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A96 DUALLING
EAST OF HUNTLY TO ABERDEEN

A96 Dualling

East of Huntly to Aberdeen scheme

DMRB Stage 2 Scheme Assessment Report

Volume 1 - Part 2

Engineering Assessment

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DMRB Stage 2 Scheme Assessment Report
Volume 1
Part 2 – Engineering Assessment

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4 Engineering Overview

4.1 Introduction

4.1.1 This chapter presents an overview of the relevant engineering design considerations in relation to the remaining better performing route options as described in Part 1, Chapter 3, Development of Route Options. Refer to Volume 1, Part 1, Figure 3.10 which illustrates these route options.

4.1.2 The engineering assessment is split by geographical section, covered in the following three chapters:

- Chapter 5 – East of Huntly to Colpy (Cyan and Red route options);
- Chapter 6 – Colpy to Pitcaple (Pink and Brown route options); and
- Chapter 7 – Pitcaple to Kintore (Violet and Orange route options)

4.1.3 The engineering assessment presents key engineering issues and findings. A concluding summary is provided for each engineering issue which identifies if any route option is considered to be more or less favourable. The overall engineering assessment summary and conclusions are contained in Volume 3, Part 5, Assessment Summary and Preferred Option Recommendation.

4.2 Design Considerations

4.2.1 A number of existing constraints and engineering physical features were identified and considered during the design process and are shown in Volume 5, Figures 2.2 to 2.24.

Properties and Local Communities

4.2.2 The route options have been developed to avoid the need for property demolition, where possible. The design of the route options also aims to minimise potential impacts on communities whilst taking cognisance of existing settlement boundaries and proposed developments in the Local Development Plan 2017.

Existing Topography

4.2.3 Areas of very challenging topography requiring disproportionate engineering works were avoided where possible. The vertical geometry of the route options has been designed to minimise earthworks where practicable, although some parts of the route options will require challenging earthworks. This is necessary to achieve appropriate gradients in line with the standards outlined in the Design Manual for Roads and Bridges (DMRB) CD 109 Highway link design, whilst still achieving required headroom clearances to road, rail and watercourse crossings.

Aberdeen to Inverness Railway Line

4.2.4 Through consultation with Network Rail, the design of railway bridges takes into account the necessary headroom and span requirements to accommodate potential improvements to the Aberdeen to Inverness Railway Line, including any future double tracking and electrification.

Public Utilities

4.2.5 There are a number of private and public utilities, both underground and overhead, located throughout the study area as summarised in Part 1, Chapter 2, Existing Conditions.

Environmental Constraints

4.2.6 There are a number of environmental constraints located throughout the study area including Scheduled Monuments, Sites of Special Scientific Interest (SSSI – geological and biological), Gardens and Designed Landscapes, Historic Battlefields and Grade A Listed Buildings as identified in Volume 2, Part 3, Environmental Assessment. Details and locations of these constraints are shown in Volume 5, Figures 8.1 to 8.13.

Local Road Network

4.2.7 The design was developed taking account of the existing local road network as shown in Volume 5, Figures 2.2 to 2.6 and reported in Volume 1, Part 1, Chapter 2, Existing Conditions.

Junctions and Accesses

4.2.8 All A-Class, B-Class, C-Class and unclassified roads that connect directly with the existing A96 were identified and shown in Volume 5, Figures 2.2 to 2.6 and reported in Volume 1, Part 1, Chapter 2, Existing Conditions.

4.2.9 Roads and private accesses to properties and businesses affected by the proposals were identified and considered in the design to ensure access is maintained. Further details for access provision will be considered at DMRB Stage 3.

Survey Data

4.2.10 The design has been developed using a ground survey model produced from a Light Detection and Ranging (LiDAR) survey undertaken in 2013 and 2014 which extended along the route of the existing A96.

4.2.11 Additional survey information was obtained from an Ordnance Survey Digital Terrain Model (DTM) covering the entire survey area.

4.2.12 A further detailed topographical survey will be undertaken to inform the DMRB Stage 3 design and assessment.

4.3 Design Approach

Introduction

4.3.1 Preliminary designs for each of the route options have been developed for the DMRB Stage 2 assessment.

4.3.2 The design of the Preferred Option will be developed further at the next stage of the assessment process (DMRB Stage 3 assessment).

Design Principles

Alignment and Road Layout

4.3.3 The DMRB sets out the principles to be used for coordinating various elements of road design to ensure the layout is acceptable in terms of the safety, operation,

economics and environmental effects. The aim should be to provide drivers with layouts that have consistent standards and are not likely to confuse them.

4.3.4 To meet the Scottish Government's commitment to connect Scotland's cities with a high-quality transport system, a Dual 2 lane all-purpose, sub-category c (D2APc) road type has been adopted for the A96 Inverness to Aberdeen Dualling Programme.

4.3.5 D2APc was formerly designated as Category 7A under the superseded version of Highway Link Design (TD 9/93). It is the highest category for a dual carriageway all-purpose road where all junctions shall be grade separated and a smooth flowing alignment is achieved by using a defined set of design principles.

4.3.6 For a D2APc road, the requirements in terms of access and junction treatments are outlined in DMRB CD 109 Highway link design, Table A.2 and are reproduced in Table 4.1.

Table 4.1 Rural Road Layouts (based on CD 109 Table A.2 Dual carriageway roads)

Type of road	Sub-category	Edge treatment	Direct access treatment	Junction treatment at minor road intersection	Junction treatment at major road intersection	Previous category reference used in TD 9/93
Dual 2 lane All-purpose roads (D2AP) 7.3 metre carriageway	c	No pedestrian footways or cycle tracks. Nearside - hard strip. Offside - hard strip	No access except isolated existing access with left turns only. Clearway (see TSM Chapter 3 [Ref7.N])	No minor junctions at-grade. No gaps in the central reserve.	Full grade separation	7A

4.3.7 The route options including junctions have been designed in accordance with the DMRB, in particular, using the following technical guidance and design standards, as applicable:

- DMRB CD 109 Highway link design;
- DMRB CD 127 Cross-sections and headrooms;
- DMRB CD 122 Geometric design of grade separated junctions;
- DMRB CD 116 Geometric design of roundabouts; and
- DMRB CD 123 Geometric design of at-grade priority and signal-controlled junctions.

4.3.8 The design of the local roads takes account of Aberdeenshire Council Standards for Road Construction Consent and Adoption (Issue C.01 December 2015).

4.3.9 The mainline alignment of all route options has been designed to a 120A kph Design Speed in accordance with DMRB CD 109.

4.3.10 The following Rural D2APc cross-section has been adopted for the mainline design in accordance with DMRB CD 127:

- 7.3m carriageways;
- 1.0m hard strip on both sides of each carriageway;
- 2.5m central reserve, with widening for visibility where required; and
- 2.5m verges, with widening for visibility where required.

4.3.11 The DMRB Stage 1 Report identified the aspiration that the entire length of the A96 Trunk Road be upgraded to a High Load Route as part of the A96 Dualling Programme. This determines that the new construction headroom for overbridges above the trunk road should be 6.45m +S (sag curve compensation) as outlined in DMRB CD 127, Table 4.1. For underbridges (over the local road network), a standard headroom of 5.30m + S has been adopted, as outlined in DMRB CD 127 Table 4.1.

4.3.12 At the western end of the scheme, the route options tie into the existing A96 single carriageway to the east of Huntly. The tie-in has been designed in accordance with the guidance in DMRB CD 127 and CD 109. This tie-in will remain in place until the adjacent Central Section (East of Fochabers to East of Huntly) of the A96 Dualling Programme is constructed.

4.3.13 At the eastern end of the scheme, the route options tie into the existing A96 dual carriageway at Kintore. The tie-in for the Violet route option is located at Gauchhill Junction and for the Orange route option is at Tavelty Junction.

Junctions

4.3.14 The junction strategy for all sections of the A96 dualling programme is set out within the A96 Dualling Programme Preliminary Engineering Services Junction Strategy (Revision 5, May 2015, Jacobs).

4.3.15 The strategy identifies the following:

- For A class roads, a junction is to be provided unless there is overriding specific justification for non-provision, or if it could be combined with another adjacent junction;
- For B and C class roads, an assessment of the potential junction shall be undertaken to determine: whether a junction should be provided; whether it is appropriate to divert the existing road via a new route; to provide a structure across the new A96 or to close the road at that location; and
- For unclassified (U) roads and private accesses, the strategy is not to provide junctions at these interfaces but to provide structures or diversions to maintain access.

4.3.16 The proposed junction locations between East of Huntly and Kintore have been determined in accordance with this strategy, supported by traffic modelling and has been further informed by feedback from the public during / following the public engagement events described in Part 1, Chapter 3.

4.3.17 The grade separated junction configurations shown on each route option are indicative layouts at this stage. The junction layouts shown are DMRB compliant and have been developed to minimise impact on existing properties and land take.

4.3.18 The Preferred Option junction configurations will be developed further during DMRB Stage 3.

Local Roads

4.3.19 For each route option, local road requirements were assessed based on the road categories and classifications provided by Aberdeenshire Council to ensure a consistent approach.

4.3.20 The majority of the local roads will continue on or close to their existing alignment and be bridged over or under the new A96 dual carriageway to minimise potential community or agricultural severance. Where this is not practicable, an appropriate diversion route will be provided to ensure connectivity for local roads and private accesses is maintained.

4.3.21 Sections of the existing A96 interfacing with the route options will be realigned to ensure continued connectivity for the existing A96 which will be subject to a Detrunking order.

Departures from Standard

4.3.22 At this stage in the design process, the geometric design standards used in the design are at or above the desirable minimum standards in the DMRB where practicable.

4.3.23 Within the Cyan route option, a one-step relaxation was applied to the horizontal geometry to negotiate the topographical constraints around the Hill of Skares to the south and the River Urie to the north. Further information is provided in Chapter 5.

4.3.24 Further departures or relaxations may be introduced during future design development to reduce environmental impacts or improve value for money, where appropriate.

Drainage

4.3.25 A preliminary drainage design has been carried out to identify catchment areas, potential outfall locations and to size and position indicative SuDS basins for treatment and attenuation of surface water run-off.

Earthworks

4.3.26 A desk-based assessment of the likely ground conditions has been undertaken. The geotechnical assessment is based on ground condition related data, which includes:

- British Geological Survey (BGS) 1:63,360 scale and 1:50,000 scale series Superficial and Solid geological maps for the area;
- BGS 1:50,000 scale Artificial Ground digital mapping for the area;
- BGS GeoSure datasets for the area;
- Geological Memoirs for the area;
- Geology of the area around Inverurie and Alford;
- Cainozoic geology and landscape evolution of north-east Scotland;
- Geology of the Huntly and Turriff Districts;

- BGS historical borehole records;
- BGS Geotechnical Hazard Datasets for the area;
- Historical mapping;
- Topographical mapping;
- Aerial photography; and
- Site Visits.

4.3.27 Earthworks slopes of 1m vertical to 3m horizontal for both cuttings and embankments have been adopted in the DMRB Stage 2 design.

4.3.28 The potential for re-use of excavated material within the works and potential material acceptability has been assessed and is discussed in the geotechnical assessment of each route option.

4.3.29 For the purpose of earthworks volume calculations and cost estimation purposes, it is assumed any excess acceptable material from each geographical section (East of Huntly to Colpy, Colpy to Pitcaple and Pitcaple to Kintore) will be transported to reduce cut / fill imbalances within other geographical sections. An allowance has been made for the use of unacceptable material within landscaped areas or environmental bunds with any further excess disposed of off-site to landfill. Further design development will be undertaken during DMRB Stage 3 and these assumptions will be re-examined at this point.

Pavement Design

4.3.30 A preliminary outline pavement design has been carried out to inform the cost estimate only. This has been designed in accordance with the DMRB, in particular the following design standards:

- DMRB CD 224 Traffic assessment;
- DMRB CD 225 Design for new pavement foundations; and
- DMRB CD 226 Design for new pavement construction.

4.3.31 A more detailed pavement design will be developed during DMRB Stage 3.

Road Restraint Systems

4.3.32 An allowance for Road Restraint System (RRS) has been included in the cost estimate based on the following assumptions:

- Use of Concrete Step Barrier (CSB) throughout the full length of the mainline central reserve; and
- Use of Tension Corrugated Beam (TCB) on the mainline verge where the embankment height is over 2m; on approach to structures; between the mainline verge and slip roads; and on the nearside verge of all slip roads.

4.3.33 The above assumptions are for costing purposes only and a detailed RRS design will be developed during DMRB Stage 3 using the Standard outlined in DMRB CD 377 (Requirement for road restraint systems).

Utilities

4.3.34 There are a significant number of buried and overhead public and private utility services between East of Huntly and Kintore including:

- Telecommunications – BT overhead and underground network and communications masts;
- National Grid – Large diameter high pressure gas pipelines and above ground installations;
- SGN (formerly known as Scotia Gas Networks) – High pressure gas pipelines and associated above ground installations, medium pressure and low pressure gas pipelines;
- GTC – medium and low pressure gas infrastructure;
- SSE (formerly known as Scottish and Southern Energy) – Extra high voltage, high voltage, medium voltage and low voltage overhead and underground electricity supply services;
- Scottish Water supply network;
- Scottish Water sewer network;
- Wind turbines and associated infrastructure; and
- Street lighting – there are areas of the existing road network that feature street lighting and will therefore include underground power cables in the vicinity of the lighting.

4.3.35 In accordance with the New Roads and Street Works Act (1991), C2 notices were issued to each of the utility providers to provide details of their networks within the study area. This enabled potential clashes between route options and utility infrastructure to be identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with potential high cost diversion items.

4.3.36 Where it has not been possible to avoid a clash with a major utility apparatus, initial consultation has been undertaken with the relevant providers and outline diversion costs have been identified.

Structures

4.3.37 All structure proposals at this stage comply with the DMRB and no Departures from Standard are required.

4.3.38 Structures will be required for grade separated junctions, local road crossings, railway bridges, river and watercourse crossings, and drainage features. Outline design options have been prepared for the significant crossings over the Rivers Don and Urie. These will be major structures and are significant cost items.

Non-Motorised Users (NMUs)

4.3.39 The following design principles have been adopted in relation to Non-Motorised Users (NMUs):

- The NMU network will be developed to satisfy the scheme objective and the A96 Dualling Programme objective (as well as the Scottish Government's aim)

of promoting and facilitating active travel in line with the overall NMU strategy for the A96 Dualling Programme;

- The NMU network will be developed taking into account the requirements of the Equality Act 2010 and Transport Scotland's Roads for All: Good Practice Guide for Roads 2013;
- There will be no NMU at-grade crossings of the dualled A96 as all NMU crossing points will be grade separated;
- Where practicable, NMU crossings in close proximity will be combined; and
- NMU crossing points will make use of other grade separated crossing facilities such as junction overbridges / underpasses and accommodation works overbridges / underpasses.

4.3.40 Provision for NMUs as part of the Preferred Option will be designed and developed during DMRB Stage 3.

Health and Safety Considerations

4.3.41 The development of the route options was informed by engineering challenges posing health and safety risks. For example, areas of very high topography were avoided, albeit some sections of challenging earthworks remain on the route options. Another example is watercourse crossings were avoided where possible and then minimised.

4.3.42 Despite efforts to avoid significant engineering challenges and therefore reduce health and safety risks during construction and maintenance, some challenges are still present and are reported in Chapters 5, 6 and 7 to inform the assessment and any future design development.

Scheme Resilience

4.3.43 The main objective of the A96 Scheme Resilience Strategy[1] is to develop a high level strategic approach to resilience in the design of the upgrade of the A96 to dual carriageway standard with an aim of improving journey time reliability by minimising or eliminating the risk of unplanned disruption to the operation of the trunk road. It considers operational resilience, winter resilience and considers the ability of the A96 to adapt and enhance resilience to the effects of climate change. Chapters 5, 6 and 7 consider each of these in turn for each of the route options.

[1] A96 Dualling Preliminary Engineering Services, Scheme Resilience Strategy, May 2015 – Rev 3, Transport Scotland.

5 Engineering Assessment: East of Huntly to Colpy

5.1 Introduction

5.1.1 This chapter describes the findings of the engineering assessment of the Cyan and Red route options between East of Huntly and Colpy. It includes a description and appraisal of the engineering features of each route option under the following subjects:

- Engineering constraints;
- Engineering description of the route option mainline alignments, junctions, local roads and accesses;
- Departures from standard;
- Topography and land use;
- Geotechnical engineering and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users;
- Health and Safety Considerations; and
- Resilience.

5.1.2 The Cyan and Red route options are shown in Volume 5, Figures 5.1 to 5.6.

5.2 Engineering Constraints

5.2.1 The route options have been designed to take cognisance of the following engineering constraints:

- The topography of the area, which is generally classified as rolling hills, including the valley of the Glens of Foudland;
- The existing A96 which is discussed in Volume 1, Part 1, Chapter 2, Existing Conditions;
- The existing local road network;
- Settlements including Kirkton of Culsalmond, Colpy and scattered residential properties;
- Commercial and agricultural properties and holdings throughout the study area;
- Public amenities such as Culsalmond Community Education centre;
- Designated Local Development Plan sites;

- Existing structures and accommodation underpasses, retaining walls and drainage culverts;
- Geological constraints including areas of made ground consisting of unknown material and potentially contaminated ground;
- The Burn of Slioch and associated floodplain;
- The River Urie, tributaries and associated floodplain;
- The Glen Water watercourse, tributaries, and associated floodplain;
- Jordan Burn and associated floodplain, which runs from north to south at Colpy; and
- Public and private utility infrastructure.

5.2.2 The design process was also guided by the environmental constraints as described in Volume 1, Part 1, Chapter 3, Development of Route Options and Volume 1, Part 2, Chapter 4, Engineering Overview. These environmental constraints are discussed within Volume 2, Part 3, Environmental Assessment.

5.3 Engineering Description – Cyan Route Option

Mainline Alignment

5.3.1 The Cyan route option is shown in Volume 5, Figures 5.1 to 5.3 and is approximately 13.3km in length.

5.3.2 Describing from west to east, the route option commences east of the town of Huntly where the C79S Gartly to Dummuies Road and C81S Slioch to Cruchie Road meet the existing A96, to the west of Leys of Dummuies.

5.3.3 The route option follows the existing A96 before diverging southwards on a right-hand curve at West Adamson. It passes to the east of the Hill of Dummuies and Ordiesnaught before turning to the south-east on a left-hand curve at Ramstone Hill, north-east of Gartly Moor.

5.3.4 The route option is on an uphill gradient throughout this length as existing ground levels rise from around 180m AOD at the start to a high point of around 280m AOD at Ramstone Hill. It is predominantly in cutting throughout this length with a short length of embankment at Den of Bogside where the existing topography falls locally between the hills at Ordiesnaught and Ramstone Hill.

5.3.5 From the high point of the surrounding ground at Ramstone Hill, the route option then switches onto embankment on a downhill gradient and continues south-eastwards through woodland via a bridge over the C66S Insch to Wraes Road, north of Saddle Hill.

5.3.6 Continuing south-eastwards on a downhill gradient, the route option bridges over the realigned A96 west of Broom Hill. It then runs in cutting to the south side of Broom Hill, parallel and to the north of the existing A96.

5.3.7 The route option continues on a downhill gradient within cutting along a left-hand curve parallel and to the north of the existing A96. It is on embankment briefly where the existing ground levels fall locally as the route option crosses the Burn of Lipsden.

5.3.8 The route option remains on a downhill gradient as the topography falls from around 250m AOD north of Whinbrae to around 200m AOD at Skares. Over the

start of this length, the route option is in cutting past Whinbrae then shallow embankment as it turns eastwards on a right-hand curve and bridges over the realigned existing A96 carriageway and Glen Water.

5.3.9 After crossing the Glen Water, the route option is in cutting to the south of Bainshole before the cutting depth increases as it turns on a right-hand curve to follow to the south of the existing A96, north of the Hill of Foudland. Within the cutting, the route option crosses the realigned existing A96 on a left-hand curve turning eastwards.

5.3.10 The route option then continues eastwards, running parallel to and between the existing A96 to the south and Glen Water to the north. The surrounding ground falls towards the Glen Water resulting in the route option being on embankment. A retaining wall replaces embankment north-east of Skares where the slope would otherwise encroach into the Glen Water and associated floodplain. A short length of Glen Water realignment is required south of Auchintender.

5.3.11 Turning southwards on a right-hand curve, the route option continues on a downhill gradient following the contours around the Hill of Skares where the surrounding ground levels fall from around 200m AOD to 160m AOD. The sidelong ground between the Hill of Skares and the Glen Water valley results in the route option being in cutting to the south and embankment to the north. Within this same length of road, the Cyan route option encroaches onto the existing A96 which is realigned to follow the same curve and runs parallel to the south of the route option. It is also crossed by the C87S Fordmouth to Placemill Road overbridge.

5.3.12 The route option runs southwards on a downhill gradient towards Colpy. A retaining wall is included adjacent to the Glen Water opposite Morgan McVeighs restaurant. South of this point west facing slip roads for Colpy Junction merge and diverge to / from the mainline. There are no east facing slip roads.

5.3.13 The route option passes to the east of the Colpy Cottage scheduled monument and proposed retaining wall and continues beneath the realigned existing A96. The route option is in cutting as it passes the western extent of Colpy.

5.3.14 The Cyan route option then continues south-eastwards, connecting to the Pink or Brown route options.

Junction Locations

5.3.15 There is one grade separated junction proposed on the Cyan route option while the existing A96 would be realigned to tie in at a priority junction to the west of the scheme.

5.3.16 The Cyan route option retains the existing A96 for local access between East of Huntly and Colpy. There are a number of local realignments of the existing A96 to maintain this local access route between East of Huntly and Colpy. The existing A96 would be realigned at the west end of the scheme, forming a staggered at-grade priority junction with the Cyan route option at Dummuies.

5.3.17 The Cyan route option interfaces with one A class road, the A920 at Colpy. A grade separated junction with west facing slip roads only would be provided to allow traffic to travel between the dualled A96 and the A920. The junction treatment is in accordance with the A96 Programme Junction Strategy.

Junction Layouts

Colpy Junction

5.3.18 Colpy Junction is proposed on the Cyan route option just north of Colpy. The junction maintains connectivity with the realigned existing A96 for local access to the west and the A920. The junction layout would be a grade separated, half diamond arrangement with west facing slip roads only. The westbound merge slip road commences at a roundabout which connects to the realigned existing A96. The eastbound diverge slip road connects to the realigned existing A96 via a priority T-junction. The realigned existing A96 connects the westbound merge slip road and eastbound diverge slip road via a bridge over the Cyan route option and then connects to the existing A96 to maintain local access to the east.

5.3.19 The westbound merge roundabout would be a three-arm roundabout connecting to the:

- Realigned existing A96 to the north of the junction;
- Dualled A96 mainline westbound merge slip road; and
- Realigned existing A96 to the south of the junction.

5.3.20 The eastbound diverge slip road connects to the realigned existing A96 via a priority T-junction.

Local Roads and Accesses

5.3.21 Table 5.1 describes the treatment required for existing local roads affected by the Cyan route option. Accesses that are not affected are not listed in the table.

Table 5.1 Local Roads and Accesses - Cyan Route Option

Local Road / Access	Name	Treatment
Existing A96	Aberdeen to Inverness	R
C81S	Slioch to Cruchie Road	R
Local Access	Leys of Dummuies Access	R
U82S	Thomastown Road	R
Local Access	West Adamston Access	R
Local Access	Den of Bogside	R
C66S	Insch to Wraes Road	B
Local Access	Newtongarry Access	R
Existing A96	Aberdeen to Inverness	B
Local Access	Whinbrae Access	R
Local Access	Wedderburn Access	R
Existing A96	Aberdeen to Inverness	B
U70S	Bainshole to Clinkstone Road	R
Local Access	Mid Bog Access	R
Local Access	East Bog Access	R

Local Road / Access	Name	Treatment
Existing A96	Aberdeen to Inverness	B
Local Access	West Skares Access	R
Local Access	Rashieslack Access	R
Existing A96	Aberdeen to Inverness	R
C87S	Fordmouth to Placemill Road	B
Local Access	Morgan McVeighs, Abbeylea, Woodside and Edinvale Accesses	R
Existing A96 / A920	Aberdeen to Inverness	J
Local Access	Colpy Cottage Access	R
Local Access	Waulkmill Access	R
U70S	Colpy to Jericho Road	R
C68S	Insch to Colpy Road	R

Key to table:

B	Bridge to be provided over or under A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge.
J	Road to be diverted through or connected to a new grade separated junction with the A96
R	Realignment or amendment of a public road or existing access to a private property.

5.3.22 Each of the above local roads and private accesses are described below.

Existing A96

5.3.23 The existing A96 is the main trunk road between Inverness and Aberdeen.

5.3.24 The existing A96 would be realigned to the north-east of the Cyan route option. The realignment starts at a priority T-junction directly off the Cyan route option and runs south-east for approximately 1000m before connecting to the existing A96 south-west of West Adamston.

C81S Slioch to Cruchie Road

5.3.25 This route connects Slioch to Cruchie running in a north-easterly direction from the existing A96 to Cruchie where it meets the A97.

5.3.26 A section of the C81S would be stopped up and diverted into the realigned existing A96 west of Slioch to maintain access.

Leys of Dummuies Access

5.3.27 This is an access to the Leys of Dummuies directly from the existing A96.

5.3.28 The access to the existing A96 would be stopped up and a new access to the C79S would be provided.

U82S Thomastown Road

5.3.29 This is the route from the existing A96 to Thomastown. It runs in an easterly direction from the existing A96 via Thomastown where it meets the C82S.

5.3.30 A section of the U82S would be stopped up west of Adamston and diverted to a priority junction with the realigned existing A96 to maintain access.

West Adamston Access

5.3.31 This is an access for West Adamston from the existing A96.

5.3.32 This access requires shortening and a new access onto the realigned existing A96 is required.

Den of Bogside Access

5.3.33 This is an access track to the Den of Bogside from the existing A96.

5.3.34 A section of the access track would be realigned and would connect with the existing A96 to maintain access.

C66S Insch to Wraes Road

5.3.35 This route connects Insch to Wraes, running in a north-easterly direction from Insch to Newtongarry where it meets the existing A96.

5.3.36 The C66S would be realigned and an underbridge would be provided to cross the Cyan route option.

Newtongarry Access

5.3.37 This is an access to Newtongarry from the existing C66S.

5.3.38 A new access onto the realigned C66S would be provided to maintain access.

Existing A96

5.3.39 The existing A96 would be realigned south-west of Broom Hill and an underbridge would be provided to cross the Cyan route option to maintain connectivity along the existing A96.

Whinbrae Access

5.3.40 This is an access to Whinbrae from the existing A96.

5.3.41 A new access onto the realigned existing A96 would be provided to maintain access.

Wedderburn Access

5.3.42 This is an access to Wedderburn from the existing A96.

5.3.43 A new access onto the realigned existing A96 would be provided to maintain access.

Existing A96

5.3.44 The existing A96 would be realigned south of Wedderburn and an underbridge would be provided to cross the Cyan route option to maintain connectivity along the existing A96.

U70S Bainshole to Clinkstone Road

5.3.45 This route connects Bainshole to Clinkstone from the existing A96 running in a westerly direction from the existing A96 to the south.

5.3.46 A section of the U70S would be stopped up and realigned to meet the realigned existing A96 at West Skares to maintain access.

Mid Bog Access

5.3.47 This is an access to Mid Bog from the existing A96.

5.3.48 A new access onto the realigned U70S would be provided to maintain access.

East Bog Access

5.3.49 This is an access to East Bog from the existing A96.

5.3.50 A new access onto the realigned U70S would be provided to maintain access.

Existing A96

5.3.51 The existing A96 would be realigned from West Skares with an overbridge provided to cross the Cyan route option and would re-join the existing A96 at Skares. The realigned section includes a priority junction with the realigned U70S.

West Skares Access

5.3.52 This is an access to West Skares from the existing A96.

5.3.53 A new access onto the realigned existing A96 would be provided to maintain access.

Rashieslack Access

5.3.54 This is an access to Rashieslack from the existing A96.

5.3.55 A new access onto the realigned existing A96 would be provided to maintain access.

Existing A96

5.3.56 The existing A96 to the east of Skares would be realigned where it passes to the north and east around the Hill of Skares. The realigned section is to the south and west of the Cyan route option. The realignment continues southwards around the Hill of Skares until the layby access at Morgan McVeighs. This section includes a priority junction with the C87S.

C87S Fordmouth to Placemill Road

5.3.57 This route connects Fordmouth and Placemill to the existing A96. It runs in a north-westerly direction from Fordmouth to north of Upper Heathfield.

5.3.58 The C87S would be realigned with an overbridge provided to cross over the Cyan route option and connects to the realigned existing A96 at a priority junction.

