland through the Native Woodland

Survey for Scotland. Woodland designated in the AWI is widespread across the study area, typically being found on the eastern valley slopes and in close proximity to the existing A9. The largest area of ancient woodland is Rotmell Wood located at the southern extents of the proposed scheme, designated as long-established of plantation origin. Other areas of ancient woodland adjacent to the existing A9 are located between Dowally and Guay, between Guay and Kindallachan (refer to Photograph 4.3) and north of Haugh of Kilmorich to the northernmost extents of the proposed scheme.

4.3.11 Woodland identified in Forestry Commission Scotland's Native Woodland Survey of Scotland (NWSS) is also widespread within the study area and along parts of the existing A9 corridor, overlapping in a number of areas with AWI woodland close to the A9, including around Dowally and Guay. The largest areas are located in close proximity to Warren Lodge and between Guay and Kindallachan, adjacent to General Wade's Military Road (Photograph 4.3).

Photograph 4.3: Ancient Woodland between Guay and Kindallachan

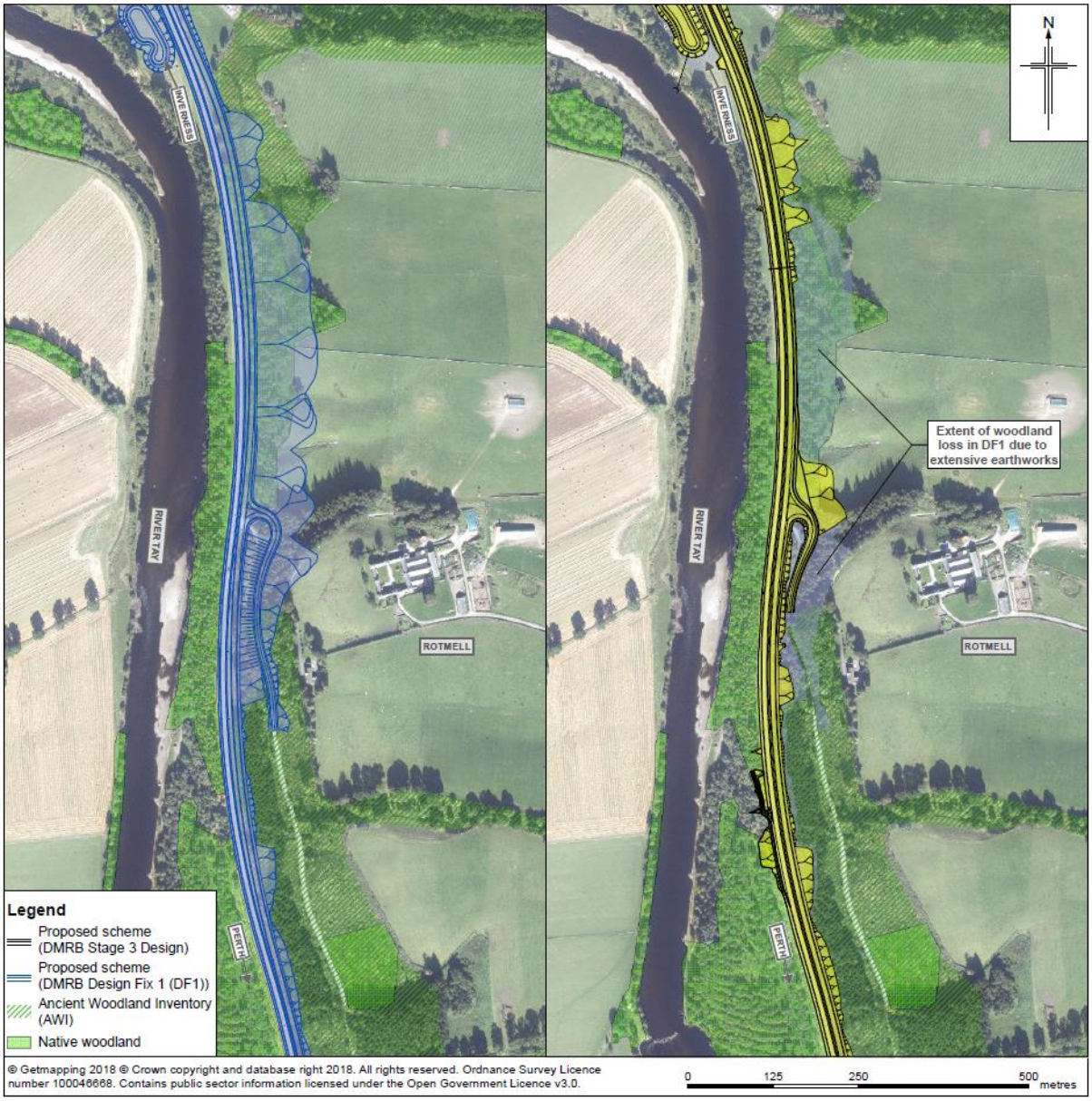
4.3.12 The iterative design process has been developed so that the final DMRB Stage 3 design avoided or reduced the loss of AWI and native woodland at the following locations:

- the footprint of the main alignment has been reduced at ch600-860, removing the need for an embankment and therefore reducing the loss of habitats listed on the AWI;
- the SuDS feature originally proposed at ch2050 was replaced by more compact geocellular storage and consequently avoids loss of NWSS woodland; and
- the alignment changes to Dunkeld - Rotmell (C502) Road and the use of retaining structures has avoided the loss of AWI and significantly reduced the loss of NWSS woodland.

4.3.13 To illustrate the reduction in loss of woodland (including AWI) at the Dunkeld – Rotmell (C502) Road Junction, Diagram 4.1 shows a comparison of an early design of the junction with the developed DMRB Stage 3 junction design incorporated into the proposed scheme.

4.3.14 The woodland loss as a result of the proposed scheme is considered to represent a practicable minimum, taking into account other constraints, particularly the River Tay SAC and technical/safety considerations such as road gradient and visibility.

Diagram 4.1: Rotmell – Dunkeld (C502) Road Junction comparison of early and developed DMRB Stage 3 design



4.3.15 In a number of areas, the alignment design has required the earthworks slope gradients to be steepened (for example ch7970-8170) in order to:

- avoid new cut slopes that result in excessive land take;
- avoid compulsory purchase of certain properties;
- take into account spatial constraints from existing and proposed features, e.g. side roads; and
- take into account environmental constraints, particularly limiting the loss of ancient or native woodland.

4.3.16 Soil nailing as part of the proposed scheme was proposed to allow cuttings to be steepened such that they could be constructed within the preferred land-take boundaries. The specific areas are on the southbound side of the proposed scheme at the following approximate chainages:

- ch600 to ch640;
- ch740 to ch770;
- ch820 to ch950;

- ch1950 to ch2090;
- ch7300 to ch7700 (70º engineered slope); and
- ch7970 to ch8170.

4.3.17 In some cases, construction of low height retaining walls have also been considered to be more suitable, primarily due to the geometry of the slope. These have been used at the Rotmell – Dunkeld (C502) Road Junction to limit loss of woodland (refer to Diagram 4.1).

Designing to Reduce Flood Risk Impacts

4.3.18 The hydraulic model indicates that without mitigation the proposed scheme would increase peak water levels locally within the River Tay floodplain. Mitigation measures to prevent these increases have therefore been considered and are discussed in more detail in the following sections.

Embedded Mitigation

4.3.19 Initially, potential changes in the proposed scheme design to reduce the impact on flood risk were considered. The embedded mitigation options considered are shown in Table 4.1, along with an explanation as to if they were incorporated within the proposed scheme or not.

Table 4.1: Embedded mitigation measures considered

Measure	Flood Risk Benefit	Incorporation in Proposed Scheme
Relocate proposed scheme to outside of floodplain	Would prevent loss of floodplain storage on the River Tay.	A multi-disciplinary technical study looking at potential alternative routes was undertaken at DMRB Stage 2. Routes that completely removed the proposed scheme from the floodplain were considered impracticable.
Reduce extent of proposed scheme within floodplain	Would reduce loss of floodplain storage on the River Tay.	A multi-disciplinary technical study looking at potential scheme layouts was undertaken at DMRB Stage 2. A desire to reduce impact on the floodplain was one of the primary reasons for widening the A9 embankment on the southbound side of the existing road. Where possible, side roads have been relocated to be outside of the functional floodplain. When considering options for the location and design of the overbridge, areas of lower flood risk have been considered in preference to areas of higher risk floodplain. Where embankment slopes are within the floodplain, where practicable these have been steepened.
Remove raised elements of SuDS ponds within the flood plain	Would reduce loss of floodplain storage on the River Tay.	Raised SuDS ponds removed from functional floodplain. Where ponds are within the floodplain they are below existing ground level.