Morgan McVeighs, Abbeylea, Woodside and Edinvale Accesses

5.3.59 This is an access to Morgan McVeighs, Abbeylea, Woodside and Edinvale from a layby on the existing A96. The layby has been formed from a section of the former A96 road made redundant by a previous realignment.

5.3.60 A new access into the layby at its north end would be connected to the realigned existing A96 to maintain access.

Existing A96 / A920

5.3.61 The existing A96 runs north-south from Morgan McVeighs including a priority junction with the A920 to Colpy.

5.3.62 New link roads would be provided from the existing A96 at Morgan McVeighs to the west of the Cyan route option and existing A96. The roads would incorporate the roundabout at the westbound merge slip road at the Colpy Junction with a further roundabout to connect with the C68S and U70S local roads. An overbridge would be provided to allow the realigned A96 to cross the dual carriageway. The link road would tie into the A920 with priority junctions linking to the Colpy Junction eastbound diverge slip road, the existing A96 at Colpy and a realigned access to Waulkmill.

Colpy Cottage Access

5.3.63 This is an access to Colpy Cottage from the existing A96.

5.3.64 A new access onto the realigned existing A96 would be provided to maintain access.

Waulkmill Access

5.3.65 This is an access to Waulkmill from the existing A96.

5.3.66 The existing access onto the existing A96 would be retained. The existing A96 to the north of Waulkmill would be stopped up. The existing A96 south of Waukmill would be used to connect to a new priority junction onto the A920 at the Colpy Junction.

U70S Colpy to Jericho Road

5.3.67 This route runs in a westerly direction from Colpy to Jericho.

5.3.68 A section of the U70S from Colpy to Lindenlea would be stopped up and realigned to meet the roundabout with the realigned existing A96 and the C68S, to the west of the Cyan route option. Colpy would be accessed via the Colpy junction overbridge and the realigned A96 on the east side of the Cyan route option.

C68S Insch to Colpy Road

5.3.69 This route connects Insch to Colpy via Largie. It runs in a northerly direction from Insch until Largie and then runs eastwards to Colpy.

5.3.70 The C68S would be realigned to meet the roundabout with the realigned A96 and U70S local road, on the west side of the Cyan route option. Colpy would be accessed via Colpy Junction overbridge and the realigned A96 on the east side of the Cyan route option.

5.4 Engineering Descriptions – Red Route Option

Mainline Alignment

5.4.1 The Red route option is shown in Volume 5, Figures 5.4 to 5.6. This route option is approximately 12.2km in length.

5.4.2 Describing from west to east, the route option starts east of Huntly where the C79S Gartly to Dummuies Road and C81S Slioch to Cruchie Road meet the existing A96, to the east of Leys of Dummuies.

5.4.3 The route option follows the existing A96 before diverging southwards on a right-hand curve at West Adamson. It passes to the east of the Hill of Dummuies and Ordiesnaught before turning to the south-east on a left-hand curve at Ramstone Hill, north-east of Gartly Moor.

5.4.4 The route option is on an uphill gradient throughout this length as existing ground levels rise from around 180m AOD at the start to a high point of around 280m AOD at Ramstone Hill. It is predominantly in cutting throughout this length with a short length of embankment at Den of Bogside where the existing topography falls locally between the hills at Ordiesnaught and Ramstone Hill.

5.4.5 From the high point of the surrounding ground at Ramstone Hill, the route option then switches onto shallow embankment on a downhill gradient and continues south-east through woodland to the south of Saddle Hill and north of Cot Hill. It crosses under Scottish and Southern Energy (SSE) 275kV high voltage overhead power lines north of Rack Moss and is crossed by the realigned C66S Insch to Wraes Road overbridge.

5.4.6 The route option enters cutting as it turns north-eastwards on a left-hand curve, continuing on a downhill gradient on shallow embankments and cuttings as it crosses the Glen Water and Burn of Stodfold to a low point at Killden. Within this length, the route option is crossed by the realigned U70S Bainshole to Clinkstone Road overbridge before turning east on a right-hand curve past Killden.

5.4.7 From Killden, the route option rises on an uphill gradient as it continues east towards the steeper sidelong topography of the Hill of Foudland and is crossed by an overbridge carrying a further realignment of the U70S Bainshole to Clinkstone Road, between Midtown and Bog Farm.

5.4.8 The route option continues eastwards then turns south-eastwards on a right-hand curve past the Hill of Foudland. The steep sidelong ground of the Hill of Foudland results in a section of embankment followed by cutting through this length. At the start of the right-hand curve, the vertical alignment changes to a downhill gradient from a high point of approximately 252m AOD where it passes under SSE 275kV high voltage overhead power lines.

5.4.9 Continuing south-eastwards on a downhill gradient from Hill of Foudland towards the lower ground around Colpy, the route option passes to the south of the Hill of Skares and north of Jericho, requiring the realignment of the U70S Colpy to Jericho Road which forms part of the proposed Colpy Junction. The mainline crosses the realigned U70S on embankment to the west of Colpy.

5.4.10 The route option heads southwards on downhill gradient and embankment past Colpy and crosses over the C68S Insch to Colpy Road. It then turns south-eastwards on a left-hand curve into cutting as the surrounding ground rises from Colpy, before connecting to the Pink or Brown route option.

Junction Locations

5.4.11 There is one grade separated junction proposed on the Red route option while the existing A96 would be realigned to tie in at a priority junction to the west of the scheme.

5.4.12 The Red route option retains the existing A96 for local access between East of Huntly and Colpy. There are a number of local realignments of the existing A96 to

maintain this local access route between East of Huntly and Colpy. The existing A96 would be realigned at the west end of the scheme, forming a staggered at-grade priority junction with the Cyan route option at Dummuies.

5.4.13 The Red route option interfaces with one A class road, the A920 at Colpy. A grade separated junction with west facing slip roads only would be provided to allow traffic to travel between the dualled A96 and the A920. The junction treatment is in accordance with the A96 Programme Junction Strategy.

Junction Layouts

Colpy Junction

5.4.14 Colpy Junction is proposed on the Red route option just north-west of Colpy. The junction layout would be grade separated with west facing loop slip roads only. The junction links to the existing A96 / A920 via the realigned U70S beneath the route option mainline. A roundabout would be provided to link the junction with the A920 and the existing A96.

5.4.15 The eastbound diverge slip road and westbound merge slip road connects to the realigned U70S via a priority T-junction.

Local Roads and Accesses

5.4.16 Table 5.2 describes the treatment required for existing local roads affected by the Red route option. Accesses that are not affected are not listed in the table.

Table 5.2 Local Roads and Accesses - Red Route Option

Local Road / Access	Name	Treatment
Existing A96	Inverness to Aberdeen	R
C81S	Slioch to Cruchie Road	R
Local Access	Leys of Dummuies Access	R
U82S	Thomastown Road	R
Local Access	West Adamston Access	R
Local Access	Den of Bogside	R
Local Access	Greenmyres Access	R
C66S	Insch to Wraes Road	B
Local Access	Glennieston Access	R
Local Access	Stodfold Access	B
U70S	Bainshole to Clinkstone Road (Clinkstone – Overton)	B
U70S	Bainshole to Clinkstone Road (Killden – Midtown)	R
U70S	Bainshole to Clinkstone Road (Midtown-Bog Farm)	B
Local Access	Midtown Access	R
Local Access	Foudland Mast Access	R
U70S	Colpy to Jericho Road	J

Local Road / Access	Name	Treatment
C68S	Insch to Colpy Road	B
Local Access	Lindenlea and Colpy Farm	R

Key to table:

B	Bridge to be provided over or under the new A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge.
J	Road to be diverted / connected to a new A96 grade separated junction.
R	Realignment or amendment of a public road or existing access to a private property.

5.4.17 Each of the above local roads and private accesses are described below.

5.4.18 The following junctions and accesses are the same as the Cyan route option as described in Paragraphs 5.3.23 to 5.3.34:

- A96 Inverness to Aberdeen at East of Huntly;
- C81S Slioch to Cruchie Road;
- Leys of Dummuies access;
- U82S Thomastown Road;
- West Adamston access; and
- Den of Bogside.

Greenmyres Access

5.4.19 This is an access to Greenmyres from the existing C66S.

5.4.20 A new access to the realigned C66S would be provided to maintain access.

C66S Insch to Wraes Road

5.4.21 This route connects Insch to Wraes running in a north-westerly direction from Insch to Newtongarry where it meets the existing A96.

5.4.22 This C66S would be realigned and an overbridge would be provided to cross the Red route option to maintain access.

Glennieston Access

5.4.23 This is an access road to the properties at Glennieston.

5.4.24 A new access onto the realigned C66S would be provided to maintain access.

Stodfold Access

5.4.25 This is an access for Stodfold from the existing C66S.

5.4.26 The exiting access would be realigned and an underbridge would be provided to cross the Red route option to maintain access.

U70S Bainshole to Clinkstone Road (Clinkstone – Overton)

5.4.27 This route runs in a westerly direction from Clinkstone to the existing A96 at Bainshole.

5.4.28 A section of the U70S would be realigned and an overbridge would be provided to cross the Red route option to maintain access.

U70S Bainshole to Clinkstone Road (Killden – Midtown)

5.4.29 A section of the U70S would be stopped up and realigned to the south of the Red route option to maintain access.

U70S Bainshole to Clinkstone Road (Midtown – Bog Farm)

5.4.30 A section of the U70S would be realigned and an overbridge would be provided to cross the Red route option to maintain access.

Midtown Access

5.4.31 This is an access to Midtown from the existing U70S.

5.4.32 A new access onto the realigned U70S would be provided to maintain access.

Foudland Mast Access

5.4.33 This is an access from the U70S Colpy to Jericho Road to a telecommunications mast on Hill of Foudland.

5.4.34 The access would be realigned to the south of the Red route option to connect to the U70S.

U70S Colpy to Jericho Road

5.4.35 This route connects Colpy to Jericho, running in a north-westerly direction from Colpy to Jericho.

5.4.36 The U70S Colpy to Jericho Road would be realigned and an underbridge would be provided to cross the Red route option as part of the Colpy Junction.

C68S Insch to Colpy Road

5.4.37 This route connects Insch to Colpy via Largie. It runs in a northerly direction from Insch until Largie and then runs easterly to Colpy.

5.4.38 The C68S would be realigned via a bridge under the Red route option to maintain access.

Lindenlea and Colpy Farm

5.4.39 These are properties currently accessed from the U70S to the north-west of Colpy.

5.4.40 A new access would be formed between the existing and realigned U70S to access these properties.

5.5 Departures from Standard

Cyan Route Option

5.5.1 The Cyan route option has been designed to the standards outlined in the Design Manual for Roads and Bridges (DMRB) CD 109 Highway link design and includes one relaxation within this standard which is a 720m radius curve in the horizontal

alignment between the Hill of Skares and the Hill of Tillymorgan. This is a one-step relaxation in relation to the desirable minimum of 1020m radius for 120kph design speed.

5.5.2 The relaxation has been utilised to allow the route option mainline to sit within the existing valley and within the existing A96 corridor, thereby minimising impact on the topography of the area, the River Urie and its associated floodplain.

5.5.3 This relaxation is not deemed to compromise the safety of the Cyan route option as Desirable Minimum Stopping Sight Distance is provided through verge and central reserve widening.

5.5.4 There are no Departures from Standard included in the Cyan route option mainline design.

Red Route Option

5.5.5 The Red route option mainline design has been developed without any Departures from Standard or relaxations at this stage.

5.6 Topography and Land Use

Topography

5.6.1 Both the Cyan and Red route options would introduce changes to the existing topography through construction of cuttings and embankments, grade separated junctions, structures, attenuation basins, watercourse diversions and local road realignments.

5.6.2 The existing topography comprises rolling hills with peak elevation of 275m to the west and the valley of the Glens of Foudland to the east (typically 200m AOD). The Cyan route option generally follows the valley floor of the Glens of Foudland along the existing A96 corridor. The Red route option runs along the southern side of the Glens of Foudland then turns to run further south to pass between the Hill of Foudland and the Hill of Skares.

5.6.3 The topography surrounding the Red route option generally comprises hilly terrain. The Red option deviates away from the existing A96 corridor and passes through areas of terrain with significantly changing elevation, adjacent to and across the Glen Water and its tributaries. It passes between Cot Hill and Saddle Hill and rises to pass between the Hill of Foudland and Hill of Skares.

5.6.4 The impact of the route options upon the local landscape is considered in Volume 2, Part 3, Chapter 17, Landscape.

Land Use

5.6.5 Both the Cyan and Red route options are largely surrounded by mixed use agricultural land, scattered properties and holdings.

5.6.6 There are areas of woodland at Hillhead, the Hill of Foudland and Hill of Skares. There are also wind farms at Ramstone Hill and Hill of Bainshole, as well as individual turbines at numerous locations.

5.6.7 Communities of Colpy and Kirkton of Culsalmond are located towards the south-eastern end of both route options and contain residential and commercial properties and community facilities including a community centre and a church.

5.6.8 Land use is considered in further detail in Volume 2, Part 3, Chapter 12, People and Communities and Chapter 13, Agriculture, Forestry and Sporting Interests.

5.7 Geotechnics and Earthworks

Existing Ground Conditions

Sources of Information

5.7.1 Sources of information used in the assessment of likely ground conditions are as described in Paragraph 4.3.26.

5.7.2 The study area used for the identification of ground conditions in this chapter is defined by a 1km buffer around the route options.

General Ground Conditions

Superficial Geology

5.7.3 The area between east of Huntly and Colpy containing the Cyan and Red route options is underlain primarily by glacial till, with localised areas of peat and alluvium. The superficial geology map also shows areas of shallow rock present at the surface where there is no drift cover, which typically occurs in areas of higher ground. Superficial deposits between east of Huntly and Colpy are summarised in Table 5.3 and are shown in Volume 5, Figures 5.7 to 5.10.

Table 5.3 Superficial Deposits within the Study Area

Strata	Typical Description	Distribution
Glacial Till	Sandy diamictons and clayey diamictons deposited by glacial ice, with clasts of various sizes and origins.	Extensive distribution, except in areas of higher ground where rock is typically mapped at the surface.
Alluvium	Compressible silty clay with layers of silt, sand, peat and basal gravel, deposited by rivers.	Local to the River Urie / Glen Water, Jordan Burn and Burn of Stodfold.
Peat	An accumulation of partially decomposed vegetation and organic material.	Present at Rack Moss to the south of the existing A96 in the Glens of Foudland.

5.7.4 It is noted that the superficial geological mapping of this area (Map Sheet 86W, Huntly) was undertaken in 1955 and does not appear to be as detailed as the superficial geological mapping in other parts of the study area. It is therefore possible that other unmapped superficial deposits may be present between East of Huntly and Colpy.

Artificial Ground

5.7.5 Artificial Ground is described as areas where the ground surface has been significantly modified by human activity. The BGS “Artificial Ground” mapping does not show any large areas of artificial ground between East of Huntly and Colpy, however it is anticipated that areas of made ground are likely to be present locally associated with the development of infrastructure, residential properties and farm properties. Additionally, former pits and quarries within the study area may have been infilled with spoil or waste materials.

5.7.6 The composition of any made ground and backfill materials is unknown and across the scheme it is likely to comprise a highly variable mixture of engineered-fills, road pavement make-up, reworked soils and rock fragments as wells as man-made materials, waste and spoil. Historic buried structures and man-made obstructions are also likely to be present in the vicinity of current and former buildings and infrastructure.

Bedrock Geology

5.7.7 For ease of reference, rock types are defined in the report glossary.

5.7.8 The majority of the study area is underlain by metasedimentary rocks of the Macduff Formation, which is part of the Southern Highland Group. The lower part of the Macduff Formation comprises a major pelitic unit, the Hill of Foudland Pelite Member, which has been hornfelsed through contact metamorphism to form the east-west trending range of “slate hills” that includes the Hill of Tillymorgan, Hill of Skares, Hill of Foudland and Hill of Wishach. The upper part of the Macduff Formation occurs to the north of the slate hills and comprises interbedded units of micaceous psammite, semi-pelite and pelite, with subsidiary metaconglomerate.

5.7.9 Around Colpy to the south of the slate hills, the study area is underlain by olivine-gabbro, olivine monzonite, olivine monzodiorite and syenitic rock belonging to the Upper Zone of the Insch Pluton, which is a cumulate intrusion extending from Colpy to Inveramsay and composed of a range of predominantly basic and ultrabasic igneous rocks.

5.7.10 Several inferred geological faults are shown within the study area, although the directions and magnitudes of displacement are not stated. The extent of disturbed rock around faults is also unknown. Bedding in the Macduff Formation is shown to dip to the south and south-east at angles of 34° to 76°. Foliation in the Hill of Foudland Pelite Member is inclined to the south and south-east, with foliation planes inclined at angles of 38° to 68°.

5.7.11 Bedrock is shown at or close to the surface in areas of higher ground at the Hill of Dummuies, Ramstone Hill, Saddle Hill, Hill of Foudland, Hill of Skares and Hill of Tillymorgan. Many disused quarries are present on the Hill of Foudland, Hill of Skares and Hill of Tillymorgan.

5.7.12 The BGS Memoirs for the area indicate that localised deep pockets of weathered bedrock occur within the study area. Between East of Huntly and Colpy, deep weathering is most likely to be found in potential feldspathic psammite bands within the Macduff Formation and in the basic rocks of the Insch Pluton.

5.7.13 Bedrock Geology is shown in Volume 5, Figures 5.11 to 5.14.

Existing Ground Investigation Information

5.7.14 Existing ground investigation information within the section between East of Huntly and Colpy is very limited with only five exploratory holes being shown within 500m of the Cyan and Red route options. The exploratory hole information has been reviewed and is summarised in Table 5.4.

Table 5.4 Existing Ground Investigation Information - Cyan and Red Route Options

Scheme / Investigation	Coverage	General Findings
A96 Whinbrae Underpass	Four boreholes adjacent to existing A96, between Broomhill and Whinbrae farms	Topsoil over dense clayey silty sandy gravel and stiff sandy very gravelly silt to depths up to 2m, underlain by broken weathered Schist to depths of at least 5m
Glennieston Farm, Huntly	Single rotary open-hole borehole at Glennieston Farm, to south of A96	Clay to 1.3m, underlain by weathered schist to 18m and unweathered grey schist to at least 30m. Groundwater at 10m

Identified Geotechnical Constraints

5.7.15 The main geotechnical constraints include potential for settlement and subsidence / ground instability where embankments are to be constructed over areas of compressible ground and the slope instability of cuttings. Compressible ground is typically associated with alluvium, peat and man-made soils such as made ground.

5.7.16 The ground conditions and geotechnical properties of the superficial deposits and bedrock beneath the route options will require to be confirmed through ground investigation at DMRB Stage 3.

Cyan Route Option

5.7.17 Ratings for potential geotechnical hazards are defined by the BGS for the existing ground conditions, although do not necessarily reflect the risk in relation to the scheme. These are summarised below for the area in the immediate vicinity of the Cyan route option, with areas of moderate and high hazards shown in Volume 5, Figures 5.15 and 5.16:

- No hazard to very low hazard potential for collapsible ground
- High hazard potential for compressible ground associated with areas of peat deposits, moderate hazard potential associated with alluvium deposits within the river / burn valleys and very low hazard potential associated with the glacial till deposits and shallow rock;
- No hazard potential for ground dissolution features;
- No hazard or very low hazard potential for landslides with localised areas of low to moderate hazard potential associated with alluvium deposits in the valley of the River Urie and the Jordan Burn. Localised areas of moderate hazard potential also occur in the valley of the River Urie at the Hill of Skares;
- No hazard to low hazard potential associated with running sand; and
- Very low hazard potential for the presence of shrinking or swelling clay across the majority of the study area with no hazard potential in areas of shallow rock.

5.7.18 The following potential geotechnical constraints and hazards have been identified from a review of historical mapping information:

- Unknown infilled ground (pits, quarry etc) adjacent to existing A96 at West Adamston.

5.7.19 The following potential additional geotechnical constraints and hazards are also applicable to the Cyan route option, in relation to the identified earthworks:

- Ten pits or quarries are identified on historic maps, potentially infilled with unknown materials;
- Potential zones of highly fractured rock and increased groundwater flow in the vicinity of geological faults shown on BGS mapping;
- Potential shallow groundwater table and subsequent requirement for dewatering; and
- Potential slope instability associated with cuttings through areas of slate around the Hill of Skares.

Red Route Option

5.7.20 Ratings for potential geotechnical hazards are provided by the BGS for the existing ground conditions, although it does not necessarily reflect the risk in relation to the scheme. These are summarised below for the area in the immediate vicinity of the Red route option, with areas of moderate and high hazards shown in Volume 5, Figures 5.17 and 5.18:

- No hazard to very low hazard potential for collapsible ground;
- High hazard potential for compressible ground associated with areas of peat deposits, moderate hazard potential associated with alluvium deposits within the river / burn valleys, and very low hazard potential associated with the glacial till deposits and shallow rock;
- No hazard potential for ground dissolution features;
- No hazard or very low hazard potential for landslides with localised areas of low to moderate hazard potential associated with alluvium deposits in the valley of the River Urie and the Jordan Burn. Localised areas of moderate hazard potential also occur in some areas of glacial till and shallow rock on the slopes of the Hill of Foudland and the Hill of Wishach;
- No hazard to low hazard potential associated with running sand; and
- Very low hazard potential for the presence of shrinking or swelling clay across the majority of the study area with no hazard potential in areas of shallow rock.

5.7.21 The following potential geotechnical constraints and hazards have been identified from a review of historical mapping:

- Unknown infilled ground (pits, quarry etc) adjacent to existing A96 at West Adamston;
- Potentially contaminative industrial use - quarrying beneath the Red route option at the Hill of Foudland;
- Potentially contaminative industrial use - former spirit distillery adjacent to the Red route option at Jericho; and
- Potentially contaminative industrial use - historic quarrying beneath the Red route option between Colpy and Jericho.

5.7.22 The following potential geotechnical constraints and hazards are applicable to the Red route option, in relation to the identified earthworks:

- Six pits or quarries are identified on historic maps, including a large area of quarrying and spoil tips at the Hill of Foudland, and potentially infilled with unknown materials;
- Potential zones of highly fractured rock and increased groundwater flow in the vicinity of geological faults shown on BGS mapping;
- Potential shallow groundwater table and subsequent requirement for dewatering; and
- Potential slope instability associated with large cuttings that are required through areas of slate at the Hill of Foudland, including through areas of quarrying and spoil tips.

Discussion

5.7.23 Peat occurs beneath both route options at Rack Moss. Peat deposits are typically very weak, highly compressible and generally unacceptable for reuse in earthworks. The design proposals indicate that the Cyan route option would cross the area of peat on an embankment, whilst the Red route option would comprise a combination of embankments and at-grade construction over Rack Moss. The thickness of peat in this area is unknown.

5.7.24 Alluvium deposits are typically very weak and can contain highly compressible silt and clay layers. Alluvium may also contain lenses of peat. The majority of the areas of mapped alluvium occur beneath at-grade sections or embankments, however current geological baseline information shows that a number of small cuttings on both the Cyan and Red route options are potentially required through localised areas of alluvium.

5.7.25 The potentially compressible nature of the peat and alluvium deposits may result in significant settlements beneath embankments, as well as potential slope instability issues during construction. Additionally, alluvial deposits are associated with running sands and seepage flows and cuttings below the groundwater table in these deposits are likely to require dewatering.

5.7.26 The angle of cut slopes in alluvial deposits and peat will depend on a number of factors including slope height, groundwater levels and specific characteristics and geotechnical properties of these materials. If groundwater is at a high-level, slope drainage may be required.

5.7.27 Potential measures to mitigate issues associated with compressible superficial deposits include removal and replacement; staged construction; load transfer platforms; accelerated settlement / consolidation through surcharging; and the use of band-drains or drainage layers. Where the route option is at grade or on a low height embankment it may be feasible to reinforce the subgrade with geotextiles combined with granular materials.

5.7.28 The applicability of these measures will depend on the construction programme, as well as the extent and properties of the potentially compressible materials. The nature of the compressible deposits would need to be determined through ground investigation at DMRB Stage 3.

5.7.29 Infilled ground is recorded in localised pockets associated with potentially infilled pits and quarries. However, it is anticipated that made ground and man-made

buried obstructions may be present along a greater extent of the route options, as a review of historic mapping has identified a number of former buildings and historic quarries in the vicinity of both the Cyan and Red route options. Potentially contaminated land may also be present in the vicinity of former industrial land uses, such as quarrying and spirit distilling. It should be noted that the full extent of these former pits and quarries is unknown and therefore the area of the route option at risk is unknown at this stage. Contaminated land may also be present within former and current farms relating to former and current farming activities.

5.7.30 Given the proximity of the route options to Aberdeen City, a high-level review of the Unexploded Ordnance (UXO) risk has been completed using online Unexploded Bomb (UXB) risk maps. This preliminary assessment has determined the risk to be low due to a low intensity of bombing. The potential UXO risk will be assessed further during DMRB Stage 3.

5.7.31 Both route options include deep cuttings in areas of shallow rock, which presents a potential constraint as shallow rock is likely to be more difficult to excavate than shallow superficial deposits. Additionally, the Red route option includes a large cutting through an area of slate which may present slope instability challenges, particularly where spoil from former quarrying activities is present. Geological faulting is also noted to be mapped within some of the potential cuttings, which may result in additional engineering challenges.

5.7.32 Potential measures to mitigate issues associated with cuttings in shallow rock include alternative excavation techniques such as blasting; localised retaining measures including rock bolting; and retaining walls where slope instability is a concern. The scale of these measures is dependent on the rock mass properties which would be determined during the ground investigation in DMRB Stage 3.

5.7.33 A comparison of ground conditions beneath the route option centrelines is provided in Table 5.5. This summarises the length of each route option that is underlain by the ground conditions which are considered to be more challenging based on mapped surface geology only.

Table 5.5 Comparison of Ground Conditions

Route Option	Approximate length[1] (m) and proportion of Route Option centreline underlain by geotechnical hazards				Total (m)
	Artificial Ground [2]	Shallow Rock	Alluvium	Peat	
Cyan	0 (0%)	550 (4%)	1000 (8%)	400 (3%)	1,950 (15%)
Red	50 (<1%)	450 (4%)	450 (4%)	350 (3%)	1,300 (11%)

[1] Length relates to mainline only, rounded to nearest 50m
[2] Artificial ground includes pits and quarries identified from historic mapping and areas of potentially infilled ground.

5.7.34 The summary of ground conditions underlying each of the route options between East of Huntly and Colpy is based on published information with the following limitations:

- The summary is based primarily on the geology that is mapped at the surface on the BGS 1:50,000 digital superficial geology maps. Other potentially unfavourable ground conditions with geotechnical risks and hazards may be present at depth, however there is insufficient existing ground investigation

information to allow ground modelling of the sub-surface across all route options.

- The occurrence of the different types of superficial deposits is based on the available geological mapping, which is noted to be dated 1955 and may be lacking in detail compared to more modern mapping in other areas of the scheme. As such, unrecorded superficial deposits may be present.
- Shallow Rock is defined by BGS as areas with less than 1m of superficial deposit cover above bedrock. Rock is also likely to be encountered in deeper cuttings beneath the mapped superficial deposits.
- There is very limited existing published ground investigation data in the vicinity of the Cyan and Red route options, which does not provide any substantial information on ground conditions beyond what is shown on the geological maps. In-situ ground conditions and the potential for contamination should be confirmed by an intrusive ground investigation during DMRB Stage 3.
- Unrecorded areas of unfavourable superficial deposits or made ground may be present beneath both route options. The nature, extent and properties of made ground is unknown and will need to be investigated as part of the DMRB Stage 3 ground investigation.

Junctions

5.7.35 A brief qualitative summary of the surface geology for the junctions on the Cyan and Red route options is presented in Paragraphs 5.7.36 and 5.7.37. The engineering considerations relating to ground conditions discussed in Paragraphs 5.7.23 to 5.7.32 are also applicable to the junctions. Ground conditions for the East of Huntly to Colpy route option junctions are shown in Volume 5, Figures 5.15 to 5.18.

Colpy Junction – Cyan Route Option

5.7.36 Colpy Junction is located predominantly on glacial till. A small section of one of the local roads is within an area of alluvium associated with the Jordan Burn. The main carriageway through Colpy Junction includes a cutting in glacial till.

Colpy Junction – Red Route Option

5.7.37 Colpy Junction is located predominantly on glacial till, with some local roads and slip roads located within an area of alluvium associated with the Jordan Burn. The main carriageway embankment through Colpy Junction is predominantly over glacial till, with some areas of alluvium and shallow rock.