Compensatory Flood Storage

4.3.20 Where it has not been possible to prevent the proposed scheme from impacting on the functional floodplain by embedding mitigation within the design, the initial measure considered for standalone mitigation has been the provision of compensatory storage that, in accordance with SEPA guidance, provides '*the same volume and be at the same level relative to the design flood level as that lost*' (SEPA, 2015). The same SEPA guidance also accepts that '*there may be exceptions*' and that a '*robust model*' should be used to demonstrate '*that there would be no increase in flood risk upstream or downstream of the development*'.

4.3.21 There are significant constraints to provision of compensatory storage within the proposed scheme area, including geological, ecological, environmental and land constraints. These have all been taken into account as part of the assessment of mitigation measures and appropriate levels of mitigation have been proposed that reflect these constraints.

4.3.22 The primary aim in mitigation design and assessment has been to achieve a neutral impact on flood risk as a result of the proposed scheme. Where this has been identified as impracticable due to local constraints, prevention of increase in flood risk to sensitive receptors such as buildings and local

infrastructure has been prioritised over increases to agricultural and other undeveloped land within the existing floodplain.

4.3.23 As the proposed scheme design has progressed an iterative approach to design of mitigation has been followed. The process for identifying required mitigation has generally been as follows:

- Identify areas of floodplain loss or flood risk change as a result of the proposed scheme;
- Identify longlist of potential mitigation options, including areas of potential level for level compensation;
- Undertake multi-criteria analysis of longlist to create shortlist for more detailed consideration; and
- Detailed analysis of shortlisted options, generally including hydraulic modelling.

4.3.24 The assessment of impacts on flood risk is presented in Chapter 11 (Road Drainage and the Water Environment).

Maintaining Connectivity Between Settlements

4.3.25 The DMRB Stage 3 preferred route option announced in December 2016 included an overbridge and side road junction located north of Kindallachan (Kindallachan North Overbridge) to provide local road connectivity between settlements and facilitate access to the northbound carriageway. During ongoing consultation, members of the local community suggested consideration of an additional option located between Dowally and Guay. An overbridge option at a similar location had been considered as part of the DMRB Stage 2 design process but was not taken forward due to the potential impacts on property, water quality, ancient woodland and landscape and visual when assessed in accordance with the Junction and Access Strategy criteria. An overbridge and junction option (Guay South Overbridge) was developed at the suggested location to a similar standard as the Kindallachan North Overbridge to allow a comparative assessment to be undertaken.

4.3.26 The assessment indicated that the Guay South Overbridge had recognised benefits with reduced land-take, severance and business impacts, however, it was assessed to have greater floodplain volumetric loss than the DMRB Stage 3 Kindallachan North Overbridge option, although flood risk (post mitigation) was not increased. Following an engineering, environmental, traffic and economic assessment, consultation with SEPA and further public consultation, the Guay South Overbridge option was progressed as part of the DMRB Stage 3 design.

4.3.27 The DMRB Stage 2 route option selected for progression at DMRB Stage 3 included a side road which following an alignment to the rear of Guay Farmhouse and the front of The Knoll. This provided connection between Dowally, Guay and Kindallachan, and also connected to the U163 Guay to Tulliemet Road to the south of Guay. This connection between settlements has been retained as part of the proposed scheme, however a number of technical, engineering and environmental factors influenced changes to the alignment of the side road in the vicinity of Guay, as described later in this chapter (paragraphs 4.3.42 to 4.3.49).

4.3.28 Disguise Junction, a junction proposed within the Pass of Birnam to Tay Crossing project (Project 02) to the south of the proposed scheme, is intended to accommodate turning traffic utilising the southbound left-in left-out junctions proposed on Project 03 under the completed A9 Dualling Programme. It will also be required for turning traffic utilising the northbound left-in left-out junction at The Hermitage within Project 02.

4.3.29 Dalguise Junction is required to facilitate turning traffic utilising the left-in left-out junctions within the proposed scheme. However, it was identified that the proposed scheme may be progressed in advance of Project 02, and therefore Dalguise Junction may not be in place to facilitate this aspect of its safe operation.

4.3.30 As a result, a number of options were considered to accommodate turning traffic for the proposed scheme in the absence of Dalguise Junction, which are summarised below.

- Option 1: Construct permanent Dalguise Junction as part of the proposed scheme.

- Option 2: Interim roundabout in proposed permanent location of Dalguise Junction (part of Project 02) included in the proposed scheme.
- Option 3: Interim roundabout at the current tie-in of Project 02 and the proposed scheme.
- Option 4: Interim grade separated junction at the current tie-in of Project 02 and the proposed scheme.
- Option 5: No turning facility provided. Existing side road network utilised.
- Option 6: Interim roundabout at the current junction with the B898 (Dalguise).
- Option 7: Interim turning facility provided off the main A9 carriageway on the B898 (Dalguise) with access from the existing priority junction.

4.3.31 Each option was recognised as having a number of benefits and dis-benefits. Option 3 introduces an interim roundabout, similar to Options 2 and 6. However Option 3 is designed at-grade, its size would be limited to that required to meet safety standards and the interim roundabout would operate solely as a turning facility. Option 3 was recommended as the preferred option and progressed in the design as the A9 Southern Tie-In Interim Roundabout.

Drainage Design to Reduce Impacts

Floodplain Constraints

4.3.32 During the development of the drainage design from DMRB Stage 2 to DMRB Stage 3, it became clear that the extent of the River Tay floodplain would have an effect on the type and location of proposed SuDS components, resulting in a departure from the preferred provision of conventional SuDS at some locations. Six constrained drainage catchments were identified during the iterative drainage design process. Conventional SuDS were not possible due to the 3.33% AEP (30-year) and 0.5% AEP (200-year) flood extents of the River Tay:

- Drainage Catchments B, F and G - to provide attenuation and treatment, a combination of proprietary SuDS features was proposed: geocellular storage units to provide attenuation at carriageway level and a hydrodynamic vortex separator (HVS) in addition to filter drains to provide pollutant removal.
- Drainage Catchment D - it was proposed to provide swales as a second level of treatment and locate them below existing ground level to avoid impact on the River Tay floodplain. Although the SuDS features would be inundated during the 3.33% AEP (30-year) flood event, attenuation and enhanced treatment would be provided during the most frequent events.
- Drainage Catchment E – a SuDS pond was proposed to provide a second level of treatment, although this would be inundated during the 3.33% AEP (30-year) flood event. Attenuation and enhanced treatment would be provided during the most frequent events.
- Drainage Catchment H – to avoid impact on the 0.5% AEP (200-year) River Tay floodplain and any necessary compensatory flood storage at this location, a shallow wetland feature below the existing ground level was proposed to provide the second level of SuDS treatment for this catchment.

4.3.33 To further reduce the impact of the proposed SuDS features on the floodplain as the design developed, Existing runoff rates were applied to constrained outfalls. Existing runoff rates account for the area of existing road pavement in the calculation of the allowable discharge and are higher than ‘Greenfield’ discharge rates which have been applied at less constrained outfalls. Applying existing runoff rate results in a post-construction flood risk that is no greater than the current situation. By allowing runoff to flow through the SuDS feature at a higher rate this reduces the attenuation volume necessary to accommodate the runoff during peak flows, therefore reducing the footprint of the SuDS and its impact on the floodplain area.

4.3.34 The iterative design developments developed during DMRB Stage 3 to reduce the impact on the River Tay floodplain were discussed and agreed with SEPA and Perth & Kinross Council. This consultation is detailed in Appendix A7.2 (Summary of Consultation Responses).

Reducing Impacts on Habitats and SAC

4.3.35 Various iterations have been made to the DMRB Stage 3 drainage design to avoid or reduce potential impacts on sensitive ecological areas and the River Tay SAC. These include moving outfall headwalls away from specific locations to reduce the risk of sediment and pollutants entering watercourses during construction, including:

- outfall headwalls at various locations relocated on the River Tay to avoid sensitive ecological areas identified during ecological surveys;
- outfall at ch6400 moved to minor water feature (WF) 42 to avoid the construction of a headwall structure within the River Tay SAC;
- outfall at ch7200 moved to minor WF50 to avoid the construction of a headwall structure within the River Tay SAC; and
- outfall to the River Tummel at the northern extent adjacent to Inch Farm moved to minor WF55 to avoid the construction of a headwall structure within the River Tay SAC.

SuDS: Detention Basin vs. Pond/Wetland

4.3.36 The proposed scheme includes five SuDS ponds/basins to attenuate runoff from the dual carriageway via filter drains. The SuDS is designed to treat road runoff pollutants to acceptable levels before it enters watercourses. The construction and footprint of the SuDS features are included as part of the DMRB Stage 3 design of the proposed scheme as an embedded measure to mitigate potential water quality impacts.