Earthworks Balance

Acceptability of Excavated Material

5.7.38 The majority of cuttings on both the Cyan and Red route options between east of Huntly and Colpy are formed within areas of glacial till or shallow rock. The potential cuttings in shallow rock are shown to be formed within several different geological formations comprising multiple lithologies, with likely variation in suitability for reuse. Some comparatively small areas of cut may be formed within alluvium or peat on the Red route option at Rack Moss and on the Cyan route option at Jericho. These deposits are considered to have limited potential for reuse in earthworks.

5.7.39 The reuse potential for each route option has been determined by splitting the route options into areas based on the anticipated ground conditions and likely composition of excavated materials.

5.7.40 Acceptability of materials for reuse will be confirmed through intrusive ground investigation and laboratory testing which will be undertaken at DMRB Stage 3.

Acceptability of Excavated Material – Cyan Route Option

5.7.41 It is estimated at this stage that between East of Huntly and Fordmouth, 75% of excavated materials may be acceptable for reuse as general engineering fill.

5.7.42 It is estimated at this stage that between Fordmouth and Colpy, 50% of excavated materials may be acceptable for reuse as general engineering fill.

5.7.43 It is estimated at this stage that between Colpy and the end of the Cyan route option at its convergence with the Pink / Brown route options, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Acceptability of Excavated Material – Red Route Option

5.7.44 It is estimated at this stage that between east of Huntly and East Bog farm, 75% of excavated materials may be acceptable for reuse as general engineering fill.

5.7.45 It is estimated at this stage that between East Bog farm and Colpy, 50% of excavated materials may be acceptable for reuse as general engineering fill.

5.7.46 It is estimated at this stage that between Colpy and the end of the Red route option at its convergence with the Pink / Brown route options, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Unacceptable Material and Contaminated Land

5.7.47 At this stage, it is anticipated that not all of the material generated from the earthworks cuttings will be acceptable for reuse as general engineering fill. However, it may be feasible to reuse some of these materials elsewhere in other works on site such as in noise or landscaping bunds or through treatment to make a proportion of it acceptable as general engineering fill. Materials that may be unacceptable for reuse as general engineering fill include:

- Natural soils with high moisture content (e.g. peat and alluvium);
- Slate bedrock;
- Weathered bedrock; and
- Infilled ground and man-made soils / materials.

5.7.48 Recorded peat deposits are localised to Rack Moss in the north of the route options. Any peat that is excavated from cuttings or excavated and replaced beneath embankments may require to be disposed of either on or off-site. In its natural state, the peat material would likely be unacceptable for use in soft-landscaping due to its inherently low shear strength, compressible nature and high-water content.

5.7.49 The nature of the alluvium is currently unknown and may comprise a mixture of soft silt and clays, as well as granular deposits of alluvial sand and / or gravel. The nature, extent and engineering properties of alluvium beneath the preferred route option should be determined through means of a ground investigation at DMRB Stage 3. Soft silt and clay within the alluvium is likely to be unacceptable for reuse

as engineering fill and may require to be disposed of on or off-site. In its natural state, soft compressible alluvium may also be unacceptable for reuse in landscaping and bunds, however disposal volumes could be minimised through ground improvement techniques, the feasibility of which should be investigated at DMRB Stage 3.

5.7.50 In general, excavated bedrock is likely to be acceptable for reuse as general engineered fill if suitably crushed and processed to meet the classification requirements of the Specification for Highways Works. However, excavated slate may be difficult to reuse due to the inherently foliated and tabular nature of this material, which may restrict its placement as engineering fill. These properties should be investigated at DMRB Stage 3.

5.7.51 Bedrock that has been affected by deep weathering may also be unacceptable for reuse as engineering fill. Deeply weathered bedrock is likely to contain degraded minerals, potentially resulting in an increased fines content that may make this excavated material unacceptable for use as general engineering fill. The occurrence, extent and properties of weathered bedrock should be determined through means of a ground investigation at DMRB Stage 3.

5.7.52 Whilst most of the excavated glacial till is anticipated to be acceptable for reuse, some of the excavated glacial till may be unacceptable, particularly where the fines content exceeds the grading limits of the Specification for Highways Works. Additionally, large cobbles and boulders can be expected within the glacial till and this may also restrict its acceptability unless these can be removed by screening.

5.7.53 At this stage, it is considered unlikely that significant contaminated land would be encountered within either the Cyan or Red route options. This is due to the predominantly rural nature of this part of the study area and the lack of any major contaminative industrial uses. Potential contamination may be encountered within the recorded small infilled quarries affecting both route options. Contamination may also be associated with historic large-scale quarrying at the Hill of Foudland (Red route option) and with a former distillery at Jericho (Red route option). These historic activities are however not anticipated to present a significant constraint to development. Whilst the nature, extent and properties of these materials is unknown, it is anticipated that they will be generally unacceptable for reuse and may require to be disposed of off-site. Contaminated land and its impact on the scheme is discussed in detail in Volume 2, Part 3, Chapter 19, Geology, Soils, Contaminated Land and Groundwater.

Cut / Fill Balance

5.7.54 For the purpose of the earthworks assessment, it is assumed that any surplus material from the East of Huntly to Colpy sections will be available for use within other geographic sections on the scheme and that surplus material from other route options on the scheme will also be available for use on the Cyan and Red route options.

5.7.55 Table 5.6 summarises the preliminary earthworks volumes for the Cyan and Red route options:

- Bulk fill material required – The bulk earthworks fill volume required for the mainline, local roads, junctions and attenuation basins, including an adjustment for capping materials and topsoil;
- Bulk excavated material – Total volume of excavated material from the mainline, local roads, junctions and attenuation basins, including an adjustment for capping materials and topsoil;

- Acceptable excavated material – The volume of material excavated from each route option which is estimated to be acceptable for reuse within earthworks plus an allowance for treatment of some of the unacceptable material to render it acceptable as general engineering fill;
- Unacceptable excavated material – The volume of material excavated from each route option which is estimated to be unacceptable for reuse as general engineering fill;
- Acceptable Cut / fill balance – The overall balance between the bulk fill requirements and volume of acceptable excavated material on each route option; and
- Total Cut / Fill Balance – The overall balance between the bulk fill requirements and the volume of total excavated material on each route option.

5.7.56 All values have been rounded to the nearest 10,000 m^3.

Table 5.6 Earthworks Volumes (approximate)

Volume	Cyan Route Option	Red Route Option
Bulk Fill Material Required (m^3)	1,660,000	2,040,000
Bulk Excavated Material (m^3)	3,720,000	5,050,000
Acceptable Excavated Material (m^3)	3,170,000	4,120,000
Unacceptable Excavated Material (m^3)	550,000	930,000
Bulk Cut / Fill Balance (m^3)	+2,060,000 surplus	+3,010,000 surplus
Acceptable Cut / Fill Balance (m^3)	+1,510,000 surplus	+2,080,000 surplus

5.7.57 A positive volume for cut / fill balance above indicates the excavation (cut) of acceptable materials exceeds the fill requirements for the route option and that construction of the route option will therefore generate a surplus of potentially acceptable fill materials, which can be used elsewhere on the scheme if required. A negative volume indicates that there is a deficit in the volume of potentially acceptable materials available within the route option and that additional fill materials will therefore be required to be imported or transferred if surplus exists elsewhere on the scheme.

5.7.58 Both the Cyan and Red route options have positive cut / fill quantities largely due to the requirement for large cuttings around the Hill of Foudland and Hill of Skares, which will generate excess fill material. The excess material is envisaged to be reused elsewhere on the scheme.

5.8 Hydrology and Drainage

Introduction

5.8.1 The effects of the options on the water environment are considered in Volume 2, Part 3, Chapter 20, Road Drainage and the Water Environment. This section provides a summary of the engineering issues related to watercourse crossings and road drainage.

5.8.2 A preliminary assessment of hydrology was made for each route option. Following the selection of a Preferred Option, a detailed review of the hydrology, watercourse

crossings and drainage strategy will be undertaken during the DMRB Stage 3 assessment.

5.8.3 Bridge structures are described within Section 5.9. Bridge and culverted crossings of watercourses will be designed and constructed in accordance with the requirements of the Scottish Environmental Protection Agency (SEPA), Scottish Natural Heritage (SNH), Aberdeenshire Council and local stakeholders.

Watercourses

5.8.4 A number of watercourses located within the study area are affected by the route options. These watercourses are described below. All watercourses are labelled in Volume 5, Figures 20.1 to 20.4.

Burn of Slioch

5.8.5 The Burn of Slioch is a small tributary of the Knightland Burn, which in turn feeds the Burn of Cobairdy around 5.6km north-east of Huntly. The burn has a catchment area of around 3km² and flows to the north.

5.8.6 Both the Cyan route option and the Red route option require a local road to be realigned which crosses the Burn of Slioch.

Glen Water / River Urie

5.8.7 The Glen Water / River Urie is a large watercourse with a catchment area of over 300km² at the confluence with the River Don, to the south of Inverurie. In the context of the East of Huntly to Colpy section, the Glen Water becomes the River Urie at the confluence with the Mill Burn, near Hill of Skares. The River Urie has a catchment area of approximately 30km² at Colpy prior to the confluence with the Jordan Burn.

5.8.8 Both the Cyan and Red route options have multiple interactions with the Glen Water / River Urie and their tributaries. The Cyan route option passes closer to the watercourse and therefore has a greater number of direct interactions whereas the Red route option has more interactions with its tributaries. Both route options have a crossing of the Glen Water on a structure, whilst multiple culverts are required to cross the numerous small tributaries in this area. The Cyan route option also requires a 150m realignment of the Glen Water.

Jordan Burn

5.8.9 The Jordan Burn is a tributary to the River Urie with a catchment area of approximately 3km². It is largely fed by runoff from the Hill of Foudland and the Hill of Skares.

5.8.10 The Cyan route option requires the Jordan Burn to be culverted to accommodate the mainline and the realigned C68S Insch to Colpy Road at Colpy Junction. The Red route option and U70S Colpy to Jericho Road realignment requires a 1km diversion of the Jordan Burn, including three separate culverts.

5.8.11 Table 5.7 provides a summary of the watercourses affected by each route option.

Table 5.7 Hydrology and Drainage Summary

Watercourse	Cyan Route Option	Red Route Option
Burn of Slioch	Culvert	Culvert
Glen Water / River Urie	Bridge Realignment (0.15km)	Bridge
Jordan Burn	Culvert (2 no.)	Culvert (3 no.) Realignment (1.0km)
Other Watercourses	Bridge (Tributary of Glen Water) Culvert (10 no.) Extend existing culvert (1 no.) Realignments (2 no. less than 50m in length)	Culvert (16 no.) Realignment (0.4km)
Total No. of Interfaces	**19**	**23**

Drainage

5.8.12 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and sized indicatively to assess feasibility. This information has been used to inform the engineering and environmental assessments for each option. The drainage design will be developed further during DMRB Stage 3.

5.8.13 The drainage design will incorporate Sustainable Drainage Systems (SuDS) to both treat and attenuate the runoff prior to discharge to the water environment. A treatment train approach[2] will be applied in accordance with the latest guidance, incorporating SuDS both at source and at the end of a drainage system. This is likely to include a number of components including: filter drains, swales, basins and ponds.

5.8.14 The Scottish Environmental Protection Agency (SEPA) has stipulated that a minimum of two levels of treatment will be required and this will be suitable for most catchments within the scheme extents. In cases where a catchment is to discharge to a particularly small watercourse, a sensitivity check will be carried out and an additional level of treatment may be required. This will be assessed on a case by case basis at DMRB Stage 3.

5.8.15 At this stage, it has been assumed that drainage from realigned local roads will generally match the existing drainage regime, most of which is expected to flow over the carriageway edge as it does at present. Where significant new sections of local road are identified, the drainage design criterion is expected to meet current standards, with runoff both treated and attenuated prior to discharge to an appropriate watercourse.

[2] Treatment train approach is using drainage techniques in series to change the flow and quality characteristics of the runoff in stages, available at: https://www.susdrain.org/delivering-suds/using-suds/suds-principles/management-train.html

5.8.16 It is considered feasible to drain runoff from both route options to local watercourses with appropriate treatment measures in place and that there are no particular engineering issues or differences between the route options in relation to road drainage.

5.9 Structures

Introduction

5.9.1 Structure locations are shown in Volume 5, Figures 5.1 to 5.6 and are tabulated below for each route option. Further details of major river crossings and other significant structures are described below. Structures that are named are those considered in more detail and are likely to be 150m in length or greater.

Underbridges

5.9.2 The full width of the mainline including carriageway and hard strips shall be continued across the decks of the underbridges. In accordance with DMRB CD 127 (Cross-sections and headrooms, Clause 3.4) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

5.9.3 It is anticipated that underbridges would generally be of concrete construction with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option could also be considered.

Overbridges

5.9.4 It is anticipated that overbridges would generally be of steel-concrete composite construction, with steel girders supporting a concrete bridge deck.

5.9.5 The full width of the carriageway and hard strips (where provided) would be continued across the overbridges. Verges to both the local road and the A96 mainline would be continued over and under the structure in accordance with DMRB CD 127 (Clause 3.4).

Cyan Route Option

Glen Water / Realigned A96 Crossing

5.9.6 A number of constraints have been considered as follows:

- The width of the floodplain has been ascertained from SEPA flood mapping and is approximately 70m at this location;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level; and
- The existing A96 would be realigned to pass below this structure.

5.9.7 At this stage it is considered that the bridge would comprise a multi-span viaduct with an approximate length of 310m. It is anticipated that the bridge would be of composite steel beam and concrete construction. It is not planned to locate any bridge piers within the river channel.

5.9.8 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

5.9.9 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

5.9.10 The underbridges required are as detailed in Table 5.8.

Table 5.8 Cyan Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB – C66S	C66S Insch – Dunnydeer – Wraes Road	14	26
UB – Realigned A96	Realigned existing A96 at Glens of Foudland	23	26
UB – Realigned A96 and Glen Water	Realigned existing A96 and Glen Water plus a tributary	310	40

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

5.9.11 The overbridges required are as detailed in Table 5.9.

Table 5.9 Cyan Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB – Realigned A96	Realigned existing A96 at Glens of Foudland	69	14
OB – C87S	C87S Fordmouth – Stoneyhill – Placemill Road	65	14
OB – Colpy Junction	Realigned existing A96 as part of Colpy Junction	82	14

Retaining Structures

5.9.12 The retaining structures are likely to be required as detailed in Table 5.10.

Table 5.10 Cyan Route Option Retaining Structures

Name	Retained feature	Approximate Length (metres)
RS-1	Realigned A96 above Glen Water and floodplain (Wedderburn)	150
RS-2	Route option mainline above Glen Water and floodplain (Bainshole)	150
RS-3	Route option mainline above Glen Water and floodplain (Skares)	650
RS-4	Route option mainline above River Urie channel and floodplain (Morgan McVeighs)	200

5.9.13 The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on adjacent land and other constraints.

Red Route Option

Glen Water Crossing

5.9.14 A number of constraints have been considered as follows:

- The width of the floodplain has been ascertained from SEPA flood mapping and is approximately 60m at this location;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level; and
- An existing local access track runs adjacent to the river.

5.9.15 At this stage it is considered that the bridge would comprise a multi-span viaduct with an approximate length of 240m. It is anticipated that the bridge would be of composite steel beam and concrete slab construction. It is not planned to locate any bridge piers within the river channel.

5.9.16 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

5.9.17 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

5.9.18 The underbridges required are as detailed in Table 5.11.

Table 5.11 Red Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB – Glen Water	Glen Water and Local Access Track	240	43
UB – U70S	U70S Colpy – Jericho and Bainshole – Bog – Clinkstone Roads	14	45
UB – U70S – Colpy Junction Crossing	U70S Colpy to Jericho Road realignment as part of Colpy Junction	16	57

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

5.9.19 The overbridges required are as detailed in Table 5.12.

Table 5.12 Red Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB – C66S	C66S Insch – Dunnydeer – Wraes Road	50	14
OB – U70S (west)	U70S Colpy – Jericho and Bainshole – Bog – Clinkstone Roads (West)	46	14
OB – U70S (east)	U70S Colpy – Jericho and Bainshole – Bog – Clinkstone Roads (Central)	46	14

Retaining Structures

5.9.20 At this stage it is anticipated that significant retaining structures will not be required. The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on land, ecology and communities.

Ancillary Structures

5.9.21 Both route options would require the provision of a number of ancillary structures such as culverts and may require accommodation underpasses and overbridges.

Culverts

5.9.22 Culverts are anticipated to be required for minor watercourse crossings.

5.9.23 Culvert structures are anticipated to comprise either large diameter pipes, precast concrete boxes or proprietary arch units. Culverts will be subject to further design development during DMRB Stage 3.

5.9.24 Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

5.9.25 The requirement for accommodation structures will be considered during DMRB Stage 3.

Vehicular Containment and Pedestrian Restraint Over Structures

5.9.26 Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB CD 377 (Requirement for road restraint systems) and will be developed during DMRB Stage 3.

5.10 Utilities

Introduction

5.10.1 There are a significant number of buried and overhead public and private utility services between East of Huntly and Colpy including:

- Telecommunications – BT Openreach overhead and underground network and communications masts;

- SGN – high pressure gas pipelines;
- SSE – high voltage and low voltage overhead and underground electricity infrastructure;
- Scottish Water supply network;
- Scottish Water wastewater network; and
- Wind turbines.

5.10.2 Existing public utilities have been identified and key utilities are shown in Volume 5, Figures 2.20 to 2.24.

5.10.3 In accordance with the New Roads and Street Works Act (1991), C2 notices were issued to each of the utility providers to provide details of their networks within the study area. This enabled potential clashes between route options and utility infrastructure to be identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with major utility infrastructure.

5.10.4 Where it has not been possible to avoid a clash with a major utility apparatus, initial consultation has been undertaken with the relevant providers and outline diversion costs have been estimated.

5.10.5 Utilities can also represent an additional constructability challenge where the utility is strategic in nature. Long lead times with seasonal constraints, or utilisation of planned network outages often result. This can add time and expense to the construction programme of a particular route option.

Telecommunications

5.10.6 Telecommunications infrastructure owned and operated by British Telecom (BT) Openreach is present throughout most of the area between East of Huntly and Colpy. The key elements of the network are identified below.

BT Openreach Underground Network

5.10.7 This utility is located throughout this area. Underground ducts and cables run adjacent to the existing A96 and some local roads.

BT Openreach Overhead Network

5.10.8 This utility is located throughout this area. Overhead cables run adjacent to local roads and provide connections to properties.

Communication Masts

5.10.9 Communication masts are located within the area between East of Huntly and Colpy. These assets are owned and operated by a number of different organisations.

Interfaces

5.10.10 Table 5.13 summarises the number of interfaces with the telecommunications network for each route option.

Table 5.13 Interfaces with Telecommunications Apparatus

Route Option	BT Underground	BT Overhead	Communication Masts	Total Interfaces
Cyan	15	3	0	**18**
Red	9	4	0	**13**

5.10.11 The Cyan route option has a higher number of interfaces with the BT Openreach network when compared with the Red route option. It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

5.10.12 Both route options do not impact existing communication masts in this area.

Gas

5.10.13 SGN high pressure gas infrastructure is present between East of Huntly and Colpy. The key elements of this network are outlined below.

High Pressure Pipeline

5.10.14 A 273mm high pressure gas pipeline is present in this area. It runs to the south of the existing A96 before crossing at West Adamson. From there, it runs to the north of the existing A96 before crossing again at Wedderburn. It then runs between the Hill of Skares and Hill of Foudland where it is joined by a 300mm high pressure gas pipeline. The two pipelines then run to the west of Colpy. The pipelines are strategic infrastructure.

Interfaces

5.10.15 The Cyan route option has two crossings of SGN high pressure pipelines and the Red route option has three crossings in total.

5.10.16 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Electricity

5.10.17 SSE electricity transmission and supply infrastructure is present between East of Huntly and Colpy. The key elements of the network are identified below.

275kV Overhead Lines

5.10.18 SSE 275kV overhead lines with pylons at approximately 400m centres run from north-west to south-east between East of Huntly and Colpy. They run to the south of the existing A96 before crossing to the north of Colpy. 275kV transmission lines are nationally strategic infrastructure.

33kV Overhead Lines

5.10.19 This utility is present between East of Huntly and Colpy. A single line enters from the west and runs in a south-easterly direction before crossing the existing A96 at two points and turning south between Hill of Skares and Hill of Foudland. It is joined by several additional 33kV lines at various locations throughout this area.

33kV Underground Cables

5.10.20 There is a limited amount of 33kV underground electricity infrastructure present within this area. A cable serves the Dummuies windfarm in the west and cables serve the Glens of Foudland windfarm before connecting to the 33kV overhead network. A number of shorter sections of underground cable are present adjacent to the Hill of Skares.

11kV Overhead Lines

5.10.21 This utility is present throughout this area.

11kV Underground Cables

5.10.22 There is a limited amount of this utility present within this area.

Low Voltage Overhead Lines & Underground Cables

5.10.23 These utilities are present throughout the area between East of Huntly and Colpy and generally link individual properties to the high voltage network.

Interfaces

5.10.24 Table 5.14 summarises the number of interfaces with SSE Assets for each option.

Table 5.14 Interfaces with SSE apparatus

Route Option	275kV Line	33kV Line	33kV Cable	11kV Line	11kV Cable	Low Voltage	Total Interfaces
Cyan	1	2	2	15	0	3	**23**
Red	3	5	4	12	0	3	**27**

5.10.25 The Red route option has a higher number of interfaces with the SSE network when compared with the Cyan route option.

5.10.26 The Red route option interfaces with 275kV transmission at three points in comparison with one interface for the Cyan route option. The Red route option has a more extensive impact on the 33kV network.

5.10.27 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Water and Wastewater

5.10.28 Scottish Water infrastructure is present between East of Huntly and Colpy. The key elements of the network are identified below.

Water Network

5.10.29 The Scottish Water freshwater supply network is present along the existing A96 and adjacent local roads at the western end of this area. This utility is also present in the Colpy area. A limited length of raw water main is also present within this area.

Wastewater Network

5.10.30 A limited length of gravity sewer is present between East of Huntly and Colpy. This is located in the Colpy area.

Interfaces

5.10.31 Table 5.15 summarises the number of interfaces with water assets for each option.

Table 5.15 Scottish Water Interfaces

Route Option	Water Mains	Raw Water Mains	Gravity Sewer Network	Total Interfaces
Cyan	4	0	0	**4**
Red	6	0	0	**6**

5.10.32 The Cyan route option has fewer interfaces with water mains than the Red route option. Both route options have no interfaces with raw water mains.

5.10.33 Neither route option has interfaces with the gravity sewer network.

5.10.34 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Wind Turbines

5.10.35 Two windfarms are located within the study area. Dummuies wind farm is a seven turbine wind farm to the south of the existing A96. Glens of Foudland wind farm is a 20 turbine wind farm to the north of the existing A96. Kirkton Wind Farm (three turbines) is situated on the south side of the Hill of Tillymorgan. Several private wind turbines are also located in this area.

Interfaces

5.10.36 There are no interfaces between the Red or Cyan route options with wind turbines.

5.11 Non-Motorised Users (NMUs)

5.11.1 The term Non-Motorised Users (NMUs) is used to describe pedestrians, cyclists and equestrians.

5.11.2 Existing NMU routes within the study area are described in Volume 1, Part 1, The Scheme (Chapter 2, Existing Conditions) and in Volume 5, Figures 2.17 to 2.19. The effects of the route options on all travellers, including NMUs, are considered in Volume 2, Part 3, Environmental Assessment (Chapter 12, People and Communities) where the impacts of the route options are assessed.

5.11.3 One of the scheme objectives is to facilitate active travel in the A96 corridor. There are opportunities to enhance NMU facilities associated with each route option and these have been assessed at a high level during this DMRB Stage 2 assessment.

5.11.4 These opportunities are where there is the potential to improve NMU connectivity along the route option and maintain connectivity across existing NMU routes within the study area which, in turn, enables better NMU connections between communities.

East of Huntly to Colpy

5.11.5 Along this geographical section, there is an NMU route to the west of the existing A96 near Huntly but this is not interfaced by the route options. There are no settlements other than individual properties in a rural setting.

5.11.6 The Cyan route option offers slightly better opportunities for NMU connectivity over the Red route option given its proximity to the existing A96 and local road network.

5.11.7 NMU facilities will be considered further during design development of the Preferred Option during DMRB Stage 3.

5.12 Health and Safety Considerations

5.12.1 Key health and safety risks and challenges during construction, use, maintenance and demolition are reported here to inform the assessment and future design development. Important health and safety considerations which informed the development of the option development are also noted. In relation to utilities, the most onerous interfaces are discussed below.

5.12.2 The design will be subject to further consideration of issues relating to construction, use, maintenance and demolition throughout its development. Further consideration of construction phasing and maintaining existing access arrangements during the construction period will be undertaken during DMRB Stage 3. A constructability audit will also be undertaken. It should be noted however that the detail of the phasing and traffic management adopted during construction will be the responsibility of the appointed contractor to determine.

Construction Phasing and Constructability

5.12.3 Both the Cyan and Red route options include online construction to tie-in to the existing A96 to the East of Huntly. Thereafter, the route options are primarily offline construction although the Cyan route option requires four more realignments of the existing A96 than the Red route option.

5.12.4 For both route options, the tie-in would require phased construction and traffic management to minimise disruption to existing trunk road users and allow safe construction. Both route options propose an offline diversion of the existing A96 at the western extent. This minimises the potential disruption to road users.

5.12.5 There are locations where the route options cross existing routes, including the existing A96. At these locations, it may be necessary to utilise temporary diversions to facilitate construction works and minimise disruption to road users. This may include temporary road provision adjacent to works to allow construction of bridges over or under the existing routes.

Cyan Route Option

5.12.6 There are a number of elements which pose particular health and safety and constructability challenges for the Cyan route option, namely:

- Interface with SGN high pressure gas main at West Adamston;
- Interface with SGN high pressure gas main at Wedderburn;
- Construction of the Glen Water bridge structure;
- Construction of retaining structures between the Cyan route option and the Glen Water / River Urie at the Hill of Skares;

- Interfaces with the existing A96, particularly around the Hill of Skares; and
- Interface with SSE 275kV overhead electricity transmission lines at Colpy.

5.12.7 The Cyan route option crosses the existing A96 at four locations. At these interfaces, the existing A96 would require to be permanently realigned. These realignments would be constructed offline from the existing A96 although phased construction and traffic management would be required at the realignment tie-in locations.

5.12.8 There are two online sections of the existing A96 on which the Cyan route option sits, one of which being at the western tie-in. The other online section is to the north and east of the Hill of Skares.

5.12.9 The western tie-in can be constructed by building the realignment of the existing A96 to the north of the route option first. This will enable traffic to be diverted therefore enabling construction of the Cyan route option between Leys of Dummuies and West Adamston / Ordiesnaught.

5.12.10 The section at Hill of Skares is constrained by the presence of the Glen Water and the C87S Fordmouth to Placemill Road overbridge. Construction of the new eastbound carriageway adjacent to the Glen Water would enable A96 traffic to be diverted and moved away from the existing A96, thereby providing construction space for the westbound carriageway and the realignment of the existing A96.

Red Route Option

5.12.11 There are a number of elements which pose particular health and safety and constructability challenges for the Red route option, namely:

- Interface with SGN high pressure gas main at West Adamston;
- Interface with SSE 275kV overhead electricity transmission lines at Greenmyres;
- Construction of the Glen Water bridge structure;
- Interface with SSE 275kV overhead electricity transmission lines at Overton;
- Interface with SSE 275kV overhead electricity transmission lines at Hill of Foudland;
- Construction of the cutting between Hill of Foudland and Hill of Skares;
- Interface with SGN high pressure gas main between Hill of Foudland and Hill of Skares;
- Interface with electricity transmission apparatus between Hill of Foudland and Hill of Skares; and
- Realignment of the Jordan Burn.

5.12.12 As with the Cyan route option, the Red route option interfaces with the existing A96 at the western tie-in and the existing road requires permanent realignment. The western tie-in can be constructed by building the realignment of the existing A96 to the north of the route option first. This will enable traffic to be diverted therefore enabling construction of the Red route option between Leys of Dummuies and West Adamston / Ordiesnaught.

5.12.13 The remainder of the route option can be constructed offline.

5.13 Scheme Resilience

Winter Resilience

5.13.1 Upon completion of the scheme, the dual carriageway cross section will enable snow ploughing to be more easily facilitated, through the additional running lane and by ensuring there is adequate space in the verge for ploughed snow. Segregated carriageways also reduce the risk of head on collisions in adverse weather. Efficient drainage of surface water runoff from the road and adjacent areas will prevent flooding of the carriageway and assist in minimising ice formation.

5.13.2 The existing A96 east of Huntly through the Glens of Foudland is noted to be at risk from drifting snow due to a lack of shelter and high altitude[3]. This section of road is also subject to higher average wind speeds than the existing A96 east of Colpy.

5.13.3 Transport Scotland has implemented mitigation measures for the existing A96 such as roadside weather forecast sites, virtual snow gates and a location specific Winter Service Plan[4] to help address snow risk. A section of the existing A96 at the Glens of Foudland is identified in this plan as an Area Requiring Special Attention.

5.13.4 Data regarding typical wind speeds for the East of Huntly to Colpy section of the existing A96 has been reviewed. Typical wind speeds are consistent with some coastal and exposed routes and are higher than those recorded for Colpy to Pitcaple and Pitcaple to Kintore geographical sections[5]. The Cyan route option will likely be subject to the same wind conditions as the existing A96. The Red route option, due to generally higher elevation than the Cyan route option and existing A96, has the potential to be affected by more onerous wind conditions and snow drifts as a result.

5.13.5 Both the Cyan and Red route options comprise high and exposed sections of road given the topography between Huntly and Colpy. The Cyan route option follows the general line of the existing A96, whereas the Red route option generally tracks the contours further up the Hill of Foudland, although still within its lower reaches. The Red route option then climbs to pass between the Hill of Foudland and the Hill of Skares before descending towards the existing A96 corridor near Colpy.

5.13.6 The existing A96 between Skares and Bainshole is noted to be at risk of excess surface water runoff. Both the Cyan and Red route options will require drainage to be implemented to intercept runoff from adjacent areas.

5.13.7 The winter resilience of the scheme will be considered in further detail during DMRB Stage 3.

Operational Resilience

5.13.8 A new high quality dual carriageway is less likely to be subject to an incident which blocks one or both carriageways in comparison to the existing A96. Higher geometrical standards, segregation of oncoming traffic, safe overtaking opportunities and grade separated junctions are key factors which will reduce the

[3] A96 Dualling Scheme Resilience Strategy, May 2015, Revision 3, Jacobs.
[4] A Winter Service Plan is prepared by the 4th Generation Term Contract for the management and maintenance of the Scottish Trunk Road Network North East Unit for Transport Scotland.
[5] Refer to High Wind Strategy and National Wind Management Guidelines, Transport Scotland, 2009.

likelihood and severity of accidents on the new dual carriageway. Enhanced Intelligent Transport Systems (ITS) provision also has potential to improve operational resilience and assist the management of incidents.

5.13.9 Both the Cyan and Red route options retain the existing A96 between East of Huntly and Colpy. This can act as an emergency diversion route for both route options.

5.13.10 The existing A96 Scheme Resilience Strategy[6] states that purpose built emergency access links to the local road networks are not anticipated at this time. However, due to distance between junctions on this section of the scheme, this will be reviewed at DMRB Stage 3.

5.13.11 Other operational resilience features which will be considered during DMRB Stage 3 design development are emergency crossovers, emergency turnaround areas (ETAs) and other maintenance access requirements.

Climate Change Resilience

5.13.12 Climate change resilience considers the predicted ability of the new A96 to manage and mitigate the consequences of climate change influenced extreme weather events upon road users. This includes both the immediate weather events and consequential incidents such as landslips and flooding. Consideration of climate change resilience and adaptation mitigation is outlined in Volume 2, Part 3, Chapter 21, Climate.

5.14 Engineering Assessment Summary

5.14.1 A summary is provided below for each engineering issue, which identifies if any route option is considered more or less favourable.

Mainline Alignment

5.14.2 The Cyan route option has been designed without Departures from Standards however does include a one-step relaxation to its horizontal geometry. The Red route option has been designed without Departures from Standards or relaxations at this stage. Both route options are compliant with standards for a D2APc (formerly Category 7A) dual carriageway.

Junction Layouts

5.14.3 All junctions have been designed to meet DMRB standards without Departures from Standards or relaxations at this stage.

Local Roads and Accesses

5.14.4 Effects on local roads and accesses are summarised in Table 5.16.

[6] A96 Dualling Preliminary Engineering Services, Scheme Resilience Strategy, May 2015 – Rev 3, Transport Scotland.

Table 5.16 Local Road and Access Treatment Summary

Local road or access treatment	Cyan Route Option	Red Route Option
B – Bridge to be provided over or under A96 allowing continuation of local road. Includes realignment of existing road to connect to bridge.	5	5
J – Road to be diverted / connected to the new A96 grade separated junction.	1	1
R - Realignment or amendment of a public road or existing access to a private property.	20	12
Total No. of local roads and accesses affected	**26**	**18**

5.14.5 Local roads and accesses would retain connectivity with the existing A96 and other local roads. The effects are similar for both route options.

Topography and Land Use

5.14.6 The existing topography would be changed by both the Cyan and Red route options.

5.14.7 The Red route option deviates further from the existing A96 corridor and existing ground levels and requires more extensive earthworks affecting the topography.

5.14.8 Further information on land use and landscape is provide in Volume 2, Part 3, Chapter 13, Agriculture, Forestry and Sporting Interests and Chapter 17, Landscape.

5.14.9 The Cyan route option is considered to be more favourable as topography changes are less extensive than those for the Red route option.

Geotechnics and Earthworks

5.14.10 There are short lengths of the route options potentially affected by ground conditions that are considered to be more challenging (based on mapped surface geology only) are given in Table 5.5.

5.14.11 Both route options generate a large surplus of acceptable material for use in earthworks on adjoining route options. The requirement for very large cuttings through slate strata for the Red route option presents a significant engineering challenge.

5.14.12 In relation to geotechnics and earthworks, the Cyan route option is considered to be more favourable.

Hydrology and Drainage

5.14.13 A preliminary assessment of hydrology was made for each route option and both designs were developed to avoid flooding impacts.

5.14.14 Both options require a bridge over the Glen Water / River Urie. The Red route option requires more culverts than the Cyan route option.

5.14.15 The Cyan route option requires three watercourse realignments compared to two watercourse realignments on the Red route option. The Cyan route option requires a short diversion of the Glen Water / River Urie, whereas the Red route option

requires a more extensive diversion of the Jordan Burn. Although the Red route option has greater interfaces overall with watercourses and longer diversions, these are generally further upstream given its more elevated nature compared to the Cyan route option mitigating differences between the options.

5.14.16 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and indicatively sized to assess feasibility and no engineering issues have been identified for either route option.

5.14.17 Overall, the Cyan and Red route options perform similarly in terms of hydrology and drainage.

Structures

5.14.18 Table 5.17 provides a summary of the structures required for each route option.

Table 5.17 Structures Summary

Type of Structure	Cyan Route Option	Red Route Option
Major Bridges	1	1
Railway Bridges	0	0
Underbridges (total)*	3	3
Overbridges (total)*	3	3
Retaining Structures	4	0
Total	**10**	**6**

* Total includes major bridges and railway bridges

5.14.19 Both options have similar overall bridge requirements, however, the Cyan route option is marginally less favourable as it requires a more complex river crossing of Glen Water as well as various retaining structures.

Utilities

5.14.20 The comparative interfaces of the options are summarised in Table 5.18.

Table 5.18 Utilities Summary

Utility	Cyan Route Option	Red Route Option
Telecommunications	18	13
Gas	2	3
Electricity	23	27
Water and Wastewater	4	6
Total	**47**	**49**

5.14.21 The utilities that pose the most significant constraint between East of Huntly and Colpy are the SGN high pressure gas mains and SSE 275kV overhead transmission lines.

5.14.22 The SGN high pressure gas pipeline is strategic infrastructure. The Cyan route option crosses the pipeline twice and the Red route option crosses the pipeline three times.

5.14.23 SSE 275kV electricity transmission lines are also strategic infrastructure. The Cyan route option crosses once and the Red route option crosses three times.

5.14.24 Both options interface with the SGN high pressure gas network and SSE 275kV overhead electrical lines but the Red route option has a higher number of interfaces with each.

5.14.25 The Cyan route option is more favourable due to a lower number of interfaces with major utility infrastructure than the Red route option. The major utility interfaces on the Red route option are also likely to be more complex than those on the Cyan route option.

Non-Motorised Users

5.14.26 There are no significant engineering issues associated with provision for NMUs. There are currently limited existing NMU facilities within the area. NMU facilities associated with the scheme will be designed and developed during DMRB Stage 3. The Cyan route option offers slightly better opportunities for NMU connectivity over the Red route option given its proximity to the existing A96 and local road network.

Health and Safety Considerations

5.14.27 There are a number of elements which pose particular health and safety and constructability challenges. The Cyan route option presents six such challenges whereas the Red route option presents nine. Giving consideration to both the number and complexity of these issues, the Cyan route option is considered to be more favourable.

Scheme Resilience

5.14.28 Both route options are expected to provide high levels of operational resilience. In both cases, the existing A96 provides a diversionary route from East of Huntly to Colpy. With regards to winter issues, the Red route option generally tracks the contours further up the Hill of Foudland. The Red route option may have greater exposure to higher wind speeds due to elevation. Both route options would be designed to mitigate against the effects of climate change.

5.14.29 In overall terms, the Cyan route option is considered to be more favourable from a resilience perspective due to its proximity to the existing A96 and the likelihood of winter weather having more effect on the Red route option.

6 Engineering Assessment: Colpy to Pitcaple

6.1 Introduction

6.1.1 This chapter describes the findings of the engineering assessment of the Pink and Brown route options between Colpy and Pitcaple. It includes a description of the engineering features of each route option under the following subjects:

- Engineering constraints;
- Engineering description of the route option mainline alignments, junctions, local roads and accesses;
- Departures from standard;
- Topography and land use;
- Geotechnical engineering and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users;
- Health and Safety Considerations; and
- Resilience.

6.1.2 The Pink and Brown route options are shown in Volume 5, Figures 6.1 to 6.4.

6.2 Engineering Constraints

6.2.1 The route options have been designed to take into consideration the following constraints:

- The topography of the area, which is generally undulating, rounded hills and farmland;
- The existing A96 which is discussed in Volume 1, Part 1, Chapter 2, Existing Conditions;
- The existing local road network;
- The Aberdeen to Inverness Railway Line, which runs west to east through the study area, to the south of and parallel to the existing A96 from Mill of Carden to Pitcaple;
- Settlements including Colpy, Kirkton of Culsalmond, Insch, Old Rayne, Pitmachie, Oyne, Durno, Whiteford and Pitcaple and scattered residential properties;
- Commercial and agricultural properties and holdings within the study area;
- Public amenities such as local schools at Old Rayne and Logie Durno;
- Designated Local Development Plan sites;

- Existing structures including road bridges and accommodation underpasses, retaining walls and drainage culverts;
- Geological constraints including areas of made ground consisting of unknown material and potentially contaminated ground;
- The Kellock and its associated floodplain, which flows south-east through Kellockbank, before discharging into the River Urie;
- The Shevock Burn and its associated floodplain, which flows east, located north-west of Pitmachie, before discharging into the River Urie;
- The River Urie and its associated floodplain, which flows south-east largely following the existing A96 route and along the eastern edge of Inverurie, before discharging into the River Don;
- The Bonnyton Burn and its associated floodplain, which flows south-west along the northern edge of Old Rayne, before discharging into the River Urie;
- The Burn of Durno and its associated floodplain, which flows south-east to the north-east of Whiteford, before discharging into the River Urie; and
- Public and private utility infrastructure;

6.2.2 The design process was also guided by the environmental constraints as described in Volume 1, Part 1, Chapter 3, Development of Route Options and Volume 1, Part 2, Chapter 4, Engineering Overview. These environmental constraints are discussed within Volume 2, Part 3, Environmental Assessment.

6.3 Engineering Description – Pink Route Option

Mainline Alignment

6.3.1 The Pink route option is shown in Volume 5, Figures 6.1 and 6.2. This route option is approximately 10.0km in length.

6.3.2 From west to east, the route option is a continuation from either the Cyan or Red route options and commences south of Colpy and to the north-west of Old Inn Farmhouse close to Fallow Hill. The surrounding topography is around 150m AOD and the route option is in cutting. From here, it runs south-eastwards on a left-hand curve and downhill gradient following the falling topography.

6.3.3 An overbridge serving Loch Insch Fishery crosses the route option south-west of Old Inn Farmhouse. The route option continues on a left-hand curve turning eastwards and rising on shallow embankment to bridge over the existing A96 and River Urie on separate structures.

6.3.4 Kellockbank Junction is proposed at the interface of the existing A96 and the Pink route option. East facing slip roads connect with the existing A96. There are no west facing slip roads required for this junction.

6.3.5 The route option enters cutting on an uphill gradient as the surrounding ground rises from around 115m AOD at the River Urie to around 145m AOD north of Brankanentum. The route option is crossed by the C64S Brankanentum to Fisherford Road overbridge near the start of the cutting.

6.3.6 The route option then runs to the north of the B992 Lawrence Road before turning south-eastwards on a right-hand curve on embankment, under which the B992 passes.

6.3.7 The embankment continues until a point south-east of Little Newton where it switches from embankment into cutting. Local topography falls from around 145m AOD at Brankanentum to around 120m AOD north of Little Newton.

6.3.8 The surrounding ground rises locally to around 130m AOD, whilst the route option continues on a downhill gradient into cutting which allows the C59S Old Rayne to North Rayne Road (Lawrence Road at New Rayne) to cross the route option on an overbridge.

6.3.9 The route option continues the downhill gradient towards the Bonnyton Burn. The route option crosses the Bonnyton Burn as it transitions from a downhill to an uphill gradient to match the topography which rises from the burn.

6.3.10 Continuing on an uphill gradient the route option turns on a left-hand curve through steepening topography which rises locally to around 140m AOD. Within the cutting, the route option is crossed by the C60S Old Rayne to Auchintarph Road overbridge, east of Old Rayne.

6.3.11 The route option continues south-eastwards, following the surrounding topography in low height cuttings and on low embankments, which undulate between 140m AOD and around 115m AOD. It crosses over the Lewesk access road and under 275kV high voltage overhead power lines.

6.3.12 After passing to the south of The Law hill, the route option turns eastwards on a left-hand curve on a downhill gradient in cutting through woodland and passes under 275kV high voltage overhead power lines, north of Ferniebrae.

6.3.13 Continuing eastwards on a downhill gradient, the route option moves out of cutting and onto embankment as the local topography falls steeply towards the Burn of Durno. The route option crosses over the realigned C83C Durno Road and Burn of Durno on separate underbridge structures, between Durno to the north and Whiteford to the south.

6.3.14 From a low point in the local topography around 75m AOD at the Bridge of Durno, the Pink route option continues eastwards on an uphill gradient into steepening ground, moving into cutting where it connects to either the Violet or Orange route options.

Junction Locations

6.3.15 There is one junction proposed on the Pink route option. The Pink route option does not interface with any A Class roads other than the existing A96, which remains as an important distributor route for local traffic.

6.3.16 A grade separated junction with east facing slip roads only, named Kellockbank Junction, would be provided at the interface with the existing A96 near to Mains of Williamston approximately 2km south of Colpy. Kellockbank Junction is approximately 800m north of the B992 which would serve for traffic to / from Insch.

6.3.17 This junction would operate in conjunction with the west facing slip roads at Colpy (on either the Red or Cyan route options) via a 2.3km length of the existing A96. Traffic to / from eastern destinations would use the Kellockbank Junction and traffic to / from western destinations would utilise the existing A96 and the junction at Colpy.

Junction Layouts

Kellockbank Junction

6.3.18 Kellockbank Junction on the Pink route option would be located approximately 800m north of the junction of the B992 and existing A96 near to Mains of Williamston.

6.3.19 The junction would be grade separated, with east facing slip roads only which connect to the existing A96 by priority junctions either side of the proposed junction underbridge.

Local Roads and Accesses

6.3.20 Table 6.1 describes the treatment required for existing local roads affected by the Pink route option. Accesses that are not affected are not listed in the table.

Table 6.1 Local Roads and Accesses - Pink Route Option

Local Road / Access	Name	Treatment
Local access	Loch Insch Fishery Access	B
Local access	Old Inn Farm, Old Inn Cottage, Old Inn Steading and Old Inn Barn access	R
Local access	Mains of Williamston	R
Existing A96	Inverness to Aberdeen	J
C64S	Brankanentum – Culsalmond – Fisherford Road	B
B992	Whitehouse – Keig – Auchleven – Insch – Mill of Newton – Culsalmond – Fisherford – Auchterless Road	B
C59S	Old Rayne – Lathries – North Rayne Road (Lawrence Road)	R
Local access	Little Newton Access	R
C59S	Old Rayne – Lathries – North Rayne Road (Lawrence Road)	B
Local access	Westerton of New Rayne	R
Local access	Westerton of Old Rayne (also known as East Neuk of New Rayne)	R
Local access	Mill of Bonnyton Access	R
C60S	Old Rayne – Auchintarph Road	B
Local access	Newton of Lewesk Access	B
C83C	Durno Road	B
Local access	Stonefield Cottage / Cairnton / North Woodend Access	R
Local access	Hawthorn House / Woodend Cottage	R
Local access	Gatehouse / Eringahr / Burnside of Pitcaple	R

Key to table:	
B	Bridge to be provided over or under A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge.
J	Road to be diverted / connected to a new A96 grade separated junction.
R	Realignment or amendment of a public road or existing access to a private property.

6.3.21 Each of the above local roads and accesses are described below.

Loch Insch Fishery Access

6.3.22 This is an access road directly off the existing A96 into Old Inn Farmhouse and Loch Insch Fishery.

6.3.23 This access would be realigned and an overbridge would be provided to cross the Pink route option to maintain access.

Old Inn Access

6.3.24 Access to Old Inn Farm, Old Inn Cottage, Old Inn Steading and Old Inn Barn is taken from the Loch Insch Fishery access road.

6.3.25 A new access onto the realigned Loch Insch Fishery access road would be provided to maintain access.

Mains of Williamston

6.3.26 Mains of Williamston access is directly off the existing A96. This access would be realigned to accommodate slip roads for Kellockbank Junction.

Existing A96

6.3.27 The Pink route option crosses the existing A96 on an underbridge to maintain connectivity along the existing A96 for local access. A grade separated junction is provided at this location with east facing slip roads only.

C64S Brankanentum - Culsalmond - Fisherford Road

6.3.28 This route connects Kellockbank and Kirkton of Culsalmond, running in a northerly direction.

6.3.29 An overbridge would be provided to cross the Pink route option to maintain access.

B992 Whitehouse - Keig - Auchleven - Insch - Mill of Newton - Culsalmond – Fisherford - Auchterless Road

6.3.30 This route connects Kellockbank to Cairnhill on the A920. It runs due east from Kellockbank and then north towards Cairnhill.

6.3.31 The Pink route option would cross the B992 on an underbridge to maintain access.

C59S Old Rayne - Lathries - North Rayne Road (Lawrence Road)

6.3.32 This route connects the north of Old Rayne to the B992 at the point where the B992 heads north to Cairnhill.

6.3.33 The C59S Lawrence Road would be realigned into a priority junction with the B992 north of the route option.

Little Newton Access

6.3.34 This is an access to Little Newton from the C59S.

6.3.35 A new access onto a retained section of the existing C59S would be provided to maintain access.

C59S Old Rayne - Lathries - North Rayne Road (Lawrence Road at New Rayne)

6.3.36 This route runs in a northerly direction connecting Old Rayne and New Rayne.

6.3.37 The C59S would be realigned with an overbridge provided to cross the Pink route option to maintain access.

Westerton of New Rayne

6.3.38 This is an access to the Westerton of New Rayne property.

6.3.39 The existing access would be extended to meet the realignment of the C59S (Lawrence Road).

Westerton of Old Rayne (also known as East Neuk of New Rayne)

6.3.40 This is the location of a newly built residential property at the time of writing this report.

6.3.41 The existing access would be shortened to meet the realignment of the C59S (Lawrence Road).

Mill of Bonnyton Access

6.3.42 This is an access to Mill of Bonnyton from C59S.

6.3.43 A new access onto the realigned C59S would be provided to maintain access.

C60S Old Rayne - Auchintarph Road

6.3.44 This route connects Old Rayne to the C83C north of Durno. It runs in an easterly direction from Old Rayne to the C83C east of Auchintarph.

6.3.45 The C60S would be realigned with an overbridge provided to cross the Pink route option to maintain access.

Newton of Lewesk Access

6.3.46 This is an access to Newton of Lewesk from the C60S.

6.3.47 An underbridge would be provided to cross the Pink route option to maintain access.

C83C Durno Road

6.3.48 This route runs in a northerly direction from the existing A96 connecting to Whiteford and Durno.

6.3.49 The C83C would be realigned with an underbridge provided to cross the Pink route option to maintain access.

Stonefield Cottage / North Woodend / Cairnton Access

6.3.50 This is an access to Stonefield Cottage, North Woodend and Cairnton from the C83C.

6.3.51 A new access onto the realigned C83C would be provided to maintain access.

Hawthorn House / Woodend Cottage Access

6.3.52 This is an access to Hawthorn House and Woodend Cottage from the C83C.

6.3.53 A new access onto the realigned C83C would be provided to maintain access.

Gatehouse / Eringahr / Burnside of Pitcaple

6.3.54 This is an access to Gatehouse, Eringahr and Burnside of Pitcaple from the C83C.

6.3.55 A new access onto the realigned C83C would be provided to maintain access.

6.4 Engineering Description – Brown Route Option

Mainline Alignment

6.4.1 The Brown route option is shown in Volume 5, Figures 6.3 and 6.4. This route option is approximately 11.0km in length.

6.4.2 From west to east, the route option is a continuation from either the Cyan or Red route options and commences south of Colpy and to the north-west of Old Inn Farmhouse close to Fallow Hill. The surrounding topography is at around 150m AOD with the route option in cutting. From here, it runs south-eastwards on a downhill gradient to follow the falling topography.

6.4.3 There would be an overbridge serving Loch Insch Fishery approximately 400m from the start of the route option and to the south-west of the Old Inn Farmhouse. From a point between Mill Croft and Loch Insch Fishery, the route option turns southwards on a right-hand curve.

6.4.4 The Brown route option crosses The Kellock watercourse on an underbridge to the west of the Kellockbank Country Emporium. Kellockbank Junction is proposed where the route option crosses the B992 on an underbridge. East facing slip roads only connect the B992 to the new dual carriageway.

6.4.5 From a low point at the Kellock, the Brown route option changes to an uphill gradient while turning eastwards on a left-hand curve. Continuing eastwards, south of Little Lediken and north of North Lediken Croft, the route option then follows a downhill gradient from embankment into shallow cutting. The Brown route option continues towards the existing A96 before turning in a south-easterly direction on a right-hand curve.

6.4.6 Running parallel with the existing A96, through an area of woodland adjacent to the existing A96, the access overbridge for East Lediken crosses the route option which continues on a right-hand curve in cutting. On approach to Pitmachie, the route option continues in a south-easterly direction moving closer to the existing A96.

6.4.7 The surrounding topography falls towards the Shevock Burn, bringing the route option out of cutting to cross the Shevock Burn. The Shevock Burn underbridge carries the route option over the watercourse, a short distance upstream of the existing bridge carrying the existing A96 over the Shevock Burn.

6.4.8 Continuing on a downhill gradient, the local topography rises bringing the route option to existing grade. The existing topography then falls again, resulting in the route option being on embankment and bridging over the U61S Pitmachie to Daies Road. South of Pitmachie, the route option turns to the east on a left-hand curve running parallel to the existing A96.

6.4.9 Passing Mill of Pitmedden, the route option continues eastwards on approach to Carden Junction which would be a grade separated junction. Rising onto a shallow embankment, the Carden Junction underbridge carries the route option over the realigned existing A96 through the Carden Junction and through a strip of woodland on embankment.

6.4.10 The realigned existing A96 heads southwards to rejoin the existing A96 at Carden Farm. The route option continues on embankment to the north of Carden Farm along the hillside of the Moor of Carden.

6.4.11 South of North Lodge, the local topography falls from 95m AOD to 80m AOD forming the River Urie basin. The route option bridges over the River Urie, turning east on a left-hand curve in cutting through Logie Woodlands. The route option continues on an uphill gradient through steepening topography, north of the Old Parish Church at Logie. The U128S local road is realigned beneath the River Urie underbridge to maintain existing access.

6.4.12 Continuing eastwards, the Brown route option passes under SSE 275kV high voltage overhead power lines at existing grade before turning on a left-hand curve on embankment as the topography falls near Logie Durno Farm.

6.4.13 The route option bridges over the realigned U84C Logie Durno Road and continues east in cutting, into a downhill gradient as the local topography starts to fall towards the Burn of Durno.

6.4.14 The route option continues straight, east on a downhill gradient in a cutting passing under 275kV high voltage overhead power lines. The topography falls away sharply from 95m AOD to 80m AOD bringing the route option onto shallow embankment, bridging over the C83C Durno Road, midway between Durno and Whiteford.

6.4.15 The route option then bridges over the Burn of Durno and changes to an uphill gradient turning eastwards on a right-hand curve, in cutting, as the surrounding topography rises sharply from the low point at the Burn of Durno.

6.4.16 The Brown route option continues eastwards, connecting to either the Violet or Orange route options.

Junction Locations

6.4.17 There are two junctions proposed on the Brown route option. The Brown route option does not interface with any A Class roads other than the existing A96, which remains as an important distributor route for local traffic. The Brown route option interfaces with the B992 at Kellockbank, near to the existing A96 and also interfaces with the existing A96 north-east of Carden Farm. Grade separated junctions are proposed at each location.

6.4.18 East facing slip roads only are proposed at Kellockbank Junction serving Insch via the B992. Access to and from the west would be provided in conjunction with Colpy Junction (Cyan and Red route options) via a 3.2km length of the existing A96.

6.4.19 Carden Junction would provide access to and from the new A96 dual carriageway for west and eastbound traffic on the Brown route option. It serves communities between Oyne Fork and Insch and provides access to the west from Chapel of Garioch, Whiteford and Pitcaple areas.

Junction Layouts

Kellockbank Junction

6.4.20 Kellockbank Junction for the Brown route option would be located on the B992 west of Kellockbank Country Emporium which is approximately 500m west of the junction of the B992 and existing A96.

6.4.21 The junction would be a grade separated, half diamond arrangement with east facing slip roads only. The slip roads connect to the B992 with priority junctions.

Carden Junction

6.4.22 Carden Junction would be located 1.8km south-east of Pitmachie, to the north-west of Carden Farm. The junction maintains connectivity with the existing A96 to the west and east. The junction would be a grade separated, all movement, half-cloverleaf arrangement, with a roundabout on each side of the route option mainline connected via an underbridge.

6.4.23 The northern roundabout would be a three-arm roundabout connecting to the:

- Eastbound diverge and merge slip roads;
- Realigned existing A96; and
- Link road to southern roundabout.

6.4.24 The southern roundabout would be a three-arm roundabout connecting to the:

- Westbound diverge and merge slip roads;
- Realigned existing A96; and
- Link road to northern roundabout.

Local Roads and Accesses

6.4.25 Table 6.2 describes the treatment required for local roads affected by the Brown route option. Accesses that are not affected are not listed in the table.

Table 6.2 Local Roads and Accesses - Brown Route Option

Local Road / Access	Name	Treatment
Local Access	Loch Insch Fishery Access	B
Local Access	Old Inn Farm, Old Inn Cottage, Old Inn Steading and Old Inn Barn access	R
B992	Whitehouse – Keig – Auchleven – Insch – Mill of Newton – Culsalmond – Fisherford – Auchterless Road	J
Local Access	Local access via North Lediken Croft and South Lediken Farmhouse	R
Local Access	East Lediken Access	B
Local Access	Wester Shevock Access	B
U61S	Pitmachie to Daies Road	B

Local Road / Access	Name	Treatment
U61S	Pitmachie to Oyne Road	R
Existing A96	Inverness to Aberdeen	J
Local Access	Carden Farm Access	R
Local Access	Over Carden Access	R
Local Access	North Lodge to Logie Woodlands Access	B
U84C	Logie Durno Road	B
Local Access	Stanebrae Access	R
C83C	Durno Road	B

Key to table:

B	Bridge to be provided over or under the new A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge.
J	Road to be diverted / connected to a new A96 grade separated junction.
R	Realignment or amendment of a public road or existing access to a private property.

6.4.26 Each of the above local roads and accesses are described below.

Loch Insch Fishery Access

6.4.27 This is an access road directly off the existing A96 into Old Inn Farmhouse and Loch Insch Fishery.

6.4.28 This route requires realignment with an overbridge provided to cross the new dual carriageway to maintain access.

Old Inn Access

6.4.29 Access to Old Inn Farm, Old Inn Cottage, Old Inn Steading and Old Inn Barn is taken from the Loch Insch Fishery access road.

6.4.30 A new access onto the realigned Loch Insch Fishery access road would be provided to maintain access.

B992 Whitehouse - Keig - Auchleven - Insch - Mill of Newton - Culsalmond - Fisherford - Auchterless Road

6.4.31 This route connects Insch to the A96. It runs in a north-easterly direction from Insch High Street to Mill of Newton where it meets the existing A96. It interfaces with the Brown route option approximately 500m west of the existing A96.