4.3.37 During iterative design development, engineering and environmental factors were considered to confirm the design of each SuDS feature, including whether attenuation should be achieved by a dry detention basin or by a pond/wetland. The decision was based on guidance in the Construction Industry Research and Information Association (CIRIA) SuDS Manual (2015), which sets out the four pillars of SuDS design as being water quantity, water quality, amenity and biodiversity. As such, the following were considered:

- Highways Agency Water Risk Assessment Tool (HAWRAT) assessment which shows the attenuation levels of a retention pond are typically higher than a detention basin;
- size and topography of the catchment area;
- potential issues with seepage into the structural embankment;
- integrating the SuDS feature within the surrounding landscape character and topography;
- potential to contribute to visual amenity; and
- potential to contribute to biodiversity including areas of potential habitat for northern damselfly.

4.3.38 Table 11.19 (Chapter 11: Road Drainage and the Water Environment) provides the outcomes of the process, while further details of the SuDS design principles to be adopted as part of the detailed design and construction of the proposed scheme are set out in Appendix A13.7 (SuDS Design Principles).

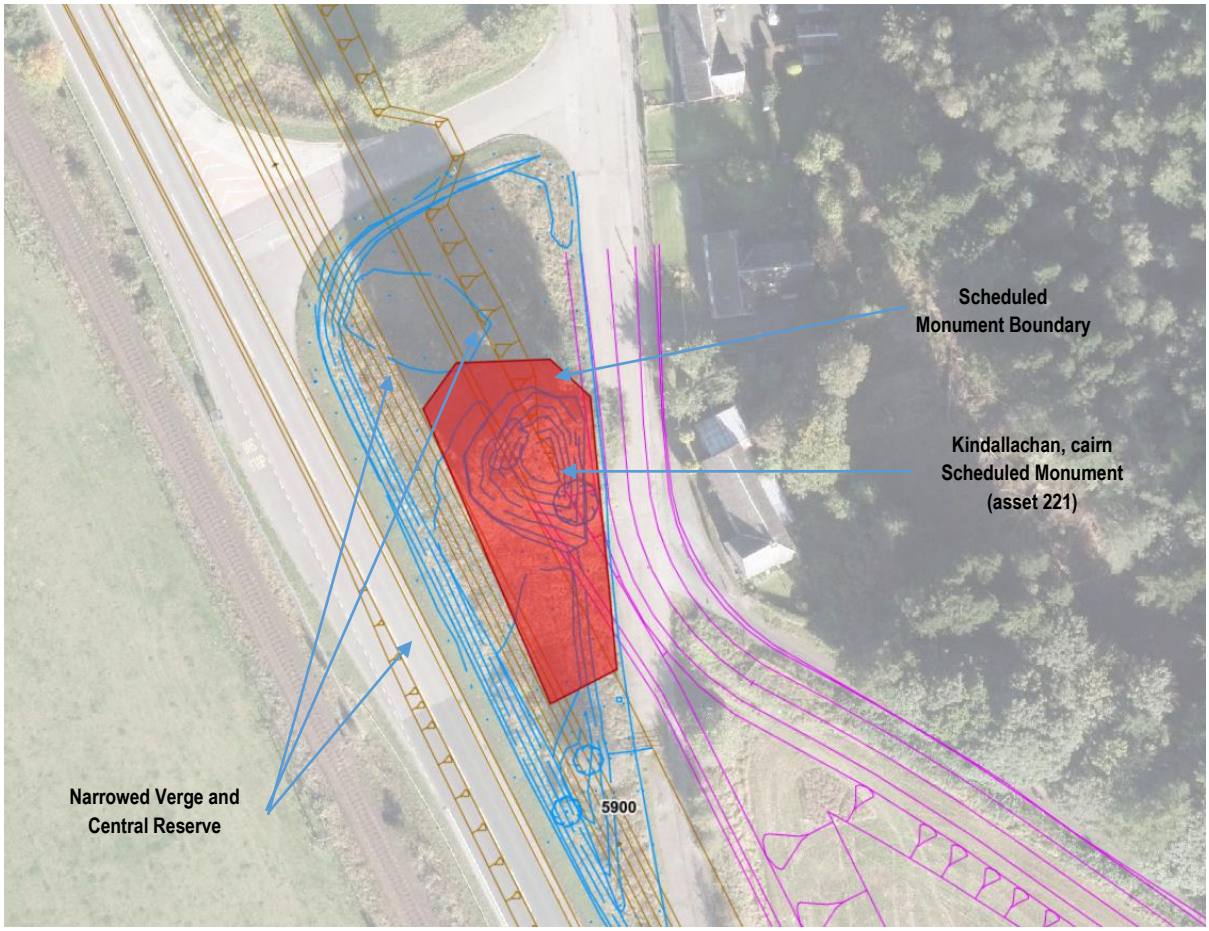
Reducing Impacts on Kindallachan Cairn & Standing Stone Scheduled Monuments

4.3.39 Chapter 3 (Alternatives Considered) provides detail on the mainline and side road route selection process up to and including identification of the preferred route at DMRB Stage 2. It was recognised during this process that there would be potential impacts on both the Kindallachan, cairn Scheduled Monument (Asset 221) and Kindallachan, standing stone Scheduled Monument (Asset 225).