6.4.32 The Brown route option bridges over the B992 at Kellockbank Junction allowing access between the B992 and the new dual carriageway via east facing slip roads.

Local access via North Lediken Croft and South Lediken Farmhouse

6.4.33 A local access route exists past North Lediken Croft and South Lediken Farmhouse from the existing B992 via a disused quarry access.

6.4.34 The access from the B992 would be stopped up and a replacement access created to the west of the Brown route option, connecting to the B992.

East Lediken Access

6.4.35 This is an access to East Lediken from the existing A96.

6.4.36 An overbridge would be provided to cross the Brown route option to maintain access.

Wester Shevock Access

6.4.37 This is an access to Wester Shevock from the existing A96.

6.4.38 An underbridge would be provided to cross beneath the Brown route option to maintain access.

U61S Pitmachie to Daies Road

6.4.39 This route runs in a south-westerly direction connecting Pitmachie to Daies from the existing A96.

6.4.40 An underbridge would be provided to cross beneath the Brown route option to maintain access.

U61S Pitmachie to Oyne Road

6.4.41 This route runs in a southerly direction from Pitmachie to Oyne.

6.4.42 A section of the U61S Pitmachie - Oyne Road would be stopped up and realigned to meet the realigned U61S Pitmachie - Daies Road to the west of the existing A96.

Existing A96

6.4.43 The existing A96 would be realigned to incorporate the Carden Junction. An underbridge would be provided to cross the Brown route option to maintain access.

Carden Farm Access

6.4.44 This is an access to Carden Farm from the existing A96.

6.4.45 The existing A96 would be realigned to tie into the Carden Junction. A new access onto the realigned existing A96 would be provided to maintain access.

Over Carden Access

6.4.46 This is an access to Over Carden from the existing A96.

6.4.47 The existing access would be shortened to tie into the realigned existing A96 south of Carden Junction to maintain access.

North Lodge to Logie Woodlands Access

6.4.48 This is a track through woodland between North Lodge and Logie Woodlands which heads in a south-easterly direction across the Brown route option.

6.4.49 The track would be realigned via the River Urie underbridge (refer to Section 6.9) to maintain access.

U84C Logie Durno Road

6.4.50 This is an unclassified road running from east to west connecting the C83C at Logie Durno School, north of Whiteford to the U128S at Strathorn Road.

6.4.51 This U84C would be realigned with an underbridge provided to cross beneath the Brown route option.

Stanebrae Access

6.4.52 This is an access to Stanebrae from the U84C.

6.4.53 A new access onto the realigned U84C would be provided to maintain access.

C83C Durno Road

6.4.54 This route runs in a northerly direction from the existing A96 connecting to Whiteford and Durno.

6.4.55 An underbridge would be provided beneath the Brown route option to maintain access.

6.5 Departures from Standard

6.5.1 Both route options have been designed in compliance with the Design Manual for Roads and Bridges (DMRB) without Departures from Standard or relaxations at this stage.

6.5.2 Departures or relaxations may be introduced during future design development of the Preferred Option during DMRB Stage 3, to reduce environmental impacts or improve value for money, as appropriate.

6.6 Topography and Land Use

Topography

6.6.1 Both route options would introduce changes to the existing topography through the introduction of new road embankments and cuttings, grade separated junctions, local road realignments and structures.

6.6.2 The topography of the area of the Pink route option generally comprises flat or gently rolling hills with elevation gradually falling towards the east.

6.6.3 The topography on the Brown route option is along the existing A96 corridor for the section between Loch Insch Fishery and Carden, where it then deviates towards Durno and Whiteford. It comprises locally undulating terrain with elevation gradually falling towards the east.

6.6.4 The impact of the route options upon the local landscape is considered in Volume 2, Part 3, Chapter 17, Landscape.

Land Use

6.6.5 Both the Pink and Brown route options are largely surrounded by agricultural land, including areas of prime agricultural land. The Brown route option follows the existing A96 corridor, running parallel to the east of the existing road until Carden where it deviates towards Durno and Whiteford.

6.6.6 Woodland in the area is largely restricted to small blocks with the largest woodland affecting the Pink route option to the south of Durno. The largest woodland affecting the Brown route option is the ancient woodland surrounding Old Logie House and to the west of Whiteford.

6.6.7 Land use is considered in further detail in Volume 2, Part 3, Chapter 12, People and Communities and Chapter 13, Agriculture, Forestry and Sporting Interests.

6.7 Geotechnics and Earthworks

Existing Ground Conditions

Sources of Information

6.7.1 Sources of information used in the assessment of likely ground conditions are as described in Paragraph 4.3.26.

6.7.2 The study area used for the identification of ground conditions in this report is defined by a 1km buffer around the route options.

General Ground Conditions

Superficial Geology

6.7.3 The area between Colpy and Pitcaple is underlain principally by drift deposits of glacial till with localised areas of alluvium, glaciolacustrine deposits, river terrace deposits, peat and head deposits. An area of glaciofluvial sheet deposits (sand and gravel) is located in the eastern part of the section within the River Urie and Burn of Durno valleys. The superficial geology map also shows areas of shallow rock present throughout the section where there is no drift cover, which typically occurs in areas of higher ground. Superficial deposits between Colpy and Pitcaple are summarised in Table 6.3 and are shown in Volume 5, Figures 6.5 to 6.8.

Table 6.3 Superficial Deposits within the Study Area (Colpy to Pitcaple)

Strata	Typical Description	Distribution
Glacial Till (Banchory Till Formation)	Sandy diamictons and clayey diamictons deposited by glacial ice, with clasts of various sizes and origins.	Extensive distribution and mapped at the surface across the majority of study area, except in valleys of watercourses and in areas of higher ground, where rock is typically mapped at the surface.
Alluvium	Compressible silty clay with layers of silt, sand, peat and basal gravel, deposited by rivers.	Local to the River Urie, the Shevock Burn, The Kellock, Burn of Durno and Bonnyton Burn.
Glaciolacustrine Deposits (Glen Dye Silts Formation and an unnamed formation)	Laminated silt, clay and silty sand, with peat and gravel. Deposited in lakes of glacial meltwater.	Within the valley of the River Urie between Newton House and Old Rayne and at Mill of Pitmedden.
Glaciofluvial Deposits	Predominantly granular material deposited by glacial meltwater, typically comprising sandy gravel with cobbles, boulders and relatively little silt / clay.	Adjacent to Burn of Durno and River Urie around Whiteford and Pitcaple.

Strata	Typical Description	Distribution
Head deposits	Unsorted fans and layers of material formed from downslope movement of soil and rock fragments. Composition may include gravel, sand, silt and clay.	Beneath Old Rayne and in the valley of the Shevock Burn to the west of Old Rayne.
Peat	An accumulation of partially decomposed vegetation and organic material.	Occurs in two locations, the area associated with Newton Moss and a small pocket to the west of Whiteford.
River Terrace Deposits (undifferentiated)	Gravel, sand, silt and clay with lenses of peat, deposited by rivers.	Occurs adjacent to the River Urie to the north of Mill of Newton and several small pockets located around the Whiteford area.

Artificial Ground

6.7.4 Artificial Ground is described as areas where the ground surface has been significantly modified by human activity. The BGS' Artificial Ground dataset shows limited areas of Artificial Ground, none of which are noted to be significant in size, between Colpy and Pitcaple. It is anticipated that areas of made ground are likely to be present locally, associated with the development of infrastructure, residential properties and farm properties. There are a number of former pits and quarries of varying size, which may have been infilled with spoil or waste materials.

6.7.5 The composition of any made ground or infilled ground is unknown and across the scheme it is likely to comprise a highly variable mixture of engineered fills, road pavement make-up, reworked soils and rock fragments. Man-made obstructions are also likely to be present in the vicinity of current and former buildings and infrastructure.

Bedrock Geology

6.7.6 For ease of reference, rock types are defined in the report glossary.

6.7.7 The study area between Colpy and Pitcaple is underlain entirely by the Insch Pluton, which is a cumulate intrusion composed of a range of predominantly basic and ultrabasic igneous rocks. Two zones of the Insch Pluton are present between Colpy and Pitcaple; The Upper Zone of the Insch Pluton is mapped between Colpy and Glenniston and comprises Iron-rich olivine-gabbro with subsidiary olivine-mozonite and olivine-monzodiorite. The Middle Zone of the Insch Pluton is mapped from Glenniston to Pitcaple (and beyond to Legatesden Farm) and comprises norite and gabbronorite.

6.7.8 Minor igneous intrusions of pegmatite, pegmatitic granite and aplitic microgranite (of the North-East Grampian Granitic Suite) occur around Logie and Durno. Quartz veins associated with the nearby Bennachie Pluton are also shown to intrude the Insch Pluton.

6.7.9 Several inferred geological faults are shown within the study area, although the direction and magnitude of displacement is not stated and the extent of disturbed rock around faults is unknown. The Brown route option crosses a south-west to north-east trending thrust fault at Carden Farm and two north-west to south-east trending normal faults around Little Lediken.

6.7.10 Bedrock is shown at or close to the surface on higher ground, including areas to the east and west of Old Rayne on either side of the River Urie and across a larger area to the south-west of Durno.

6.7.11 The BGS Memoirs indicate that localised pockets of deeply weathered bedrock occur within the A96 East of Huntly to Aberdeen study area. Between Colpy and Pitcaple, these are likely to be encountered within the basic rocks of the Insch Pluton, particularly around areas of bedrock that have been disturbed or fractured through shearing and faulting. The degree of weathering is unknown, but it is noted that it can be very variable over short distances.

6.7.12 Bedrock geology is shown in Volume 5, Figures 6.9 to 6.12.

Existing Ground Investigation Information

6.7.13 Existing ground investigation information within the section between Colpy and Pitcaple is very limited with only four exploratory holes being shown to be present with 500m of the Pink and Brown route options. Of those four exploratory holes, only one is available on the BGS database with the other three being unavailable. The available exploratory hole information has been reviewed and is summarised in Table 6.4.

Table 6.4 Existing Ground Investigation Information - Pink and Brown Route Options

Location / Coverage	General Findings
1 No. trial pit at Glenlogie, adjacent to Burn of Durno	Topsoil to 0.2m, underlain by glaciofluvial deposits to at least 3.2m depth. Glaciofluvial deposits comprise a sandy gravel with cobbles, boulders and occasional silt.

Identified Geotechnical Constraints

6.7.14 The main geotechnical constraints include the potential for settlement and subsidence / ground instability where embankments are to be constructed over areas of compressible ground and the slope instability of cuttings. Compressible ground is typically associated with alluvium, glaciolacustrine deposits, river terrace deposits, peat and man-made soils such as made ground.

6.7.15 Geotechnical hazards associated with head deposits include a potential for relict shear surfaces to be present within the deposits. This is as a result of previous downslope movement and contributes to a potential landslide hazard. However, the mapped head deposits between Colpy and Pitcaple are not present beneath either of the Pink or Brown route options and are therefore not discussed further. Likewise, the small area of river terrace deposits and areas of peat mapped within the study area between Colpy and Pitcaple are not located beneath the Pink or Brown route options and are therefore not discussed further.

6.7.16 The ground conditions and geotechnical properties of the superficial deposits and bedrock beneath the route options will require to be confirmed through ground investigation at DMRB Stage 3.

Pink Route Option

6.7.17 Ratings for potential geotechnical hazards are defined by the BGS for the existing ground conditions, although do not necessarily reflect the risk in relation to the scheme. These are summarised below for the area in the immediate vicinity of Pink route option, with areas of moderate and high hazards shown in Volume 5, Figures 6.13 and 6.14:

- Very low hazard potential for collapsible ground stability across the majority of the study area. Areas of no hazard potential noted, typically associated with the alluvium in the river / burn valleys;
- Moderate hazard potential for compressible ground associated with alluvium deposits within the river / burn valleys. The majority of the area is, however, shown as no hazard;
- No hazard potential for ground dissolution features;
- No hazard or very low hazard potential for landslides across the majority of the study area with very localised areas of low hazard potential associated with the alluvium in the Bonnyton Burn valley;
- No hazard to very low potential for hazards associated with running sands across the majority of the site. Localised areas of low hazard potential associated with the River Urie, Bonnyton Burn and Burn of Durno; and
- Very low hazard potential for shrinking or swelling clay across the majority of the study area, with localised pockets of no hazard identified.

6.7.18 The following potential geotechnical constraints have been identified from a review of historical mapping information:

- Unknown filled ground (pond, marsh, rivers, streams, dock etc) to the north-east of the Pink route option at Mill of Bonnyton; and
- Disused pits identified on historic maps adjacent to local road realignment at Saint Cloud, potentially infilled with unknown material;

6.7.19 The following potential geotechnical constraints and hazards are also applicable to the Pink route option, in relation to the identified earthworks;

- Potential zones of highly fractured rock and increased groundwater flow in the vicinity of geological faults shown on BGS mapping; and
- Potential shallow groundwater table and subsequent requirement for dewatering. This may be especially relevant to areas where the route option is close to existing surface water features.

Brown Route Option

6.7.20 Ratings for potential geotechnical hazards are defined by the BGS for the existing ground conditions, although do not necessarily reflect the risk in relation to the scheme. These are summarised below for the area in the immediate vicinity of the Brown route option, with areas of moderate and high hazards shown in Volume 5, Figures 6.15 and 6.16:

- Very low hazard potential for collapsible ground stability across the majority of the study area. Areas of no hazard potential are noted which are typically associated with alluvium within the river / burn valleys;
- Moderate potential for compressible ground associated with alluvium and glaciolacustrine deposits associated with the river / burn valleys. The remainder of the study area outwith the river valleys is shown as no hazard potential;
- No hazard potential for ground dissolution features;

- No hazard or very low hazard potential for landslides across the majority of the study area with very localised areas of low hazard potential associated with the River Urie valley to the north of Mill of Carden;
- No hazard to very low potential for hazards associated with running sands across the majority of the site. Localised areas of low hazard potential associated with The Kellock, the Shevock Burn, the River Urie and Burn of Durno; and
- Very low hazard potential for shrinking or swelling clay across the majority of the study area, with localised pockets of no hazard potential identified. One area of low hazard potential is noted associated with the undifferentiated glaciolacustrine deposits to the west of Old Rayne.

6.7.21 The following potential geotechnical constraints and hazards are applicable to the Brown route option, in relation to the identified earthworks:

- Three pits or quarries identified on historic maps, potentially infilled with unknown materials;
- Embankment on glaciolacustrine deposits between Pitmachie Farm and Mill of Pitmedden;
- Potential zones of highly fractured rock and increased groundwater flow in the vicinity of geological faults and shear zones shown on BGS mapping; and
- Potential shallow groundwater table and subsequent requirement for dewatering. This may be especially relevant to areas where the route option is close to existing surface water features.

Discussion

6.7.22 Alluvium deposits typically exhibit very low shear strength and can contain highly compressible silt and clay layers. Alluvium may also contain lenses of peat. All areas of alluvium beneath the Pink and Brown route options occur where embankments or structures would be built to cross rivers or other watercourses.

6.7.23 Glaciolacustrine deposits of the Glen Dye Silts Formation and a second unnamed formation occur beneath the Brown route option in two locations. Firstly at the Shevock Burn where the area of glaciolacustrine deposits is relatively small in extent, but occurs at the location of a structure and approach embankments. Secondly a larger extent of glaciolacustrine deposits approximately 1.1km in length is present at Mill of Pitmedden. The current design proposals at this location are for a combination of low-height embankments and at-grade construction. Glaciolacustrine deposits are anticipated to comprise very weak and highly compressible laminated silts, clays and sands. Glaciolacustrine clays may also be sensitive to changes in moisture content and remoulding, potentially resulting in poor trafficability during construction.

6.7.24 The potentially compressible nature of alluvium and glaciolacustrine deposits may result in significant settlements beneath embankments, as well as potential slope instability issues during construction if excavations are required. Alluvium and glaciolacustrine deposits are also associated with running sands and seepage flows. Both of these deposits are also unlikely to be able to be re-used as general engineering fill during construction.

6.7.25 Potential measures to mitigate issues associated with compressible superficial deposits include removal and replacement; staged construction; load transfer

platforms; accelerated settlement / consolidation through surcharging; and use of band-drains or drainage layers, where applicable. Where the route options are at-grade or on a low height embankment, it may be feasible to reinforce the subgrade with geotextiles combined with granular material.

6.7.26 The presence of potentially compressible superficial deposits beneath both the Pink and Brown route options will involve increased costs and may impact on construction programme if remedial works need to be implemented.

6.7.27 The applicability of these measures will depend on the construction programme, as well as the extent and properties of the potentially compressible materials. The nature of the compressible deposits will need to be determined through ground investigation during DMRB Stage 3.

6.7.28 Infilled ground is recorded in localised pockets associated with potentially infilled pits, quarries and water features. However, it is anticipated that made ground and man-made buried obstructions may be present along a greater extent of the route options, as a review of historic mapping has identified a number of former buildings and historic quarries in the vicinity of both the Pink and Brown route options. It should be noted that the true extent of these former pits and quarries is unknown and therefore the area of the route option at risk is unknown. Potentially contaminated land may also be present in the vicinity of current and former industrial land uses such as mills and sewage works and within current and former farms.

6.7.29 The inclination angle of cut slopes in superficial deposits will depend on a number of factors including the depth of the slope, groundwater levels and specific characteristics and geotechnical properties of the materials. If groundwater is at a high level in relation to a cut slope, slope drainage may be required.

6.7.30 Given the proximity of the route options to Aberdeen City, a high-level review of the Unexploded Ordnance (UXO) risk has been completed using Zetica UXB risk maps. This preliminary assessment has determined the risk to be low due to a low intensity of bombing. The potential UXO risk will be assessed further during DMRB Stage 3.

6.7.31 Both route options include cuttings in areas of shallow rock, which presents a potential constraint as shallow rock is likely to be more difficult to excavate than shallow superficial deposits. Very little information is available on the engineering properties of the igneous rocks of the Insch Pluton, however norite rock is extracted from the Insch Pluton at Pitcaple quarry through blasting, suggesting that these rocks are likely to be very strong and that cuttings may be difficult to excavate, without pre-treatment mitigation.

6.7.32 Potential measures to mitigate issues associated with cuttings in shallow rock could include alternative excavation techniques such as blasting and localised retaining measures including rock bolting and retaining walls where slope instability is a concern. The scale of these measures is dependent on the rock mass properties which would be determined during the ground investigation in DMRB Stage 3.

6.7.33 A comparison of the ground conditions beneath the route option centrelines is provided in Table 6.5. This summarises the length of each route option that is underlain by the ground conditions which are considered more challenging based on mapped surface geology only.

Table 6.5 Comparison of Ground Conditions

Route Option	Approximate length[1] (m) and proportion of Route Option centreline underlain by geotechnical hazards				Total (m)
	Artificial Ground[2]	Shallow Rock	Alluvium	Glaciolacustrine Deposits	
Pink	0 (0%)	1,600 (16%)	350 (4%)	0 (0%)	1,950 (20%)
Brown	50 (<1%)	1,900 (17%)	450 (4%)	1,100 (10%)	3,500 (32%)

[1] Length relates to mainline only, rounded to nearest 50m
[2] Artificial ground includes pits and quarries identified from historic mapping, and areas of potentially infilled ground.

6.7.34 The summary of ground conditions underlying each of the route options between Colpy and Pitcaple is based on published information with the following limitations:

- The summary is based primarily on the geology that is mapped at the surface on the BGS 1:50,000 digital superficial geology maps. Other potentially unfavourable ground conditions may be present at depth, however there is insufficient existing ground investigation information to allow ground modelling of the sub-surface strata across the route options.
- 'Shallow Rock' is defined by BGS as areas with less than 1m of superficial deposits cover above bedrock. Rock is also likely to be encountered in deeper cuttings beneath the mapped superficial deposits.
- There is very limited existing published ground investigation data available for the Pink and Brown route options. The ground investigation information which is available does not provide any substantial information on ground conditions or geotechnical properties of the superficial and solid geology, beyond what can be interpreted from geological maps and memoirs. In-situ ground conditions and the potential for contamination should be confirmed by intrusive ground investigation during DMRB Stage 3.
- Unrecorded areas of unfavourable superficial deposits or made ground may be present beneath the route options. The nature, extent and properties of made ground is unknown and will need to be investigated as part of the DMRB Stage 3 ground investigation.

Junctions

6.7.35 A brief qualitative summary of the surface geology for the junctions on the Pink and Brown route options is presented in Paragraphs 6.7.36 to 6.7.38. The engineering considerations relating to ground conditions, discussed in Paragraphs 6.7.22 to 6.7.32 are also applicable to the junctions. Ground conditions for the Colpy to Pitcaple route option junctions are shown in Volume 5, Figures 6.13 to 6.16.

Kellockbank Junction – Pink Route Option

6.7.36 Slip road embankments for the Kellockbank Junction are located in an area of alluvium associated with the River Urie. The main carriageway at the junction comprises an embankment over glacial till and alluvium.

Kellockbank Junction – Brown Route Option

6.7.37 The main carriageway through Kellockbank Junction comprises an embankment over glacial till, with alluvium alongside The Kellock. The junction slip roads include some small cuttings in glacial till.

Carden Junction – Brown Route Option

6.7.38 The whole of the junction including slip roads and realigned local roads are located on glacial till and shallow rock.

Earthworks Balance

Acceptability of Excavated Material

6.7.39 The majority of the currently identified cuttings on both the Pink and Brown route options between Colpy and Pitcaple are formed within areas of glacial till or shallow rock. Excavated rock from the Insch Pluton may be variable in terms of its acceptability to be reused as general engineering fill, on account of localised differences in mineralogy and the degree of weathering.

6.7.40 Acceptability of materials for reuse will be confirmed through intrusive ground investigation and laboratory testing which will be undertaken at DMRB Stage 3.

Acceptability of Excavated Material – Pink Route Option

6.7.41 It is estimated at this stage that between Colpy and Pitcaple, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Acceptability of Excavated Material – Brown Route Option

6.7.42 It is estimated at this stage that between Colpy and Pitcaple, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Unacceptable Material and Contaminated Land

6.7.43 At this stage, it is anticipated that not all of the material generated from earthworks cuttings will be acceptable for reuse as general engineering fill. However, it may be feasible to reuse some of these materials elsewhere in other works on site through treatment to make a proportion of it acceptable as general engineering fill or in noise or landscaping bunds. Materials that may be unacceptable for reuse as general engineering fill include:

- Weathered bedrock;
- Natural soils with high moisture content; and
- Infilled ground and man-made soils / materials.

6.7.44 In general, excavated bedrock is likely to be acceptable for reuse as general engineering fill if suitably crushed and processed to meet the classification requirements of the Specification for Highways Works. However, bedrock that has been affected by deep weathering may be unacceptable for reuse as engineering fill. Deeply weathered bedrock is likely to contain degraded minerals, potentially resulting in an increased fines content that may make this excavated material unacceptable for use as general engineering fill. The occurrence, extent and properties of weathered bedrock should be determined through means of a ground investigation during DMRB Stage 3.

6.7.45 Whilst most of the excavated glacial till is anticipated to be acceptable for reuse, some of the excavated glacial till may be unacceptable, particularly where the fines content exceeds the grading limits of the Specification for Highways Works. Additionally, large cobbles and boulders can be expected within the glacial till, and this may also restrict its acceptability unless these can be removed by screening.

6.7.46 At this stage it is considered unlikely that significant contaminated land will be encountered within either the Pink or Brown route options. This is due to the predominantly rural nature of this part of the study area and the lack of any major contaminative industrial uses. Potentially contaminated land associated with infilling of historic pits and quarries is expected to be encountered beneath both route options. Whilst the nature, extent and properties of these materials is unknown, it is anticipated that they will be generally unacceptable for reuse and may require to be disposed of off-site. Contaminated soils may also be encountered in the vicinity of current and former industrial uses including but not limited to mills, sewage works and farms. Additional areas of unrecorded infilled ground and potentially contaminated soils may also be encountered on both route options. Contaminated land and its impact on the scheme is discussed in detail in Volume 2, Part 3, Chapter 19, Geology, Soils, Contaminated Land and Groundwater.

Cut / Fill Balance

6.7.47 For the purpose of the earthworks assessment, it is assumed that any surplus materials from the Colpy to Pitcaple route option will be available for use within other geographic sections on the scheme and that surplus materials from other route options on the scheme will also be available for use on the Pink and Brown route options.

6.7.48 Table 6.6 summarises the earthworks volumes for the Pink and Brown route options:

- Bulk Fill Material Required – The bulk earthworks volume required for the mainline, local roads, junctions and attenuation basins, including an allowance for capping materials and topsoil;
- Bulk Excavated Material – Total volume of excavated material from the mainline, local roads, junctions and attenuation basins, including an adjustment for capping materials and topsoil;
- Acceptable Excavated Material – The volume of material excavated from each route option which is estimated to be acceptable for reuse within earthworks plus an allowance for treatment of some of the unacceptable material to render it acceptable as general engineering fill;
- Unacceptable Excavated Material – The volume of material excavated from each route option which is estimated to be unacceptable for reuse within earthworks;
- Acceptable Cut / fill balance – The overall balance between the bulk fill requirements and volume of acceptable excavated material on each route option; and
- Total Cut / Fill Balance – The overall balance between the bulk fill requirements and the volume of total excavated material on each route option.

6.7.49 All values have been rounded to the nearest 10,000 m^3.

Table 6.6 Earthworks Volumes (approximate)

Volume	Pink Route option	Brown Route option
Bulk Fill Material Required (m^3)	1,310,000	2,020,000
Bulk Excavated Material (m^3)	1,780,000	1,980,000
Acceptable Excavated Material (m^3)	1,560,000	1,740,000
Unacceptable Excavated Material (m^3)	220,000	240,000
Bulk Cut / Fill Balance (m^3)	+470,000 surplus	- 40,000 deficit
Acceptable Cut / Fill Balance (m^3)	+250,000 surplus	- 280,000 deficit

6.7.50 A negative balance between cut and fill indicates that there is a deficit in the volume of acceptable materials available within the route option and that additional fill materials will therefore require to be imported or transferred from another geographical section. Likewise, a positive balance between cut and fill indicates that the volume of acceptable materials exceeds the fill requirements for the route option and that construction of the route option will therefore generate a surplus of acceptable fill materials, which can be used elsewhere on the scheme if required.

6.7.51 The Pink route option is predicted to generate a surplus of acceptable material for re-use elsewhere in the scheme. The Brown route option requires import of acceptable material from elsewhere on the scheme or from external sources.

6.8 Hydrology and Drainage

Introduction

6.8.1 The effects of the route options on the water environment are considered in Volume 2, Part 3, Chapter 20, Road Drainage and the Water Environment. This section provides a summary of the engineering issues related to watercourse crossings and road drainage.

6.8.2 A preliminary assessment of hydrology was made for each route option. Following the selection of a Preferred Option, a review of the hydrology, watercourse crossings and drainage strategy will be undertaken during the DMRB Stage 3 assessment.

6.8.3 Bridge structures are described within Section 6.9. Bridge and culverted crossings of watercourses will be designed and constructed in accordance with the requirements of the Scottish Environmental Protection Agency (SEPA), Scottish Natural Heritage (SNH), Aberdeenshire Council and local stakeholders.

Watercourses

6.8.4 A number of watercourses located within the study area are affected by the route options. These watercourses are as described below. All watercourses are labelled in Volume 5, Figures 20.5 to 20.8.

The Kellock

6.8.5 The Kellock is a tributary to the River Urie; with a catchment area of approximately 18.3km^2, it drains an area of open farmland to the north of Insch.

6.8.6 The Brown route option requires a bridge over The Kellock, near its confluence with the River Urie. The Pink route option does not interact with The Kellock.

Shevock Burn

6.8.7 With a catchment area of 39.6km², the Shevock Burn is a large tributary of the River Urie. The Shevock Burn drains an area as far west as the Hill of Corskie including Insch and its surrounding area.

6.8.8 The Brown route option crosses the Shevock Burn on a structure, adjacent to the existing A96 near to the confluence with the Urie. The Pink route option does not interact with the Shevock Burn.

Tributary of Bonnyton Burn 1

6.8.9 The tributary is located about 1.2km to the north of Old Rayne and drains a catchment of less than 0.5km^2 associated with farmland. To accommodate the Pink route option, a 175m diversion of the watercourse is required. The Brown route option does not interact with this watercourse.

Bonnyton Burn

6.8.10 The Bonnyton Burn is a tributary of the River Urie, with a catchment area of approximately 19.2km². It drains an area of farmland to the north-east of Old Rayne, including areas to the north-east of the A920.

6.8.11 The Pink route option crosses the Bonnyton Burn to the east of Old Rayne on a bridge structure. The Brown route option does not interact with the Bonnyton Burn.

Tributary to the River Urie 19

6.8.12 With a catchment area of around 2.1km², this tributary drains an area of farmland between Old Rayne and Durno, to the north of the River Urie.

6.8.13 The Pink route option passes through the very upper reaches of this catchment, with three culverts required to maintain existing catchment areas. The Brown route option does not interact with this watercourse.

Burn of Durno

6.8.14 The Burn of Durno has a catchment area of over 20km² and discharges to the River Urie to the north-east of Pitcaple Castle. The burn accepts runoff from the area of farmland between Pitcaple and the A920.

6.8.15 Both the Pink and Brown route options cross the Burn of Durno on a bridge structure north of Whiteford.

River Urie

6.8.16 The River Urie is a large watercourse with a catchment area of over 300km² at the confluence with the River Don, south of Inverurie. In the context of the Colpy to Pitcaple geographic section, the River Urie has a catchment area of approximately 215km² at the confluence of the with the Burn of Durno at Pitcaple.

6.8.17 Both the Pink and Brown route options cross the River Urie. The Pink route option crosses on a structure to the south of Colpy, near the confluence with The Kellock. At this point, the catchment is approximately 35km². The Brown route option crosses further downstream, to the north of Mill of Carden where the catchment has increased to approximately 125km².

6.8.18 Table 6.7 provides a summary of the watercourses affected by each route option.

Table 6.7 Hydrology and Drainage Summary

Watercourse	Pink Route Option	Brown Route Option
The Kellock	N/A	Bridge
Shevock Burn	N/A	Bridge
Bonnyton Burn	Bridge	N/A
Tributary of the Bonnyton Burn 1	Realignment (175m)	N/A
Tributary of the River Urie 19	Bridge Culvert (3No.)	N/A
Burn of Durno	Bridge	Bridge
River Urie	Bridge (2No.)	Bridge
Other Watercourses	Culvert (2 no.) Realignment (less than 50m in length)	Culvert (6 no.)
Total No. of Interfaces	**12**	**10**

Drainage

6.8.19 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and sized indicatively to assess feasibility. This information has been used to inform the engineering and environmental assessments for each route option. The drainage design will be developed further during DMRB Stage 3.

6.8.20 The drainage design will incorporate Sustainable Drainage Systems (SuDS) to both treat and attenuate the runoff prior to discharge to the water environment. A treatment train approach[7] will be applied in accordance with the latest guidance, incorporating SuDS both at source and at the end of a drainage system. This is likely to include a number of components including: filter drains, swales, basins and ponds.

6.8.21 SEPA has stipulated that a minimum of two levels of treatment will be required and this will be suitable for most catchments within the scheme extents. In cases where a catchment is to discharge to a particularly small watercourse, a sensitivity check will be carried out and an additional level of treatment may be required. This will be assessed on a case by case basis.

6.8.22 At this stage, it has been assumed that drainage from realigned local roads will generally match the existing drainage regime, most of which is expected to flow over the carriageway edge as it does at present. Where significant new sections of local road are identified, the drainage design criterion is expected to meet current standards, with runoff both treated and attenuated prior to discharge to an appropriate watercourse.

[7] Treatment train approach is using drainage techniques in series to change the flow and quality characteristics of the runoff in stages, available at: https://www.susdrain.org/delivering-suds/using-suds/suds-principles/management-train.html

6.8.23 It is considered feasible to drain runoff from both route options to local watercourses with appropriate treatment measures in place. There are no particular engineering issues or differences between the Pink and Brown route options in relation to road drainage.

6.9 Structures

Introduction

6.9.1 Structure locations are shown in Volume 5, Figures 6.1 to 6.4 and are tabulated below for each route option. Further details on major river crossings and other significant structures are described below. Structures that are named are those considered in more detail and are likely to be 150m in length or greater.

Underbridges

6.9.2 The full width of the mainline including carriageway and hard strips shall be continued across the decks of the underbridges. In accordance with DMRB CD 127 (Cross-sections and headrooms, Clause 3.4) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

6.9.3 It is anticipated that underbridges would generally be of concrete construction with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option could also be considered.

Overbridges

6.9.4 It is anticipated that overbridges would generally be of steel-concrete composite construction, with steel girders supporting a concrete bridge deck.

6.9.5 The full width of the carriageway and hard strips (where provided) would be continued across the overbridges. Verges to both the local road and the A96 mainline would be continued over and under the structure in accordance with DMRB CD 127 (Clause 3.4).

Pink Route Option

Bonnyton Burn Crossing

6.9.6 This bridge is situated to the north-east of Old Rayne where the route option crosses the valley of the Bonnyton Burn at Mill of Bonnyton. The key constraints are as follows:

- The width of the floodplain has been ascertained from SEPA flood mapping and is approximately 80m wide at this location;
- The topography of the valley of the Bonnyton Burn;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level; and
- The mainline of the Pink route option and the realigned access to Mill of Bonnyton.

6.9.7 At this stage it is considered that the bridge carrying the mainline and on-slip would comprise a multi-span structure with a length of approximately 150m. It is anticipated that the bridge would be of composite steel beam and concrete slab construction. No bridge piers are planned to be located within the river channel.

6.9.8 At this stage it has been assumed that all foundations for these structures would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

6.9.9 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

6.9.10 The underbridges required are as detailed in Table 6.8.

Table 6.8 Pink Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB – Ex A96	Existing A96 at Kellockbank Junction	50	33
UB – River Urie	River Urie (mainline and merge slip road)	82	40
UB – River Urie	River Urie (diverge slip road)	86	20
UB – B992	B992 Whitehouse – Keig – Auchleven – Insch – Mill of Newton – Culsalmond – Fisherford – Auchterless Road	14	60
UB - Bonnyton Burn Crossing	Bonnyton Burn and track	150	46
UB - Lewesk Crossing	Local Access and Tributary of the River Urie 19	16	32
UB - C83C	C83C Durno Road	55	35
UB - Burn of Durno Bridge	Burn of Durno	105	30

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

6.9.11 The overbridges required are as detailed in Table 6.9.

Table 6.9 Pink Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB - Loch Insch	Local Access	54	14
OB - C64S	C64S Brankanentum - Culsalmond - Fisherford Road	57	14

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB - C59S	C59S Old Rayne – Lathries – North Rayne Road	63	14
OB - C60S	C60S Old Rayne – Auchintarph Road	50	14

Retaining Structures

6.9.12 At this stage, it is anticipated that significant retaining structures will not be required. The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on adjacent land, properties and communities.

Brown Route Option

Shevock Burn Crossing

6.9.13 A number of constraints have been considered as follows:

- The width of floodplain has been ascertained from SEPA flood mapping and is approximately 80m at this location;
- The topography of the valley of the Shevock Burn;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level; and
- The mainline of the Brown route option and the existing access to a property at Wester Shevock.

6.9.14 At this stage it is considered that the bridge would comprise a multi-span viaduct with a length of 200m. It is anticipated that the bridge would be of composite steel beam and concrete construction. No supports are planned to be placed within the Shevock Burn channel.

6.9.15 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

6.9.16 Structure type and span configurations will be developed further during DMRB Stage 3.

River Urie Crossing

6.9.17 A number of constraints have been considered as follows:

- The width of the floodplain has ascertained from SEPA flood mapping and is approximately 100m at this location;
- The topography of the valley of the River Urie;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level; and
- The mainline of the Brown route option and the realigned access to properties at Logie Woodlands and Rannoch.

6.9.18 At this stage it is considered that the bridge would comprise a multi-span viaduct with a length of 200m. It is anticipated that the bridge would be of composite steel beam and concrete construction. No supports are planned to be placed in the river channel.

6.9.19 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

6.9.20 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

6.9.21 The underbridges required are as detailed in Table 6.10.

Table 6.10 Brown Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB – The Kellock	The Kellock	120	50
UB - B992	B992 Whitehouse – Keig – Auchleven – Insch – Mill of Newton – Culsalmond – Fisherford – Auchterless Road (at Kellockbank Junction)	15	60
UB – Shevock Burn	Shevock Burn and Local Access	200	30
UB - U61S	U61S Pitmachie – Oyne and Pitmachie Daies Roads	14	30
UB - Carden Junction	Carden Junction	14	50
UB – River Urie	River Urie and Local Access	200	38
UB - U84C	U84C Logie Durno Road	16	40
UB - C83C	C83C Durno Road	65	33
UB - Burn of Durno	Burn of Durno	65	39

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

6.9.22 The overbridges required are as detailed in Table 6.11.

Table 6.11 Brown Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB - Loch Insch Fishery	Local Access	49	14
OB – East Lediken	Local Access	45	14

Retaining Structures

6.9.23 At this stage, it is anticipated that significant retaining structures will not be required. The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on adjacent land, properties and communities.

Ancillary Structures

6.9.24 Both route options would require the provision of a number of ancillary structures such as culverts and may require accommodation underpasses and overbridges.

Culverts

6.9.25 Culverts are anticipated to be required for minor watercourse crossings.

6.9.26 Culvert structures are anticipated to comprise either large diameter pipes, precast concrete boxes or proprietary arch units. Culverts will be subject to further design development during DMRB Stage 3.

6.9.27 Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

6.9.28 The requirement for accommodation structures has been considered for both route options and will be developed further during DMRB Stage 3.

Vehicular Containment and Pedestrian Restraint over Structures

6.9.29 Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB CD 377 (Requirement for road restraint systems) and will be developed during DMRB Stage 3.

6.10 Utilities

Introduction

6.10.1 There are a significant number of buried and overhead public and private utility services between Colpy and Pitcaple including:

- Telecommunications – BT Openreach overhead and underground network and communications masts;
- SGN – high pressure gas pipelines;
- SSE – high voltage and low voltage overhead and underground electricity infrastructure;

- Scottish Water supply network;
- Scottish Water wastewater network;
- Wind turbines; and
- Street Lighting – areas of the existing road network that feature street lighting and will therefore include underground power cables in the vicinity of the lighting.

6.10.2 Public utilities have been identified and key utilities are shown in Volume 5, Figures 2.20 to 2.24.

6.10.3 In accordance with the New Roads and Street Works Act (1991), C2 notices were issued to each of the utility providers to seek details of their networks within the study area. This enabled potential clashes with utility infrastructure to be identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with major utility infrastructure.

6.10.4 Where it has not been possible to avoid a clash with a major utility apparatus, initial consultation has been undertaken with the relevant providers and outline diversion costs have been identified.

6.10.5 Utilities can also represent an additional constructability challenge where the utility is strategic in nature. Long lead times with seasonal constraints, or utilisation of planned network outages often result. This can add time and expense to the construction programme of a particular route option.

Telecommunications

6.10.6 Telecommunications infrastructure is present throughout most of the study area between Colpy and Pitcaple. The key elements of the network are identified below.

BT Openreach Underground Network

6.10.7 This utility is located throughout this study area. Underground ducts and cables run adjacent to the existing A96 and along some local roads.

BT Openreach Overhead Network

6.10.8 This utility is located throughout this study area: overhead cables run adjacent to local roads and provide connections to properties.

Communication Masts

6.10.9 Communication masts are located within the study area between Colpy and Pitcaple. These assets are owned and operated by several different organisations.

Interfaces

6.10.10 Table 6.12 summarises the number of interfaces with the telecommunications networks for each route option.

Table 6.12 Interfaces with Telecommunications Apparatus

Route Option	BT Underground	BT Overhead	Communication Masts	Total Interfaces
Pink	7	3	0	**10**
Brown	12	4	0	**16**

6.10.11 The Pink route option has fewer interfaces with the BT Openreach network when compared with the Brown route option. It should be noted that each interface varies in length and this assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

6.10.12 Both route options do not impact on communication masts in this area.

Gas

6.10.13 SGN high pressure gas infrastructure is present in the study area between Colpy and Pitcaple. The key elements of this network are outlined below.

High Pressure Pipelines

6.10.14 Two high pressure gas pipelines (273mm and 300mm diameter) run broadly in parallel with the A96 between Colpy and Oyne Fork. These pipelines are strategic infrastructure.

Above Ground Installations

6.10.15 An Above Ground Installation is present to the south of Pitmachie and is connected to both pipelines.

Interfaces

6.10.16 The Brown route option runs in parallel with SGN high pressure infrastructure. The pipelines are situated to the west of the Brown route option. A realigned private access west of Kellockbank Junction crosses each of the two parallel pipelines. There are no interfaces of gas infrastructure with the Pink route option.

Electricity

6.10.17 SSE electricity transmission and supply infrastructure is present in the study area between Colpy and Pitcaple, The key elements of the network are identified below.

275kV Overhead Lines

6.10.18 Two sets of SSE 275kV overhead electricity transmission lines with pylons at approximately 400m centres are present in the study area between Colpy and Pitcaple. One set runs from north-west to south-east and the other runs broadly from north to south. Both lines cross the existing A96 to the west of Pitcaple.

33kV Overhead Lines

6.10.19 This utility is present between Colpy and Pitcaple but is confined to the west of the existing A96 in this area.

33kV Underground Cables

6.10.20 There is a limited extent of 33kV underground electricity cables present within the Insch area. There is also a 33kV underground cable route associated with Kirkton Wind Farm running north to south through the area.

11kV Overhead Lines

6.10.21 This utility is present throughout this area.

11kV Underground Cables

6.10.22 There is a limited amount of this utility present within this area.

Low Voltage Overhead Lines and Underground Cables

6.10.23 These utilities are present throughout the area between Colpy and Pitcaple within the settlements of Old Rayne and Insch with individual property connections to the high voltage network.

Interfaces

6.10.24 Table 6.13 summarises the number of interfaces with SSE Assets for each route option.

Table 6.13 Interfaces with SSE apparatus

Route Option	275kV Line	33kV Line	33kV Cable	11kV Line	11kV Cable	Low Voltage	Total Interfaces
Pink	2	0	2	11	1	1	**17**
Brown	2	0	1	10	1	2	**16**

6.10.25 The Pink route option has 17 interfaces with the SSE network while the Brown route option has 16. Each route option interfaces with the 275kV overhead electrical lines at two locations; however it is not anticipated that pylon relocation will be required.

6.10.26 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Water and Wastewater

6.10.27 Scottish Water infrastructure is present between Colpy and Pitcaple, the key elements of the network are identified below.

Water Network

6.10.28 The Scottish Water freshwater supply network is present within the existing A96 and adjacent local roads at the northern end of this area. This utility is also present in the settlements of Insch and Old Rayne.

Wastewater Network

6.10.29 Gravity pipe infrastructure is present within the settlements of Insch, Old Rayne and Whiteford within the area between Colpy and Pitcaple.

Interfaces

6.10.30 Table 6.14 summarises the number of interfaces with water assets for each option.

Table 6.14 Scottish Water Interfaces

Route Option	Water Mains	Raw Water Mains	Gravity Sewer Network	Total Interfaces
Pink	3	0	0	**3**
Brown	4	0	0	**4**

6.10.31 The Pink route option has three interfaces with water mains while the Brown route option has four. Both route options have no interfaces with raw water mains.

6.10.32 Both route options have no interfaces with the gravity sewer network.

6.10.33 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Wind Turbines

6.10.34 There are a number of private wind turbines between Colpy and Pitcaple.

Interfaces

6.10.35 The Pink route option has one interface with a private wind turbine which would need to be removed or relocated. The Brown route option has no interfaces. Details of connecting cables is covered in Paragraph 6.10.20.

6.11 Non-Motorised Users (NMUs)

6.11.1 The term Non-Motorised Users (NMUs) is used to describe pedestrians, cyclists and equestrians.

6.11.2 Existing NMU routes within the study area are described in Volume 1, Part 1, The Scheme (Chapter 2, Existing Conditions) and in Volume 5, Figures 2.17 to 2.19. The effects of the route options on all travellers, including NMUs, are considered in Volume 2, Part 3, Environmental Assessment (Chapter 12, People and Communities) where the impacts of the route options are assessed.

6.11.3 One of the scheme objectives is to facilitate active travel in the A96 corridor. There are opportunities to enhance NMU facilities associated with each route option and these have been assessed at a high level during this DMRB Stage 2 assessment.

6.11.4 These opportunities are where there is the potential to improve NMU connectivity along the route option and maintain connectivity across existing NMU routes within the study area which, in turn, enables better NMU connections between communities.

Colpy to Pitcaple

6.11.5 There are several existing NMU routes between Colpy and Pitcaple which creates opportunities to provide links to these existing routes. This would also provide better NMU connection between the communities of Colpy, Pitmachie, Old Rayne and Durno / Whiteford.

6.11.6 The Pink route option affects four core paths and two existing local routes and the Brown route option affects six core paths and three existing local routes. Each of these routes will be maintained or alternative provision will be made with the potential for enhancements to be incorporated.

6.11.7 There are also further opportunities to provide better NMU access between existing communities and local destinations e.g. from Old Rayne to Loch Insch Fishery.

6.11.8 The Brown route option is considered to have more opportunity to improve NMU facilities based on the greater number of the existing NMU routes and settlements in its vicinity.

6.11.9 NMU facilities will be considered further during design development of the Preferred Option during DMRB Stage 3.

6.12 Health and Safety Considerations

6.12.1 Key health and safety risks and challenges during construction, use, maintenance and demolition are reported here to inform the assessment and any future design development. Important health and safety considerations which informed the development of the option development are also noted below.

6.12.2 The design will be subject to further consideration of issues relating to construction, use, maintenance and demolition throughout its development. Further consideration of construction phasing and maintenance of existing access arrangements during the construction period will be undertaken during DMRB Stage 3. A constructability audit will also be undertaken. It should be noted however that the detail of the phasing and traffic management adopted during construction will be the responsibility of the appointed contractor to determine.

Construction Phasing and Constructability

6.12.3 The Pink and Brown route options tie into adjacent route options at offline locations and are predominantly offline throughout their lengths. There are locations where the route options cross existing routes, including the existing A96. At these locations, it may be necessary to utilise temporary diversions to facilitate construction works and minimise disruption to road users. This may include temporary road provision adjacent to the works to allow construction of bridges over or under the existing routes.

Pink Route Option

6.12.4 There are a number of elements which pose particular health and safety and constructability challenges for the Pink route option, namely:

- Construction of underbridges crossing the existing A96 and the River Urie at Mains of Williamston, including Kellockbank Junction;
- Construction of the Bonnyton Burn crossing;
- Interface with SSE 275kV overhead electricity transmission lines at Newton of Lewesk;
- Interface with SSE 275kV overhead electricity transmission lines south of Durno;
- Long and deep cuttings in rock to the south of Durno; and
- Construction of the crossings of the C83C and Burn of Durno.

Brown Route Option

6.12.5 There are a number of elements which pose particular health and safety and constructability challenges for the Brown route option, namely:

- Construction of Kellockbank Junction at the interface with the B992 including the crossing of the Kellock;
- Construction of the Shevock Burn crossing;
- Construction of Carden Junction at the interface with existing A96, including management of traffic;
- Construction of the River Urie crossing;
- Interface with SSE 275kV overhead electricity transmission line north of Old Logie Cottage;
- Deep cuttings in rock at Logie Woodland;
- Cuttings in rock at the interface with the U84C;
- Interface with SSE 275kV overhead power lines north of Ferniebrae; and
- Construction of the crossings of the C83C and Burn of Durno.

6.13 Scheme Resilience

Winter Resilience

6.13.1 The existing A96 between Colpy to Pitcaple has not had any recorded snow closures over the last eight years. It is generally more low lying than the East of Huntly to Colpy section. It ranges from 150m AOD at Colpy to approximately 85m AOD at Pitcaple.

6.13.2 Data on typical wind speeds for the Colpy to Pitcaple section of the existing A96 and the Colpy to Oldmeldrum section of the A920 have been reviewed. Typical wind speeds are consistent with inland and non-exposed low altitude routes[8].

6.13.3 Both the Pink and the Brown route options are outside the section of the existing A96 already identified for the location of a specific Winter Service Plan[9]. The Pink route option follows higher ground than the Brown route option. Met Office data for 1981 to 2010 has been consulted and both route options are subject to similar snowfall.

6.13.4 Both the Pink and Brown route options will require drainage to be implemented to intercept runoff from adjacent areas to reduce the risk of ice formation on the road.

6.13.5 The winter resilience of the scheme will be considered in further detail during DMRB Stage 3.

Operational Resilience

6.13.6 A new high quality dual carriageway is less likely to be subject to an incident which blocks one or both carriageways in comparison with the existing A96. Higher geometric standards, segregation of oncoming traffic, safe overtaking opportunities and grade separated junctions are key factors which will reduce the likelihood and severity of accidents on the new dual carriageway.

[8] Refer to High Wind Strategy and National Wind Management Guidelines, Transport Scotland, 2009.
[9] A Winter Service Plan is prepared by the 4th Generation Term Contract for the management and maintenance of the Scottish Trunk Road Network North East Unit for Transport Scotland.

6.13.7 Both the Pink and Brown route options retain the existing A96 between Colpy and Pitcaple. This can act as an emergency diversion route for both route options subject to connections made by adjacent route options. The Brown route option has two connections to the existing A96 while the Pink route option has one junction with the existing A96 with east facing slip roads only.

6.13.8 The A96 Scheme Resilience Strategy[10] states that purpose-built emergency access roads linking with the local road networks are not anticipated at this time. However, this will be reviewed at DMRB Stage 3.

6.13.9 Other operational resilience features which will be considered during DMRB Stage 3 design development are emergency crossovers, emergency turnaround areas (ETAs) and other maintenance access requirements.

Climate Change Resilience

6.13.10 Climate change resilience considers the predicted ability of the new A96 to manage and mitigate the consequences of climate change influenced extreme weather events upon road users. This includes both the immediate weather events and consequential incidents such as landslips and flooding. Consideration of climate change resilience and adaptation mitigation is outlined in Volume 2, Part 3, Chapter 21, Climate.

6.14 Engineering Assessment Summary

6.14.1 A summary is provided below for each engineering issue, which identifies if one route option is considered more or less favourable.

Mainline Alignment

6.14.2 Both route options have been designed to meet DMRB standards without Departures or relaxations from standard at this stage.

Junction Layouts

6.14.3 All junctions have been designed to meet DMRB standards without Departures from standard or relaxations at this stage.

Local Roads and Accesses

6.14.4 Effects on local roads and accesses are summarised in Table 6.15.

Table 6.15 Local Road and Access Treatment Summary

Local road or access treatment	Pink Route Option	Brown Route Option
B – Bridge to be provided over or under A96 allowing continuation of road. Includes realignment of existing local road as required to connect to the bridge.	7	7
J – Road to be diverted / connected to a new A96 grade separated junction	1	2

[10] A96 Dualling Preliminary Engineering Services, Scheme Resilience Strategy, May 2015 – Rev 3, Transport Scotland.

Local road or access treatment	Pink Route Option	Brown Route Option
R – Realignment or amendment of a public road or existing access to a private property.	10	6
Total No of local roads and accesses affected	**18**	**15**

6.14.5 Local roads and accesses would retain connectivity with the existing A96 and other local roads. The effects are similar for both route options.

Topography and Land Use

6.14.6 Topography and land use effects are similar for both route options. The Brown route option follows the existing A96 corridor from Colpy to Carden. From an engineering perspective, the topography is less constrained on the Pink route option since it is offline with less interaction with existing infrastructure.

Geotechnics and Earthworks

6.14.7 Both route options pass through areas of potential shallow groundwater levels such as near to the Loch Insch Fishery.

6.14.8 The lengths of the route options potentially affected by ground conditions that are considered to be more challenging (based on mapped surface geology only) are given in Table 6.5.

6.14.9 The Pink route option generates a surplus of excavated material of 250,000m^3 acceptable for re-use within adjacent route options. The Brown route option requires import of 280,000m^3 acceptable material from elsewhere on the scheme or from external sources.

6.14.10 The Pink route option is considered more favourable due to the Brown route option having more areas of potentially compressible ground including Alluvium and Glaciolacustrine Deposits. The Pink route option is also considered more favourable due to the surplus of acceptable material it generates which can be used elsewhere on the scheme thus reducing haul distances associated with the earthworks, whereas the Brown route option has a deficit of acceptable material, resulting in increased haul distances.

Hydrology and Drainage

6.14.11 A preliminary assessment of hydrology was made for each route option and both designs were developed to minimise flooding impacts.

6.14.12 Both route options require a similar number of bridges and culverts. The Pink route option requires a 175m realignment of a tributary and one minor watercourse realignment. The Brown route option does not require any watercourse realignments. Both route options are considered to perform similarly with regards works affecting existing watercourses.

6.14.13 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and indicatively sized to assess feasibility and no engineering issues have been identified for either route option.

6.14.14 Overall, the Pink and Brown route options perform similarly in terms of hydrology and drainage.

Structures

6.14.15 Table 6.16 provides a summary of the structures required for each route option.

Table 6.16 Structures Summary

Type of Structure	Pink Route Option	Brown Route Option
Major Bridges	1	2
Railway Bridges	0	0
Underbridges (total)*	8	9
Overbridges (total)*	4	2
Retaining Structures	0	0
Total	**12**	**11**

* Total includes major bridges and railway bridges

6.14.16 Both route options have similar overall structure requirements, however, the Brown route option is less favourable due to larger and more complex river crossings.

Utilities

6.14.17 The comparative interfaces of the route options are summarised in Table 6.17.

Table 6.17 Utilities Summary

Utility	Pink Route Option	Brown Route Option
Telecommunications	10	16
Gas	0	2
Electricity	17	16
Water and Wastewater	3	4
Private Wind Turbines	1	0
Total	**31**	**38**

6.14.18 The utilities that pose most significant constraint between Colpy and Pitcaple are SSE 275kV overhead transmission lines.

6.14.19 Strategic high pressure gas mains are present in this area. The Brown route option runs in parallel with this infrastructure for a considerable distance and a realigned private access crosses both pipelines.

6.14.20 Both route options interface with strategic SSE 275kV overhead electrical lines at two locations. The Pink route option is considered to have more complex interfaces than the Brown route option.

6.14.21 The Brown route option has more utility interfaces than the Pink route option. The Pink route option has more complex interfaces with strategic infrastructure.

6.14.22 The Brown route option is considered to be slightly more favourable due to additional complexities of the 275kV crossings for the Pink route option.

Non-Motorised Users

6.14.23 There are no significant engineering issues associated with provision for NMUs for either route option. NMU facilities will be designed and developed during DMRB Stage 3. The Brown route option is considered to have more opportunity to improve NMU facilities based on the number of the existing NMU routes and settlements in its vicinity.

Health and Safety Considerations

6.14.24 There are a number of elements which pose particular health and safety and constructability challenges. The Pink route option poses six such challenges compared with nine for the Brown route option. The Brown route option has more interaction with the existing A96. The Pink route option passes through a less constrained area with slightly more favourable topography than the Brown route option. Considering both the number and complexity of these issues, the Pink route option is considered slightly more favourable.

Scheme Resilience

6.14.25 The Pink and Brown route options perform similarly in terms of winter resilience since both pass through limited elevated and exposed topography. Both route options are expected to require similar levels of winter maintenance activities.

6.14.26 Both the Pink and Brown route options are expected to provide high levels of operational resilience. However, the Carden Junction on the Brown route option provides more diversion and emergency access options.

6.14.27 In overall terms, the Brown route option is considered to be marginally more favourable from a resilience perspective.

7 Engineering Assessment: Pitcaple to Kintore

7.1 Introduction

7.1.1 This chapter describes the findings of the engineering assessment of the Violet and Orange route options between Pitcaple and Kintore. It includes a description of the engineering features of each route under the following subjects:

- Engineering constraints;
- Engineering description of the route option mainline alignments, junctions, local roads and accesses;
- Departures from standard;
- Topography and land use;
- Geotechnical engineering and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users;
- Health and Safety Considerations; and
- Resilience.

7.1.2 The Violet and Orange route options are shown in Volume 5, Figures 7.1 to 7.7.

7.2 Engineering constraints

7.2.1 The route options have been developed to take into consideration the following constraints:

- The topography of the area, which is generally undulating and includes the valleys of the River Urie and River Don;
- The existing A96 which is discussed in Volume 1, Part 1, Chapter 2, Existing Conditions;
- The existing local road network;
- The Aberdeen to Inverness Railway Line which runs north-west to south-east through Pitcaple, Inverurie and Port Elphinstone;
- Settlements including Pitcaple, Inveramsay, Inverurie, Port Elphinstone and Kintore and scattered residential properties;
- Designated Local Development Plan sites;
- Existing structures including road bridges and accommodation underpasses, abutments, retaining walls and drainage culverts;
- Commercial and agricultural properties and holdings within the study area;

- The River Urie and its associated floodplain, which flows south-east largely following the existing A96 route and along the eastern edge of Inverurie, before discharging into the River Don;
- The River Don and its floodplain, which flows from west to east at the south end of Inverurie, at Port Elphinstone where it meets the River Urie and continues south-eastwards towards Aberdeen;
- Various other smaller watercourses and their floodplains; and
- Public and private utility infrastructure.