4.3.40 Further survey work of the Kindallachan Cairn including archaeological geophysical survey (Appendix A15.3: Kindallachan Cairn Archaeological Geophysical Survey) was undertaken to better understand the nature of the asset and the potential unknown archaeological remains within the Scheduled Monument designated area. The findings of the survey were reviewed to reduce or avoid impacts on any important features if practicable. Development of the DMRB Stage 3 design minimised both

central reserve and verge widths in the vicinity of Kindallachan Cairn to reduce the direct impacts on the scheduled area as far as practicable.

Diagram 4.2: Kindallachan Cairn Scheduled Monument



4.3.41 Potential impacts on the Kindallachan, standing stone Scheduled Monument (Asset 225) have been reduced through provision of relaxation from standards for horizontal curvature and stopping site distance, and a retaining wall structure on the southbound carriageway. This avoids the need for a cutting and limits the direct impacts on the Scheduled Monument to loss of a small section of the scheduled area as illustrated in Figure 15.4. Following this design development, there would be no direct physical impact on the fabric of the Kindallachan, standing stone (Asset 225) by the proposed scheme (Chapter 15: Cultural Heritage).

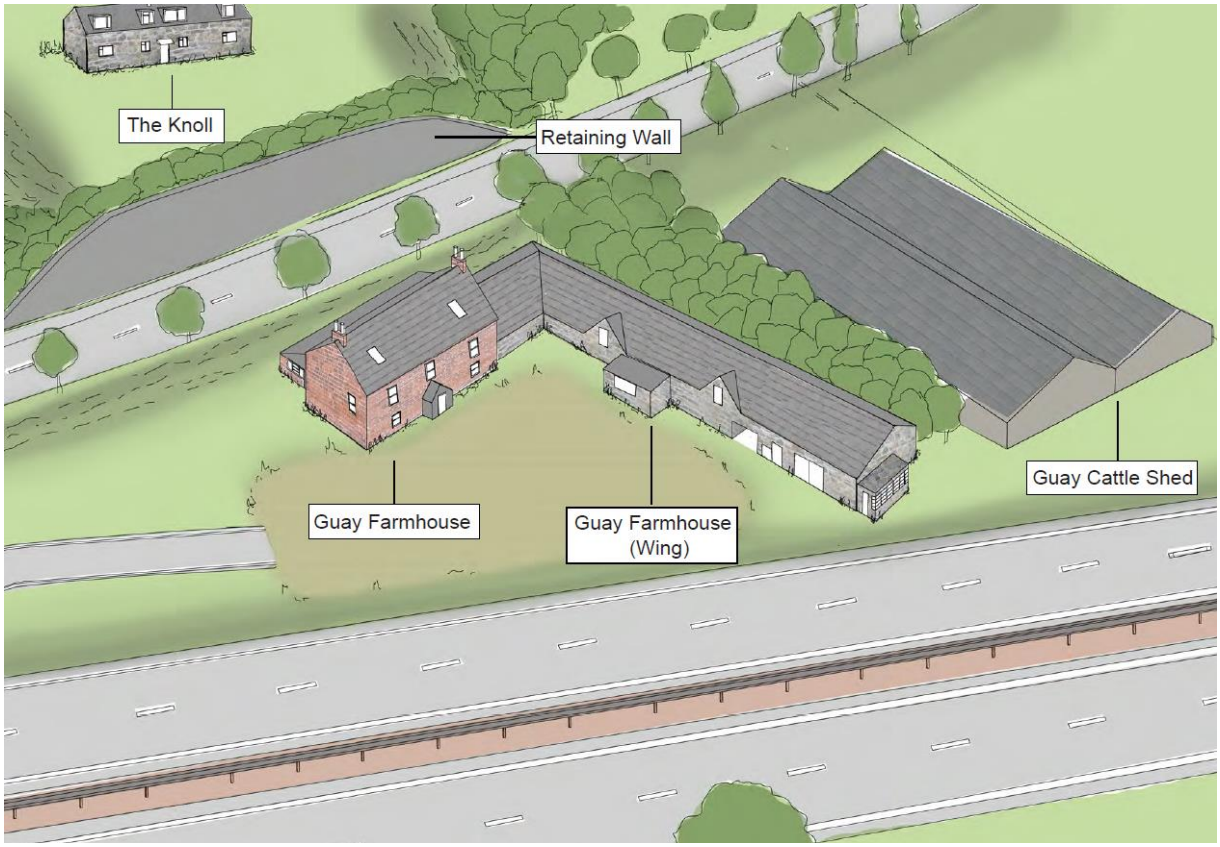
Refining Side Road Alignment at Guay Farmhouse and The Knoll