7.2.2 The design process was also guided by the environmental constraints as described in Volume 1, Part 1, Chapter 3, Development of Route Options and Volume 1, Part 2, Chapter 4, Engineering Overview. These environmental constraints are discussed within Volume 2, Part 3, Environmental Assessment.

7.3 Engineering Description – Violet Route Option

Mainline Alignment

7.3.1 The Violet route option is shown in Volume 5, Figures 7.1 to 7.4 This route option is approximately 17.7km in length.

7.3.2 Describing from west to east, the route option is a continuation from either the Pink and Brown route options and commences north of Pitcaple Quarry, south of Burnside of Pitcaple and to the east of the Burn of Durno.

7.3.3 The Violet route option commences in cutting on a right-hand curve and then rises out of cutting in a south-easterly direction onto shallow embankment at Pitscurry Moss.

7.3.4 The route option continues south-east on an uphill gradient on shallow embankment bridging over the U77C Mackstead to Daviot Road. Following existing topography, the route option changes to a downhill gradient beyond Mackstead.

7.3.5 The route option continues south-east on a right-hand curve on embankment approaching the proposed Daviot Junction, south of Broadward. Continuing on a right-hand curve the route option bridges over the realigned B9001 local road at the Daviot Junction and crosses the realigned Ides Burn.

7.3.6 Continuing south-east, the Violet route option runs parallel to the B9001 close to existing ground level. The route option then continues into a downhill gradient to the south-west of Hillhead of Lethenty in shallow cutting. Surrounding topography falls from 85m AOD to 75m AOD.

7.3.7 On approach to the proposed Uryside Junction West, on a downhill gradient, the route option moves out of shallow cutting onto shallow embankment. Surrounding topography falls from 70m AOD to 65m AOD to a low point as it crosses the Lochter Burn and the line of the existing U82C Auchencleith to Lethenty Road.

7.3.8 The Violet route option continues south-east on a left-hand curve running adjacent to the existing Portstown Link Road as it climbs with surrounding topography towards the B9170 and the proposed Uryside Junction East. The route option crosses over the B9170 and continues on an uphill gradient on embankment through an area of woodland towards Hillbrae.

7.3.9 The route option continues climbing in a south-easterly direction on a right-hand curve at grade, south-west of Hillbrae. The C69C Inverurie to Old Bourtie Road crosses the route option on an overbridge.

7.3.10 Continuing south-eastwards, the Violet route option follows the contours of the Hill of Selbie in cutting on a left-hand curve where it changes to a downhill gradient.

7.3.11 Continuing on a downhill gradient, in a south-easterly direction, the route option alignment straightens and passes through woodland south of Ordiefauld on embankment.

7.3.12 The route option continues on a downhill gradient and embankment in a south-easterly towards the B993. The Violet route option bridges over the realigned B993 before commencing a right hand bend to turn to the south.

7.3.13 The route option continues south on embankment passing Isaacstown, crossing over the access to Ashlea Grange and passing east of Altons Cottages. The route option then continues on a downhill gradient into a cutting as the surrounding topography rises locally where it then passes beneath an overbridge for the realigned C67C Kinmuck Road.

7.3.14 Continuing south on a downhill gradient the Violet route option follows a left-hand curve, with surrounding topography falling from 135m AOD to 110m AOD. The route option heads out of cutting onto a shallow embankment. The route option crosses two National Grid high pressure gas pipelines north-west of Heatherwick.

7.3.15 The route option continues southwards on embankment with an underbridge crossing over the realigned C68C Heatherwick Road and the Densy Burn. As the route option passes between Heatherwick and Hogholm, it enters a right-hand curve continuing downhill towards the River Don.

7.3.16 On approach to the River Don, the route option is largely within cutting to the north-west of Balbithan. It then clips the edge of a woodland before continuing south on a left-hand curve on a viaduct crossing of the River Don and floodplain.

7.3.17 To the south of the River Don, the route option crosses the Aberdeen to Inverness Railway Line and continues through the existing Tavelty Junction on a downhill gradient. Tavelty Junction requires remodelling to accommodate the Violet route option and its connections to the existing A96 to Inverurie and other local roads.

7.3.18 To the east of Tavelty Junction, an additional lane would be required on the existing A96 in the eastbound direction between Tavelty Junction and Gauchhill Junction. The lane gain requires widening of the existing A96 and the replacement of the existing Forrest Road overbridge. The additional lane is dropped at Gauchhill Junction where the Violet route option terminates by a direct tie-in to the existing A96 dual carriageway.

Junction Locations

7.3.19 There are four junctions on the Violet route option. New junctions are proposed with the B9001 and B9170 to the north of Inverurie while alterations would be required to two existing junctions at Kintore as the Violet route option ties into the existing A96.

7.3.20 The B9001 serves traffic from Daviot, Rothienorman and beyond travelling to the A96 at Inverurie. Daviot Junction to the south of Daviot is proposed for these road users. The Uryside Junction West also provides westbound slip roads onto the B9001.

7.3.21 The B9170 serves traffic to / from Oldmeldrum travelling to / from Inverurie. Uryside Junction East with eastbound slip roads is proposed to connect the Violet route option with the B9170. Accessibility between the Uryside West and East junctions would be available via the existing Portstown Link Road which would also serve destinations in north / eastern Inverurie along the B9001 and B9170.

7.3.22 The Violet route option interfaces with the existing A96 where it joins the existing dual carriageway at the existing Tavelty and Gauchhill junctions. A grade separated junction would be required between the Violet route option, the existing A96 and existing local roads in the vicinity of the existing Tavelty Junction. The eastbound diverge slip road at Gauchhill Junction also requires alterations to accommodate a lane drop arrangement.

Junction Layouts

Daviot Junction

7.3.23 Daviot Junction on the Violet route option would be located south of Broadwood, 1km south of Daviot. The junction maintains connectivity with the B9001 and C76C local roads. The junction would be a grade separated half cloverleaf arrangement, with a roundabout on each side of the mainline connected via a proposed underbridge.

7.3.24 The northern roundabout would be a four-arm roundabout connecting to the:

- Eastbound merge and diverge slip roads;
- Realigned B9001;
- Realigned C76C; and
- Link road to southern roundabout.

7.3.25 The southern roundabout would be a four-arm roundabout connecting to the:

- Westbound merge and diverge slip roads;
- Realigned B9001;
- Realigned C76C; and
- Link road to northern roundabout.

Uryside Junction

7.3.26 The Uryside Junction on the Violet route option would be located north of the Uryside area of Inverurie. The junction is in two elements, connected via the existing Portstown Link Road. These elements are referred to as Uryside Junction West and Uryside Junction East.

7.3.27 Access to and from the westbound carriageway would be via a new roundabout constructed adjacent to the existing B9001 to the north of the roundabout connecting the B9001, Portstown Link Road and U81C. Slip roads are in a half diamond arrangement.

7.3.28 Access to and from the eastbound carriageway would be via a new roundabout constructed on the line of the B9170 north of the Bourtie Industrial Park. Slip roads are in a half cloverleaf arrangement.

7.3.29 The western roundabout would be a four-arm roundabout connecting to the:

- Westbound merge slip road;
- Westbound diverge slip road;
- Realigned B9001 towards Inverurie; and
- Realigned B9001 towards Rothienorman.

7.3.30 The eastern roundabout would be a four-arm roundabout connecting to the:

- Realigned B9170 towards Oldmeldrum;
- Eastbound merge and diverge slip roads;
- Realigned B9170 towards Inverurie; and
- Realigned U82C.

Tavelty Junction

7.3.31 The Violet route option requires the reconstruction of the existing Tavelty Junction north of Kintore to accommodate the dual carriageway mainline and maintain connections to all local roads.

7.3.32 The junction would be a grade separated gyratory arrangement with the mainline above two proposed underpasses for the circulatory carriageway. The existing underpass may be able to be retained as one of the underpasses but would require extending to accommodate the Violet route option as it approaches on a different alignment compared to the existing A96.

7.3.33 The gyratory would be a seven-arm roundabout connecting to the:

- Eastbound diverge slip road;
- B987 to / from Kintore;
- Eastbound merge slip road;
- Westbound diverge slip road;
- Tom's Forest Quarry access;
- Existing A96 (realigned) to / from Inverurie; and
- Westbound merge slip road.

7.3.34 The eastbound merging traffic flows, primarily from Inverurie via the realigned A96, would require a lane gain arrangement in the eastbound direction on the existing A96. It is therefore necessary to widen the existing A96 eastbound from the junction which results in a requirement to demolish and replace the existing Forest Road Overbridge.

Gauchhill Junction

7.3.35 The existing Gauchhill Junction currently contains west facing slip roads only which connect to the B977. Traffic volumes require the provision of an additional eastbound lane on the existing A96 between Tavelty Junction and Gauchhill Junction. The eastbound diverge slip road at Gauchhill Junction requires alterations to accommodate a lane drop arrangement, returning the eastbound carriageway to two-lanes beyond the slip road diverge nose. The existing

westbound carriageway and slip road would be unaltered as would both eastbound and westbound slip road junctions with the B977.

Local Roads and Accesses

7.3.36 Table 7.1 describes the treatment required for existing local roads affected by the Violet route option. Accesses that are not affected are not listed in the table.

Table 7.1 Local Roads and Accesses - Violet Route Option

Local Road / Access	Name	Treatment
U77C	Mackstead to Daviot Road	B
Local Access	Mossfield Access	R
C76C	Whiteford to Fingask Road	J
B9001	Inverurie to Forgue Road	J
Local Access	Broadward	R
U83C	Harlaw to Inveramsay Road	R
Local Access	Hillhead of Lethenty Access	B
U82C	Auchencleith to Lethenty Road	R
B9001	Inverurie to Forgue Road	J
B9170	Inverurie to New Deer Road	J
U82C	Auchencleith to Lethenty Road	J
C69C	Inverurie to Old Bourtie Road	B
B993	Whiterashes to Torphins Road	B
Local Access	Eastfield Access	R
Local Access	Ashlea Grange / Codwells / Isaacstown / Burnside Access	B
C67C	Kinmuck Road	B
Local Access	Altons Cottages	R
C68C	Heatherwick Road	B
Local Access	Hogholm Farm Stables	R
Local Access	Heatherwick Farm Cottages	R
Existing A96	Existing A96 Tavelty to Inverurie	J
B987	Kintore Road	J
Local Access	Kintore Railway Station, Whinstone and Tavelty Farm	J
Local Access	Tom's Forest Quarry	J
Local Access	Kintore Business Park and Kintore New Cemetery	R
C113C	Forest Road / Townhead Road	B

Key to table:	
B	Bridge to be provided over or under the new A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge.
J	Road to be diverted through or connected to a new grade separated junction with the A96
R	Realignment or amendment of a public road or existing access to a private property.

7.3.37 Each of the above local roads and accesses are described below.

U77C Mackstead to Daviot

7.3.38 This route connects Mackstead to Daviot, running in a northerly direction from the C76C at Mill of Pitcaple to Daviot where it meets the C77C.

7.3.39 The U77C would be realigned and an underbridge would be provided to cross the new dual carriageway to maintain access.

Mossfield Access

7.3.40 This is an access to Mossfield from the U77C.

7.3.41 A new access onto the realigned U77C would be provided required.

C76C Whiteford to Fingask Road

7.3.42 This route connects Whiteford to Fingask House, running in an easterly direction from Whiteford to the A920 east of Fingask. The C76C intersects the Violet route option to the south of Broadward.

7.3.43 The C76C would connect to the realigned B9001 through the Daviot Junction. New sections of road would be constructed to both the north and south side of the junction to connect the C76C to Daviot Junction.

B9001 Inverurie to Forgue Road

7.3.44 This is the main route connecting Inverurie to Rothienorman. It runs in a northerly direction from Inverurie town centre to the A97 north of Huntly via Rothienorman and Forgue.

7.3.45 The B9001 south of Broadward would be realigned to accommodate the Daviot grade separated junction. The B9001 would be realigned between the two roundabouts at the junction and an underbridge would be provided to cross the new dual carriageway.

Broadward Access

7.3.46 There are two accesses to Broadward from the B9001.

7.3.47 Both accesses would be amended to connect with the realigned B9001 to the north of Daviot Junction to maintain access.

U83C Harlaw to Inveramsay Road

7.3.48 This route connects Harlaw to Mill of Den, running in a northerly direction from Harlaw to the C76C north of Gunhill.

7.3.49 The U83C would be realigned to meet the realigned B9001 south of the Daviot Junction to maintain access.

Hillhead of Lethenty Access

7.3.50 This is an access to Hillhead of Lethenty from the B9001. It runs in a northerly direction from the B9001 to Hillhead of Lethenty.

7.3.51 The current access to Hillhead of Lethenty from the B9001 would be stopped up. A replacement access would be created from the B9001 near to Uryside westbound junction under the new A96 and running parallel with the Violet route option to tie into the existing access at Lethenty.

U82C Auchencleith to Lethenty Road

7.3.52 This is the route from the C76C at Auchencleith to B9170 near Mill of Collyhill. It runs in a south-easterly direction from the C76C at Auchencleith to the B9170 at Collyhill with a branch from Lethenty Station where it meets the B9001.

7.3.53 The U82C branch from Lethenty Station to the B9001 would connect to the realigned Hillhead of Lethenty Access.

B9001 Inverurie to Forgue Road

7.3.54 This is the main route connecting Inverurie to Rothienorman. It runs in a northerly direction from Inverurie town centre to the A97 north of Huntly via Rothienorman and Forgue.

7.3.55 The B9001 south of Lethenty Mill would be realigned to tie into the roundabout at Uryside Junction West.

B9170 Inverurie to New Deer Road

7.3.56 This is the main route connecting Inverurie to Oldmeldrum. It runs in a northerly direction from Inverurie to New Deer via Oldmeldrum and Methlick.

7.3.57 The B9170 would be realigned and a four-arm roundabout as part of Uryside Junction East. South of the junction an underbridge would be provided to cross the Violet route option.

U82C Auchencleith to Lethenty Road

7.3.58 This is the route from the C76C at Auchencleith to B9170 near Mill of Collyhill. It runs in a south-easterly direction from the C76C at Auchencleith to the B9170 at Collyhill.

7.3.59 The U82C would connect to the roundabout for the Uryside Junction East.

C69C Inverurie to Old Bourtie Road

7.3.60 This route connects Uryside (Inverurie) to Old Bourtie. It runs in a north-easterly direction from the B9170 at Uryside to the A947 at Kingoodie via Old Bourtie.

7.3.61 An overbridge would be provided to cross the Violet route option to maintain access.

B993 Whiterashes to Torphins Road

7.3.62 This route connects Whiterashes to Torphins, running in a south-westerly direction from the A947 at Whiterashes to Torphins via Inverurie and Kemnay.

7.3.63 The B993 would be realigned with an underbridge provided to cross the Violet route option.

Eastfield Access

7.3.64 This is a private access from the B993 to Eastfield.

7.3.65 The access would be extended to connect with the realigned B993.

Ashlea Grange / Codwells / Isaacstown / Burnside Access

7.3.66 This is an access to Ashlea Grange, Codwells, Isaacstown and Burnside from the existing C67C.

7.3.67 An underbridge would be provided to cross the Violet route option to maintain access.

C67C Kinmuck Road

7.3.68 This route connects the B993 to the B977 via Kinmuck. Its runs in a south-easterly direction from the B993 at Keith Hall Manse to the B977 at Cothill.

7.3.69 The C67C would be realigned with an overbridge provided to cross the Violet route option.

Altons Cottages

7.3.70 This is an access to Altons Cottages from the C67C.

7.3.71 The route would be extended to connect with the realigned C67C to maintain access.

C68C Heatherwick Road

7.3.72 This route connects the B993 to the B977 via Heatherwick. It runs in a south-easterly direction from the B993 Kinkell Belt to the B977 Milton of Fintray.

7.3.73 The C68C would be realigned with an underbridge provided to cross the Violet route option.

Hogholm Farm Stables

7.3.74 This is an access to Hogholm Farm Stables from the C68C.

7.3.75 The access would be amended to connect with the realigned C68C.

Heatherwick Farm Cottages

7.3.76 This is an access to Heatherwick Farm Cottages from the C68C.

7.3.77 The existing access to the C68C would be retained as would a section of the existing C68C which would be connected to the realigned C68C to maintain access.

Existing A96 – Inverurie to Tavelty Junction

7.3.78 This is a dualled section of the existing A96 between Thainstone Roundabout and through the existing Tavelty Junction.

7.3.79 The existing A96 would be realigned south of Kintore New Cemetery to connect with the new Tavelty Junction gyratory roundabout. The realignment would be dual carriageway standard maintaining a dual carriageway connection between Tavelty Junction and Inverurie Roundabout at Port Elphinstone.

B987 Kintore Road

7.3.80 The B987 Kintore Road connects to the eastern roundabout of the existing Tavelty Junction.

7.3.81 The B987 would be realigned to connect with the gyratory roundabout at the reconstructed Tavelty Junction.

Kintore Railway Station, Whinstone and Tavelty Farm

7.3.82 Access for Kintore Railway Station and adjacent properties is taken from the B987 Kintore Road.

7.3.83 This access would be amended to connect to the realigned B987 Kintore Road.

Tom's Forest Quarry

7.3.84 Tom's Forest Quarry Road connects to the western roundabout at the existing Tavelty Junction.

7.3.85 This road would be realigned to connect with the gyratory roundabout at the reconstructed Tavelty Junction.

Kintore Business Park and Kintore New Cemetery

7.3.86 Access to Kintore Business Park is currently taken from the eastbound A96 via a left in / left out junction.

7.3.87 Existing access to Kintore New Cemetery and The Steading is taken alongside the existing A96 from a junction with Tom's Forest Road.

7.3.88 Part of the existing dualled A96 would be re-used to provide access to Kintore Business Park, The Steading and Kintore New Cemetery from a junction with the realigned existing A96.

C113C Forest Road / Townhead Road

7.3.89 This road runs west from Kintore, crossing the existing dualled A96 to the south of Tavelty Junction on the existing Forest Road overbridge.

7.3.90 Provision of an additional lane eastbound between Tavelty and Gauchhill junctions requires construction of a replacement overbridge to maintain access.

7.4 Engineering Description – Orange Route Option

Mainline Alignment

7.4.1 The Orange route option is shown in Volume 5, Figures 7.5 to 7.7. This route option is approximately 12.8km in length.

7.4.2 Describing from west to east, the route option is a continuation from either the Pink and Brown route options and commences north of Pitcaple Quarry, south of Burnside of Pitcaple and to the east of the Burn of Durno.

7.4.3 The Orange route option starts in cutting on a right-hand curve and then rises out of cutting in a south-easterly direction onto shallow embankment across Pitscurry Moss where Pitscurry Junction is proposed, enabling connection with the existing B9001.

7.4.4 Leaving Pitscurry Junction, the route option continues the right-hand curve turning southwards close to the existing ground level on a downhill gradient into shallow cut south-west of Mackstead.

7.4.5 As the topography falls towards the River Urie, the route option runs onto shallow embankment as it runs parallel to the U77C Mackstead to Daviot road. The

mainline downhill gradient steepens towards the River Urie and approaches the C76C Whiteford to Fingask Road in cutting. The C76C is subject to realignment and crosses the Orange route option on an overbridge.

7.4.6 Passing Legatesden Farm, the surrounding topography falls more sharply from 85m AOD to 65m AOD as the route option emerges from cutting onto embankment, as it continues south towards the River Urie.

7.4.7 The Orange route option changes onto an uphill gradient before crossing the River Urie and its floodplain on a viaduct which also passes over the existing A96, the Aberdeen to Inverness Railway line and the realigned U83C unclassified road near Station Cottages.

7.4.8 West of Milton of Inveramsay, local topography rises sharply from 65m AOD to 85m AOD. The route option cuts into the slope as it runs parallel to the existing A96 along the contours of Gallows Hill.

7.4.9 The route option turns south-east on a left-hand curve on an uphill gradient across the Strathnaterick Burn and its local valley. The route option is on embankment through the Drimmies Junction including an underbridge over a realignment of the C120C Inverurie to Mill of Carden Road, north-west of Drimmies Cottages.

7.4.10 Passing Drimmies cottages, the route option heads into cutting as it passes across steep side long ground to the west of the existing A96 and east of Netherton of Balqhain. The route option crosses National Grid high pressure gas pipelines before diverging away from the existing A96 corridor and passing to the west of Dilly Hill.

7.4.11 West of Dilly Hill, the Orange route option passes beneath 275 kV high voltage overhead powerlines and is crossed by a realignment of the U120aC Mains of Balquhain to Dubston Road upon an overbridge.

7.4.12 Continuing south beyond Dilly Hill, the surrounding topography falls as the route option heads onto embankment on approach to the Blackhall Road Junction.

7.4.13 Between Dubston and Alton, the route option crosses the existing Blackhall Road / Newbiggin Access Road where a grade separated junction would be provided. From this location, the route option continues on shallow embankment on a downhill gradient, turning south-east on a left-hand curve at Burnside of Manar.

7.4.14 East of Newseat of Manar, the Orange route option continues south-east on a downhill gradient passing through a shallow cutting and then towards the River Don valley. The route option passes over the River Don valley (105m AOD to 60m AOD) on a viaduct. The River Don crossing bridges over the realigned C116C Dalbraidie to Inverurie Road, and the River Don.

7.4.15 South-west of Haughton Farm, the route option turns on a left-hand curve and passes along the east side of Roquharold Hill, on side long ground at the edge of an area of woodland.

7.4.16 The route option continues east across the Woodend Burn, heading on an uphill gradient. It passes beneath SSE 275kV high voltage overhead powerlines. The B993 Whiterashes Torphins Road crosses via an overbridge before the mainline turns south-east on a right-hand curve.

7.4.17 South-west of Crichie Cottages and Crichie Farm, the route option is in a significant cutting across the north-east slope of Shaw Hill, below Crichie Plantation.

7.4.18 Local topography falls sharply from 130m AOD at Shaw Hill to 65m AOD at the interface with existing A96. Continuing south-east from Shaw Hill, the route option

is on a downhill gradient and emerges from significant cutting onto embankment at Thainstone Junction.

7.4.19 North-east of Thainstone House, the route option turns south-east on a right-hand curve on a downhill gradient to tie into the existing A96 dual carriageway adjacent to Aberdeen and Northern Marts Thainstone Centre.

Junction Locations

7.4.20 The Orange route option does not interface directly with the B9001 north-west of Inverurie. However, this road carries significant volumes of traffic to Inverurie and to the existing A96 at Inverurie from Daviot, Rothienorman and beyond. A grade separated junction at Pitscurry would be provided offering a connection between the Orange route option and the B9001 to the north-west of Inverurie.

7.4.21 To the north-west of Inverurie, the Orange route option runs in parallel to the existing A96 from Inveramsay to approximately 900m south of the C120C junction with the existing A96. A grade separated junction is proposed at Drimmies providing access to the west of Inverurie, the existing A96 and to the Chapel of Garioch area.

7.4.22 A grade separated junction is proposed at the interface of the Orange route option and the C116C and Blackhall Road west of Inverurie to serve the west of Inverurie and routes via Blackhall Roundabout.

7.4.23 A further grade separated junction is proposed to the south of Inverurie at Thainstone. This would connect Inverurie via the junction and a realigned section of dual carriageway from Inverurie Roundabout to the Orange route option and the existing A96 to / from Aberdeen. A link road on the west side of the grade separated junction would provide access for residential and commercial properties including Aberdeen and Northern Marts Thainstone Centre.

Junction Layouts

Pitscurry Junction

7.4.24 Pitscurry Junction on the Orange route option would be located due north of Pitcaple Quarry, south-east of Daviot and north-east of Whiteford.

7.4.25 The junction connects to the B9001 and U77C to the east via a new link road and roundabout. The junction is grade separated, with a half-diamond arrangement for the eastbound carriageway and a loop arrangement for the westbound carriageway. A roundabout is located on the east side of the route option mainline. An overbridge links the roundabout and the westbound loop slip roads.

7.4.26 The eastern roundabout would be a four-arm roundabout connecting the:

- Eastbound diverge slip road;
- Eastbound merge slip road;
- Link road to new roundabout connecting U77C and B9001; and
- Westbound slip roads.

Drimmies Junction

7.4.27 Drimmies Junction on the Orange route option would be located 2.2km north-west of Inverurie, south-west of Inveramsay and east of Drimmies Cottages and Drimmies Farm.

7.4.28 The junction maintains connectivity with the existing A96 to the west and east and the Chapel of Garioch area via the C120C local road. The junction would be grade separated, with direct slip roads serving the westbound carriageway and a half cloverleaf arrangement serving the eastbound carriageway.

7.4.29 The eastbound diverge and merge slip roads connect to the realigned C120C via a priority T-junction on the east side of the mainline of the Orange route option.

7.4.30 The westbound diverge and merge slip roads connect to the realigned C120C via a T-junction on the west side of the mainline.

Blackhall Road Junction

7.4.31 Blackhall Road Junction on the Orange route option would be located 1.4km west of Blackhall Roundabout. The junction maintains connectivity with the existing A96 to the east via Blackhall Road and to the west via the C116C. The junction would be grade separated, with a half cloverleaf arrangement serving the westbound carriageway. A roundabout with direct slip roads serves the eastbound carriageway. The Newbigging access road would require diversion through the new underbridge.

7.4.32 The eastern roundabout would be a five-arm roundabout connecting the:

- Eastbound diverge slip road;
- Eastbound merge slip road;
- Realigned C116C towards Blackhall Road;
- Realigned C116C towards Burnside of Manar; and
- Realigned Newbigging access road.

7.4.33 The westbound diverge and merge slip roads connect to the realigned Newbigging access road via a priority T-junction.

Thainstone Junction

7.4.34 Thainstone Junction on the Orange route option would be located directly north of the Aberdeen and Northern Marts Thainstone Centre, south of Inverurie, primarily providing connectivity to the existing A96 towards Port Elphinstone and Inverurie.

7.4.35 A section of the existing A96 from Port Elphinstone would be realigned to connect to the junction. An additional link road would be constructed south to Thainstone Business Park and Aberdeen and Northern Marts Thainstone Centre. The junction would be a grade separated gyratory arrangement beneath the Orange route option mainline.

7.4.36 The gyratory would be a six-arm gyratory roundabout connecting the:

- Eastbound diverge slip road;
- Eastbound merge slip road; and
- Realigned existing A96, north-east to Inverurie and Port Elphinstone roundabout;
- Westbound diverge slip road;
- Westbound merge slip road; and

- U113C link road extension past Aberdeen and Northern Marts Thainstone Centre to the U113C Tom's Forest Road.

7.4.37 As this junction would be the closest to Aberdeen serving Inverurie, the predicted traffic volumes are such that a lane gain in the eastbound direction would be required on the eastbound merge slip road. The additional lane eastbound would be provided between the proposed Thainstone Junction and the existing Tavelty Junction where it would terminate at a lane drop diverge layout. Tavelty Junction eastbound diverge slip road would be amended to accommodate the lane drop but would otherwise remain unaltered.

Local Roads and Accesses

7.4.38 Table 7.2 described the treatment required for existing local roads affected by the Orange route option. Accesses that are not affected are not listed in the table.

Table 7.2 Local Roads and Accesses - Orange Route Option

Local Road / Access	Name	Treatment
B9001	Inverurie to Forgue Road	R
U77C	Mackstead to Daviot Road	R
Local Access	Pitcaple and Legatesden SSSI	R
C76C	Whiteford to Fingask Road	B
Local Access	Legatesden Farm	R
Local Access	Millwood Access	R
Existing A96	Aberdeen to Inverness	B
U83C	De-trunked section of the A96 (Inveramsay)	B
C120C	Inverurie to Mill of Carden Road	J
Local Access	Drimmies Local Access	R
U120aC	Mains of Balquhain to Dubston Road	B & R
Local Access	Newbigging Access Road	J
Local Access	Alton Cottages Access	R
C116C	Dalbraidie – Burnhervie – Inverurie Road	J, R & B
Local Access	Newseat of Manar Access	R
B993	Whiterashes to Torphins Road	B
Local Access	Haughton Farm Access	R
Existing A96	Aberdeen to Inverness	J
Local Access	Thainstone House Hotel	R
U114C	Thainstone Road, Aberdeen and Northern Marts Thainstone Centre & Thainstone Business Park	R

Local Road / Access	Name	Treatment
U113C	Tom's Forest Road	J
Local Access	Thainstone Roundabout Eastern Access, including Kirkwood Commercial Park	R
Local Access	Kintore Business Park Access	R

Key to table:

B	Bridge to be provided over or under the new A96 allowing continuation of road. Includes realignment of existing road as required to connect to the bridge
J	Road to be diverted through or connected to a new grade separated junction with the A96.
R	Realignment or amendment of a public road or existing access to a private property.