4.3.42 As previously noted in Chapter 3 (Alternatives Considered), the alignment and design of the proposed scheme was particularly constrained in the vicinity of Guay Farmhouse (approximate chainage ch5300), giving very limited alignment options for both the A9 mainline and the side road linking Dowally with Kindallachan. The following paragraphs explain the iterative design process, which sought to balance a number of considerations; constructability, feedback from affected property owners, cultural heritage and ecology.

4.3.43 Early iterations of the DMRB Stage 3 design included the side road passing between The Knoll and Guay Farmhouse (including Cattle Shed and Dutch Barn). This alignment is referred to as Option 1, and was as shown in Diagram 4.3. This alignment necessitated demolition of the Dutch Barn, land-take from The Knoll, and extensive construction works to provide a 7m high retaining wall to the rear of Guay Farmhouse. The alignment also effectively isolated Guay Farmhouse with roads infrastructure in close proximity to both the front and rear of the building.

4.3.44 A number of retaining wall construction options were identified as part of the design development process, including a cantilever contiguous piled wall, an 'L' shaped cast in-situ retaining wall, a modular retaining structure, a concrete crib wall, cut and cover box, and soil mixing/soil nailing. However, the various construction options all had the potential to cause structural damage to Guay Farmhouse and The Knoll. A number of constructability issues were also identified, included limited access and the need for a temporary cut slope with land-take from the garden of The Knoll.