7.4.39 Each of the above local roads and accesses are described below.

B9001 Inverurie to Forgue Road

7.4.40 This route connects Inverurie (Uryside) and Daviot and crosses the U77C Mackstead to Daviot Road, immediately south of Mains of Glack.

7.4.41 The link road for the Pitscurry Junction connects with the B9001 at the existing crossroads formed by the B9001 and the U77C. Both the B9001 and the U77C would be realigned into a roundabout serving all routes.

U77C Mackstead to Daviot Road

7.4.42 This route connects Mackstead to Daviot. It runs in a northerly direction from the C76C at Mill of Pitcaple to Daviot where it meets the C77C. It crosses the B9001 at Mains of Glack before reaching Daviot.

7.4.43 The U77C at its junction with B9001 would be realigned into a roundabout serving the U77C, the B9001 and a new link road to Pitscurry Junction. The U77C at its junction with the C76C would be realigned to tie into a realigned section of the C76C Whiteford to Fingask Road.

Pitcaple and Legatesden SSSI

7.4.44 This is an access into Pitcaple and Legatesden SSSI from the U77C.

7.4.45 A new route onto the realigned U77C would be provided to maintain access.

C76C Whiteford to Fingask Road

7.4.46 This route connects Whiteford to Fingask House, running in an easterly direction from Whiteford to the A920 east of Fingask.

7.4.47 The C76C would be realigned with an overbridge provided to cross the Orange route option.

Legatesden Farm Access

7.4.48 This is an access to Legatesden Farm from the C76C.

7.4.49 A new route onto the realigned C76C would be provided to maintain access.

Millwood Access

7.4.50 This is an access to Millwood from the C76C.

7.4.51 A new route onto the realigned C76C would be provided to maintain access.

Existing A96

7.4.52 The existing A96 is the main trunk road between Inverness and Aberdeen.

7.4.53 The Orange route option would cross the existing A96 on a viaduct north of Inveramsay.

U83C De-trunked section of the A96 (Inveramsay)

7.4.54 This is an access to Station Cottages, Dier Cottage and Dockendale on a previously de-trunked section of the A96 at Inveramsay connecting to the existing A96 west of Inveramsay Bridge.

7.4.55 The U83C would be realigned under a viaduct carrying the Orange route option to maintain access.

C120C Inverurie to Mill of Carden Road

7.4.56 This route connects Inverurie, Drimmies, Chapel of Garioch and Mill of Carden. It runs in a north-westerly direction from Inverurie, crossing the existing A96 at Drimmies to re-connect with the existing A96 at Mill of Carden.

7.4.57 A section of the C120C would be realigned to accommodate the Drimmies grade separated junction, forming a new priority junction with the existing A96 to the north of the existing A96/C120C junction. An underbridge would be provided on the realigned C120C to cross the Orange route option to maintain existing along the C120C from the new junction with the existing A96.

Drimmies Local Access

7.4.58 The existing C120C provides access to four properties between its junction with the existing A96 at Drimmies and the Orange route option.

7.4.59 This section of the C120C would be retained to maintain access to the properties at Drimmies via the existing A96/C120C junction. The C120C would be stopped up immediately west of Drimmies Cottages where it is severed by the Orange route option. Access to the C120C west of the Orange route option would be via the realigned C120C at the new Drimmies Junction.

U120aC Mains of Balquhain to Dubston Road

7.4.60 This is a route connecting the C120C at Mains of Balquhain to the C116C at Dubston. It runs in a south-easterly direction from the C120C to the C116C.

7.4.61 The U120aC would be realigned with an overbridge provided to cross the Orange route option to maintain access.

7.4.62 The U120aC at its junction with the C116 would be amended to tie in with the realigned C116C at the new Blackhall Road Junction.

Newbigging Access Road

7.4.63 This is an access to several properties from the C116C east of Alton Cottages.

7.4.64 A section of the Newbigging access road would be realigned to accommodate the Blackhall Road grade separated junction. A new underbridge would be provided to cross the Orange route option to maintain access.

Alton Cottages Access

7.4.65 This is an access to Alton Cottages from the Newbigging access road.

7.4.66 A new route onto the realigned Newbigging access road would be provided to maintain access.

C116C Dalbraidie – Burnhervie – Inverurie Road

7.4.67 This is the route connecting the B993 at St James's Place, Inverurie to the C121C at Dalbraidie with a branch from Newseat to the existing A96 at Blackhall Roundabout. It runs in south-westerly direction from Inverurie to Dalbraidie. The branch provides a loop from St James's Place to the existing A96 at Blackhall Roundabout.

7.4.68 A section of C116C towards Blackhall Road and a section of the C116C at Burnside of Manar would both be realigned into a roundabout as part of the Blackhall Road grade separated junction.

7.4.69 A section of the C116C at Davah Lodge would be stopped up and realigned between Burnside of Manar and Davah Lodge.

7.4.70 A section of the C116C would be stopped up and would be realigned between Braeside and Coldwells to tie directly into the St James's Place section of the C116C. This realigned section of the C116C would pass under a viaduct carrying the Orange route option.

7.4.71 The C116C at Coldwells would be realigned to form a junction of the Blackhall Road branch of the C116C with the realigned C116C St James's Place section.

Newseat of Manar Access

7.4.72 This is an access to Newseat of Manar from the C116C.

7.4.73 A new access onto the realigned C116C would be provided to maintain access.

B993 Whiterashes to Torphins Road

7.4.74 This route connects Whiterashes to Torphins, running in a south-westerly direction from the A947 at Whiterashes to Torphins via Inverurie and Kemnay.

7.4.75 The B993 would be realigned with a new overbridge provided to cross the Orange route option to maintain access.

Haughton Farm Access

7.4.76 This is an access to Haughton Farm from the U115C.

7.4.77 The existing access from the U115C would be stopped up and a new route onto the realigned B993 would be provided to maintain access.

Existing A96

7.4.78 The existing A96 is the main trunk road between Inverness and Aberdeen.

7.4.79 The existing A96 would be realigned from Inverurie Roundabout at Port Elphinstone to tie into with the gyratory at the new Thainstone Junction to provide access to the Orange route option.

Thainstone House Hotel

7.4.80 Access to Thainstone House Hotel is currently taken from a priority junction near to Thainstone Roundabout from the U114C.

7.4.81 A new priority junction would be formed onto the U113C link road extension from the new Thainstone Junction.

U114C Thainstone Road, Aberdeen and Northern Marts Thainstone Centre and Thainstone Business Park

7.4.82 This is an access to the Aberdeen and Northern Marts Thainstone Centre and the Thainstone Business Park from the existing A96 at Thainstone Roundabout.

7.4.83 The existing access would be stopped up and a new access provided onto the U113C link road extension from the new Thainstone Junction.

U113C Tom's Forest Road

7.4.84 This route connects the C113C at Ratchhill to the existing A96 at Fullerton via Clovenstone. It runs in a south-westerly direction from the existing A96 to the C113C. The junction with the A96 is restricted, allowing access and egress from the westbound carriageway only.

7.4.85 The access to the existing A96 would be stopped up and the U113C would be realigned and extended past Aberdeen and Northern Marts Thainstone Centre to tie into the gyratory at the new Thainstone Junction.

Thainstone Roundabout Eastern Access, including Kirkwood Commercial Park

7.4.86 A number of industrial and residential properties gain access from the east arm of Thainstone Roundabout. This includes the residential properties of Murrayfield, Fullerton, Riverside House and Sangara. The access road also leads to Kirkwood Commercial Park.

7.4.87 The existing access to Thainstone Roundabout would be stopped up and a new link road would be created to tie in with Mill Road. The existing junction of Mill Road and the B993 at Port Elphinstone provides access to Inverurie and to the existing A96 via Inverurie Roundabout.

Kintore Business Park Access

7.4.88 This is an access to Kintore Business Park from the existing A96. The junction with the A96 is restricted allowing access and egress from the eastbound carriageway only.

7.4.89 The existing access would be stopped up and a new access road would be provided parallel to the existing A96 connecting to the B987 at Kintore. Access to all directions can be made via the B987 connection to Tavelty Junction.

7.5 Departures from Standard

7.5.1 Both route options have been designed in compliance with the Design Manual for Roads and Bridges (DMRB) without Departures from Standard or relaxations at this stage.

7.5.2 Departures or relaxations may be introduced during future design development of the Preferred Option during DMRB Stage 3, to reduce environmental impacts or improve value for money, as appropriate.

7.6 Topography and Land Use

Topography

7.6.1 Both route options would introduce changes to the existing topography through construction of cuttings and embankments, grade separated junctions, structures, attenuation basins, watercourse diversions and local road realignments.

7.6.2 The topography surrounding the Violet route option is a combination of local undulating and hilly terrain. The Violet route option features extended sections of at-grade road or embankment from Pitcaple to around Keith Hall. The remainder of the section features a series of cuttings with a long viaduct crossing over the River Don and adjacent floodplain to the north of Kintore.

7.6.3 The topography surrounding the Orange route option is a combination of local undulating and hilly terrain and includes the valleys of the River Urie and River Don. There are large cuttings and embankments throughout the route option. There are two major bridge crossings – a viaduct over the River Urie and floodplain and another over the valley of the River Don.

7.6.4 The impact of the route options upon the local landscape is considered in Volume 2, Part 3, Chapter 17, Landscape.

Land use

7.6.5 Both the Violet and Orange route options are largely surrounded by agricultural land as well as areas of woodland and communities (notably Inverurie and Kintore) and scattered properties. The Orange route option encroaches into LDP land associated with development at Crichie, south-west of Inverurie.

7.6.6 Land-use is considered in further detail in Volume 2, Part 3, Chapter 12, People and Communities and Chapter 13, Agriculture, Forestry and Sporting Interests.

7.7 Geotechnics and Earthworks

Existing Ground Conditions

Sources of Information

7.7.1 Sources of information used in the assessment of likely ground conditions are as described in Paragraph 4.3.26.

7.7.2 The study area used for the identification of ground conditions in this report is defined by a 1km buffer around the route options.

General Ground Conditions

Superficial Geology

7.7.3 The area between Pitcaple and Kintore is underlain by a wide variety of superficial deposits and can be split into two main categories:

- Valleys and floodplains of the River Don and River Urie which are underlain by a variety of recent fluvial deposits, including alluvium and river terrace

deposits, and glacial deposits including glaciofluvial sheet deposits and glaciolacustrine deposits.

- Areas of higher ground and areas away from major watercourses, which are characteristically underlain by glacial till and shallow rock where there is no drift cover, typically in areas of higher ground.

7.7.4 Superficial deposits between Pitcaple and Kintore are summarised in Table 7.3 and in Volume 5, Figures 7.8 to 7.12.

Table 7.3 Superficial Deposits within the Study Area (Pitcaple to Kintore)

Strata	Typical Description	Distribution
Glacial Till (Banchory Till Formation)	Sandy diamictons and clayey diamictons deposited by glacial ice, with clasts of various sizes and origins.	Extensive distribution in areas away from major watercourses. Absent from some areas of higher ground, where rock is typically mapped at the surface.
Glaciofluvial Sheet Deposits	Predominantly granular material deposits by glacial meltwater, typically comprising sandy gravel with cobbles, boulders and relatively little silt / clay.	Large spreads of glaciofluvial sheet deposits shown in the valley of the River Urie, and in the valley of the River Don around Inverurie. Small areas of glaciofluvial material shown in vicinity of other minor watercourses.
Alluvium	Compressible silty clay with layers of silt, sand, peat and basal gravel, deposited by rivers.	Alluvium distributed in the centre of the valleys of the River Don and River Urie and local to minor watercourses such as the Lochter Burn and Gourock Burn.
River Terrace Deposits (undifferentiated)	Gravel, sand, silt and clay with lenses of peat, deposited by rivers.	Local to the River Don Valley at Port Elphinstone, Tavelty and Kintore and to the River Urie at Uryside.
Glaciolacustrine Deposits (Glen Dye Silts Formation)	Laminated silt, clay and silty sand, with peat and gravel. Deposited in lakes of glacial meltwater.	Mapped in localised areas to the south of the River Urie at Conglas, east of the River Urie at Uryside and in the valley of the Lochter Burn from Muirton to the River Urie.
Peat	An accumulation of partially decomposed vegetation and organic material.	Occurs in isolated small patches local to Sunnybrae, Hillbrae, and Cairntown Wood. Cluster of peat areas mapped between Broadward and Pitcaple, including a larger area of peat at Pitscurry Moss.
Alluvial Fan Deposits	Detrital material of varying clast sizes, deposited by rivers at the mouth of tributary valleys.	Very localised area of Alluvial Fan deposits at Legatesden Farm near Pitcaple.

Artificial Ground

7.7.5 Artificial Ground is described as areas where the ground surface has been significantly modified by human activity. The BGS Artificial Ground mapping shows several areas of Artificial Ground between Pitcaple and Kintore, as summarised in Table 7.4.

Table 7.4 Artificial Ground within the Study Area (Pitcaple to Kintore)

Category	Classification	Distribution
Infilled Ground	Areas where the ground has been cut away and then wholly or partially backfilled.	Large areas of infilled ground to the north-west of Kintore on either side of the Bridgealehouse Burn and beneath Kintore Business Park.
Made Ground	Man-made deposits such as embankments and spoil heaps on the natural ground surface.	Small areas shown on maps, local to Govals, Sunnybrae, adjacent to the River Urie south of the B9170 and various small pockets within Inverurie and Port Elphinstone.
Worked Ground	Areas where the ground has been cut away, such as quarries and road cuttings.	Adjacent to and beneath the existing A96 at Port Elphinstone, Tavelty and Kintore and at Pitscurry Quarry and Legatesden Quarry.

7.7.6 In addition to the areas of artificial ground identified in Table 7.4, it is anticipated that additional areas of made ground are likely to be present locally associated with the development of infrastructure, residential properties, farm properties and industrial and commercial activities. There are numerous former pits and quarries within the study area which may have been infilled with spoil or waste materials.

7.7.7 Data provided by the Scottish Environmental Protection Agency (SEPA) shows a number of registered landfill sites between Pitcaple and Kintore. A number of closed former landfill sites are present in the south of the section between Port Elphinstone and Kintore. There are no active landfill sites within the study area. The types of waste accepted by the former landfill sites is not stated and the nature of materials within the landfill sites is unknown.

7.7.8 The composition of any made ground, landfill or infilled ground is unknown and across the scheme it is likely to comprise a highly variable mixture of engineered-fills, road pavement make-up, reworked soils and rock fragments, as well as man-made materials, waste and spoil. Historic buried structures and man-made obstructions are also likely to be present in the vicinity of current and former buildings and infrastructure.

7.7.9 Recorded areas of artificial ground are shown in Volume 5, Figures 7.8 to 7.12.

Bedrock Geology

7.7.10 The majority of the study area between Pitcaple and Kintore is underlain by metasedimentary rocks of the Aberdeen Formation, which is part of the Argyll Group. Within the study, the Aberdeen Formation predominantly comprises interbedded units of psammite and semi-pelite, with subsidiary pelite. The Aberdeen Formation also contains a zone of hornfelsed psammite and hornfelsed semi-pelite at the geological contact with the Middle Zone of the Insch Pluton in

the north of the study area. The BGS memoir[11] states that the range of lithologies within the Aberdeen Formation (and other formations of the Argyll Group) range from slates and phyllites through to schists and migmatitic gneisses, but that lithology is not that well understood due to the lack of outcrop and exposures in the area. Inclined foliation planes within the Aberdeen Formation are shown to dip predominantly to the north-west at angles between 34° and 78°.

7.7.11 According to the BGS geological map in the south of the study area, the Kemnay Pluton underlies Kintore and is described as a foliated muscovite-biotite granite. Minor outliers of the Kemnay Pluton can be found at Craigforthie, Crichie and Port Elphinstone.

7.7.12 Two zones of the Insch Pluton are present in the north and north-west of the study area. The Lower Zone of the Insch Pluton is mapped between Oldmeldrum and Hillhead of Lethenty and is formed of serpentinised mafic and ultramafic igneous rocks including troctolites, serpentinites and olivine-gabbros. The Middle Zone of the Insch Pluton is mapped from the north of Inveramsay and comprises norite and gabbro-norite, which are mafic igneous rocks.

7.7.13 Minor igneous intrusions of metamorphosed pre-Caledonian amphibolite and hornblende schist are shown to intrude the Aberdeen Formation to the north-west of Inverurie. Other minor igneous intrusions shown to intrude the Aberdeen Formation include Siluro-Devonian Felsite, Carboniferous quartz-microgabbro, and pegmatites from the nearby Bennachie Pluton. The Middle Zone of the Insch Pluton is intruded by Ordovician microgranites and pegmatites.

7.7.14 Several inferred geological faults are shown within the study area, although the direction and magnitude of displacement is not stated and the extent of disturbed rock around faults is unknown. Both the Violet and Orange route options cross a number of east-west trending thrust faults between Inveramsay and Pitcaple around the contact between the Middle Zone of the Insch Pluton and the Aberdeen Formation.

7.7.15 Bedrock is shown at or close to surface on higher ground including areas around Pitscurry Quarry, Hillhead of Lethenty, Hill of Selbie, Isaacstown, Hogholm, Shaw Hill, Roquharold Hill, Hill of Ardtannes and Dilly Hill.

7.7.16 The BGS memoirs for the area indicate that localised pockets of deeply weathered bedrock occur within the study area and between Pitcaple and Kintore, deep weathering is most likely to be encountered within granite of the Kemnay Pluton and in the basic igneous rocks of the Insch Pluton. The memoir notes that deep weathering is also known to be concentrated around areas of rock that have been disturbed or fractured through shearing and faulting and may therefore be found around the thrust faults that are shown on the map. Localised deep weathering is also known to occur in feldspathic psammite bands within the Aberdeen Formation but is comparatively uncommon in pelitic rocks.

7.7.17 An active quarry is present at Pitcaple, extracting norite rock from the Middle Zone of the Insch Pluton principally for use as aggregate. Pitcaple Quarry and the nearby disused Legatesden Quarry form a designated Site of Special Scientific Interest (SSSI) as two different kinds of gabbro from the Insch Intrusion are exposed at these sites.

[11] Geology of the country around Inverurie and Alfred Geological Memoir, British Geological Survey, 1997.

7.7.18 Bedrock Geology is shown in Volume 5, Figures 7.13 to 7.17.

Existing Ground Investigation Information

7.7.19 Existing ground investigation information within the study area is limited, with available borehole and trial pit logs typically only available in the immediate vicinity of the existing A96. The exploratory hole information available within 500m of the Violet and Orange route options have been obtained from the BGS database. This information has been reviewed and is summarised in Table 7.5 and 7.6.

Table 7.5 Existing Ground Investigation Information - Violet Route Option

Scheme / Investigation	Coverage	General Findings
Broadward, Daviot	1 No. borehole in north of study area in vicinity of the Junction with the B9001 junction (Daviot Junction).	Topsoil over gravels to 1mbGL. Weathered rock (gabbro) from 1mbGL to 5mbGL. Competent gabbro (recovered as chippings) to a proven depth of 30mbGL.
Cairnhill, Kinmuck	1 No. borehole in east of study area, to north of Cairnhill Farm, west of Kinmuck.	Medium dense clayey sand and gravel to 2.2mbGL, overlying weathered “whin” (dark) rock to 4.1mbGL, with competent rock to 4.3mbGL.
River Don, Kintore	1 No. borehole adjacent to River Don in centre of Don floodplain south-east of Tavelty.	Topsoil over clayey alluvium to 1.4mbGL, underlain by glaciofluvial deposits (sandy gravel) to 4.3mbGL, underlain by glaciolacustrine deposits (silty sandy clay) to 5.8mbGL, underlain by glacial till to a proven depth of 7.3mbGL.
Tavelty, Kintore	24 No. boreholes and trail pits around existing A96 in vicinity of the junction at Tavelty.	Made ground comprised black sandy gravel and silty sand and was recorded in several boreholes and trial pits to maximum depth of 1.55mbGL. Otherwise, topsoil underlain by recent alluvium and / or river terrace deposits, typically loose to medium-dense silty gravelly sand and soft to firm sandy silt with cobbles and occasional organic lenses up to 5.00mbGL. Glaciofluvial deposits generally encountered below alluvium or river terrace deposits, comprising sandy gravel with cobbles and boulders up to 12.40mbGL. Glacial till encountered beneath glaciofluvial deposits at some locations, with maximum recorded thickness of 4.50m. The glacial till was encountered as both cohesive and granular diamictons and was sometimes interbedded.

Scheme / Investigation	Coverage	General Findings
		Granite bedrock encountered at 4.50mbGL to 20.0mbGL. The weathered zone of the bedrock was recorded with a proven thickness of 4.3m in one borehole, with fresh rock below.
Existing A96, Kintore bypass	8 No. boreholes around existing A96 in vicinity of Forest Road overbridge.	Topsoil underlain by Glaciofluvial deposits to around 5.0mbGL, typically comprising sandy gravel with cobbles, boulders and occasional lenses of silt and clay Glacial till encountered beneath glaciofluvial deposits at some locations, with maximum recorded thickness of 4.40m. The glacial till was encountered as both cohesive and granular diamictons and was sometimes interbedded. Granite bedrock encountered between 7.40mbGL and 10.0mbGL.

Table 7.6 Existing Ground Investigation Information - Orange Route Option

Scheme / Investigation	Coverage	General Findings
Inveramsay Underpass	4 No. boreholes on existing A96 at Inveramsay.	Topsoil and sandy silty clay and clayey sandy silt up to 1.9mbGL, underlain by moderately weathered gneiss bedrock.
Strathnaterick Burn Culvert	6 No. boreholes where Strathnaterick Burn is culverted beneath existing A96 at Drimmies / Inveramsay	Topsoil over very stiff gravelly sandy silty clay or clayey gravelly sand. Schist bedrock encountered from 3.0mbGL at shallowest, and from 6.4mbGL at deepest.
Haughton	1 No. trial pit and 1 No. borehole on south side of River Don.	Alluvium with proven thickness of at least 3.0m in trial pit, comprising upper unit of silty sandy clay (to 1.2mbGL), and an underlying lower unit of sandy gravel with cobbles and boulders. Glaciofluvial deposits encountered in borehole to depths of at least 6.8mbGL, comprising gravel with cobbles and cross-bedded pebbly sand.

Scheme / Investigation	Coverage	General Findings
Kintore Business Park	1 No. borehole and 5 No. trial pits at existing A96 adjacent to Kintore Business Park.	Localised made ground comprising paper waste and dark brown gravelly silt was encountered in three exploratory holes, to depths up to 5.1mbGL, although base of made ground was not proven in any holes. Glacial till encountered at the surface in two locations, described as stiff sandy gravelly silt, with proven thickness of at least 2.2m.

Identified Geotechnical Constraints

7.7.20 The main geotechnical constraints include potential for settlement and subsidence / ground instability where embankments are to be constructed over areas of compressible ground and also the slope instability of cuttings. Compressible ground is typically associated with alluvium, alluvial fan deposits, peat, glaciolacustrine deposits, river terrace deposits and man-made soils infilled ground including landfill and made ground.

7.7.21 The ground conditions and geotechnical properties of the superficial deposits and bedrock beneath the route options will require to be confirmed through ground investigation at DMRB Stage 3.

Violet Route Option

7.7.22 Ratings for potential geotechnical hazards are provided by the BGS, for the existing ground conditions, however it does not necessarily reflect the risk in relation to the scheme. These are summarised below for the footprint and immediate vicinity of Violet route option, with areas of moderate and high hazards shown in Volume 5, Figures 7.18 to 7.20.

- Very low hazard potential for collapsible ground stability across the majority of the study area associated with glacial till, glaciofluvial deposits, glaciolacustrine deposits, river terrace deposits superficial deposits and shallow rock. Areas of no hazard potential noted, typically associated with peat and alluvium;
- High hazard potential for compressible ground associated with areas of peat. Moderate hazard potential associated with areas of alluvium, glaciolacustrine deposits and infilled ground. Low hazard potential associated with alluvial fan deposits. The majority of the area is shown as very low to no hazard potential associated with glacial till, glaciofluvial deposits and shallow rock;
- No hazard potential for ground dissolution features;
- No hazard to very low hazard potential for landslides across the majority of the study area with localised areas of moderate hazard potential associated with alluvium in the edges of valleys around Lochter Burn and the River Don;
- No hazard to low hazard potential for hazards associated with running sands; and

- Very low hazard potential for the presence of shrinking or swelling clay across the majority of the study area (all superficial deposits) with no hazard potential in areas of shallow rock.

7.7.23 The following potential geotechnical constraints have been identified from a review of historical mapping information:

- Unknown filled ground (previous water body) beneath the route option at Hillcrest;
- Unknown filled ground (pit, quarry etc) beneath the junction with the existing A96 north of Kintore; and
- potentially contaminative industrial use - quarrying, in several locations beneath and around the junction with the existing A96 north of Kintore.

7.7.24 The following potential geotechnical constraints and hazards are also applicable to the Violet route option, in relation to the earthworks:

- Two pits or quarries identified on historic maps, potentially infilled with unknown materials;
- Potential zones of highly fractured rock and increased groundwater flow in vicinity of geological faults and shear zones shown on BGS mapping;
- Potential shallow groundwater table and subsequent requirement for dewatering;
- At Lethenty, significant deposits of alluvium and glaciolacustrine deposits underlie Uryside Junction West and the mainline embankment associated with approach to Lochter Burn; and
- At Pitscurry deposits of peat underlie the mainline embankment.

Orange Route Option

7.7.25 Ratings for potential geotechnical hazards are provided by the BGS, for the existing ground conditions, however it does not necessarily reflect the risk in relation to the scheme. These are summarised below for the footprint and immediate vicinity of Orange route option, with areas of moderate and high hazards shown in Volume 5, Figures 7.21 and 7.22:

- Very low hazard potential for collapsible ground stability across the majority of the study area associated with glacial till, glaciofluvial deposits, glaciolacustrine deposits, river terrace deposits, superficial deposits and shallow rock. Areas of no hazard potential noted, typically associated with peat and alluvium;
- High hazard potential for compressible ground associated with areas of peat. Moderate hazard potential associated with areas of alluvium, glaciolacustrine deposits and infilled ground. Low hazard potential associated with alluvial fan deposits. The majority of the area is shown as very low to no hazard potential associated with glacial till, glaciofluvial deposits and shallow rock;
- No hazard potential for ground dissolution features;

- No hazard to very low hazard potential for landslides across the majority of the study area with localised areas of moderate hazard potential associated with alluvium in the edges of valleys around the River Urie and the River Don;
- No hazard to low hazard potential for hazards associated with running sands; and
- Very low hazard potential for the presence of shrinking or swelling clay across the majority of the study area (all superficial deposits) with no hazard potential in areas of shallow rock.

7.7.26 The following potential geotechnical constraints have been identified from a review of historical mapping information:

- Unknown filled ground (previous body of water) to north-east of the route option mainline at Crichie Cottages;
- Unknown filled ground (pit, quarry etc) beneath existing A96 and junction at Thainstone;
- Potentially contaminative industrial use - quarrying at Legatesden, Pitcaple, partially beneath a junction footprint;
- Potentially contaminative industrial use - former railway station at Inveramsay, in vicinity of the river crossing and beneath local road;
- Potentially contaminative industrial use - quarrying of sand and clay, beneath existing A96 and new the junction at Thainstone; and
- Potentially contaminative industrial use - factory or works and quarrying adjacent to the route at Kintore Business Park.

7.7.27 The following potential geotechnical constraints and hazards are also applicable to the Orange route option, in relation to the identified earthworks:

- One registered landfill site (SEPA) at Kintore Business Park;
- Seven pits or quarries identified on historic maps, potentially infilled with unknown materials;
- Potential zones of highly fractured rock and increased groundwater flow in vicinity of geological faults and shear zones shown on BGS mapping;
- Potential shallow groundwater table and subsequent requirement for dewatering;
- Potential subsurface voids or obstructions in vicinity of a disused military pill-box or bunker beneath local roads at Mill of Pitcaple; and
- At Pitscurry deposits of peat underlie Pitscurry Junction and the mainline embankment.

Discussion

7.7.28 Peat occurs beneath both the Violet and Orange route options at the location of Pitscurry Moss. Both route options would be constructed on embankments at this location. Smaller areas of peat are also present at various other locations on each route option. Current design proposals indicate that an attenuation basin on the Violet route option at the northern junction with the B9001 would be constructed

upon a small area of peat. A local road diversion associated with the Orange route option may also encounter a small area of peat to the north-west of Inverurie. The thickness of peat in these areas is unknown. Peat deposits are typically very weak, highly compressible and are generally unacceptable for reuse in earthworks.

7.7.29 Alluvium deposits are typically very weak and can contain highly compressible silt and clay layers. Alluvium can also contain lenses of peat. All areas of alluvium beneath the Violet and Orange route options occur where the alignment is