Diagram 4.3: Guay Side Road Option 1

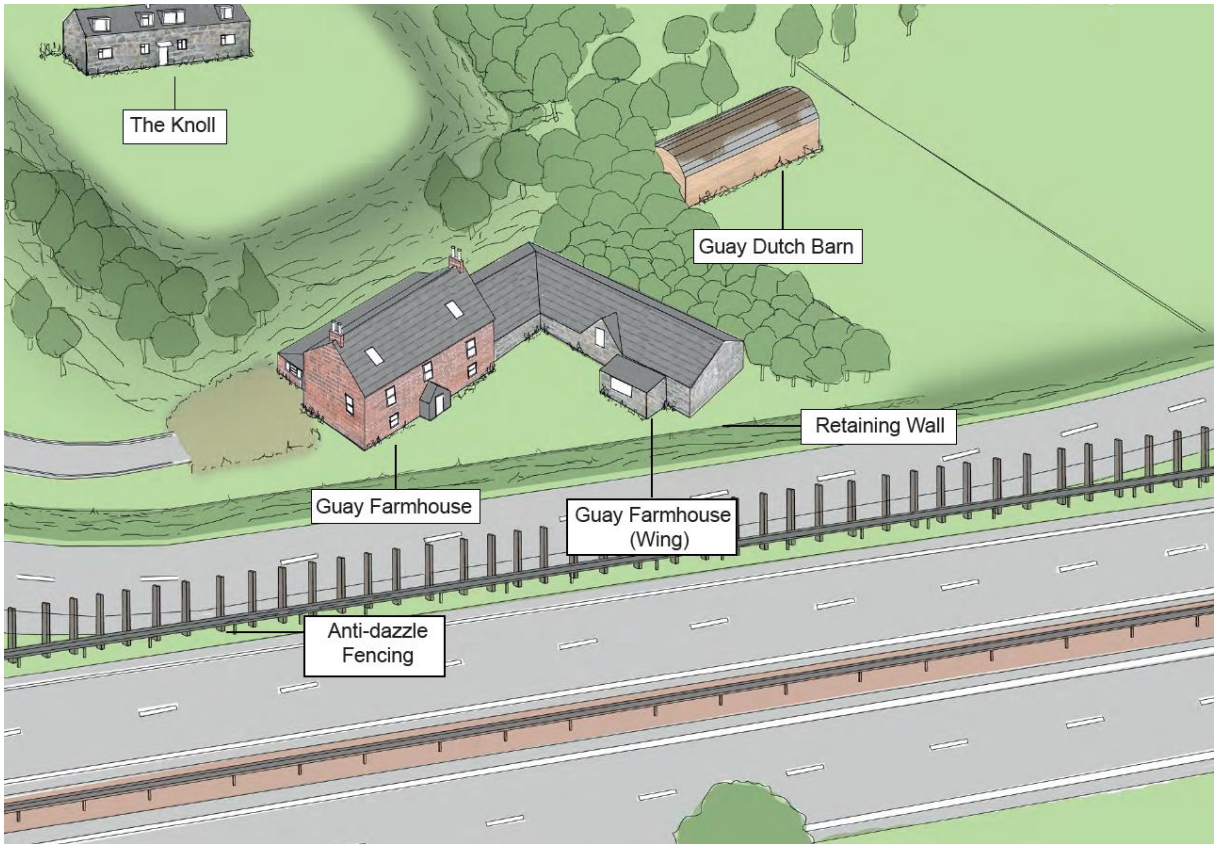


4.3.45 Following landowner consultation and a review of the side road alignment, an alternative side road option (Guay Side Road Option 2) was developed, which has been incorporated into the DMRB Stage 3 proposed scheme design. The alignment proceeds parallel to the mainline in a northerly direction from the U163 past Guay Farmhouse before connecting to the A9 mainline. The alignment will not impact on The Knoll, does not require demolition of the Dutch Barn, limits roads infrastructure to one side of the farmhouse, has improved constructability, and lower potential for construction impacts. However, it does encroach on the Wing of Guay Farmhouse and Guay Cattle Shed and will require alteration and demolition of these structures respectively.

4.3.46 A retaining wall up to 1.5m in height is proposed to the front (south-west) of Guay Farmhouse to reduce the extent of alteration to the Wing of Guay Farmhouse. To reduce visual disturbance at Guay Farmhouse due to vehicle headlights at night-time, anti-glare protection is proposed between the mainline and the side road at the property; anticipated to be achieved through the use of a fence.

4.3.47 An illustration of the proposed scheme incorporating Guay Side Road Option 2 is provided in Diagram 4.4.

Diagram 4.4: Guay Side Road Option 2



4.3.48 Guay Farmhouse and its full extents would be acquired to allow the alteration works, and the principle of this acquisition was discussed with the property owner as part of the DMRB Stage 3 landowner consultation. As the farmhouse is a Category B Listed Building, it will be necessary to obtain listed building consent and planning permission and as such a number of meetings and discussions have been held with Perth & Kinross Council and Historic Environment Scotland as detailed in Chapter 7 (Consultation and Scoping).

4.3.49 Ecological surveys have identified the presence of bats, with maternity roosts, summer roosts and hibernation roosts for a range of bat species (brown long-eared bat, common pipistrelle, soprano pipistrelle and Natterer's bat). A European Protected Species derogation licence would be required to allow disturbance or destruction of bat roosts and so would be necessary for either of the side road options considered. The potential impacts and licensing requirements have been discussed with SNH and are reported in Chapter 12 (Ecology and Nature Conservation).

Provisions for Non-Motorised Users

4.3.50 During the design development, the engineering and environmental teams worked to fully consider, maintain and where possible enhance NMU routes affected by the proposed scheme. Embedded mitigation that emerged from this process includes:

- Guay South Overbridge providing east-west connectivity; and
- NMU route realignments (refer to Table 4.2 and Figure 9.2).

Table 4.2: NMU Route Realignments, as shown on Figure 9.2

Location (Path ref.)	Description of Realignment Proposed
Path 53	Local path realigned along new access track.
Path 56/RCR83	NMUs rerouted along new segregated path with provision of signage to direct NMUs along cycle route.
Path 60	NMUs rerouted via Guay South Overbridge.

4.3.51 The assessment of impacts on all travellers is presented in Chapter 9 (People and Communities – All Travellers).

4.4 Conclusions

4.4.1 The DMRB Stage 3 design for the proposed scheme is the result of an iterative design development process that avoids or reduces the potential for impacts on the surrounding environment. It has developed and improved the preferred route option that was identified at DMRB Stage 2 (refer to Chapter 3: Alternatives Considered) to reach a design that is described in Chapter 5 (The Proposed Scheme) and assessed as part of the DMRB Stage 3 EIA.

4.5 References

Construction Industry Research and Information Association (2015). The SuDS Manual, CIRIA C753.

SEPA (2015). Technical Flood Risk Guidance for Stakeholders (SS-NFR-P-002). Available online at: https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf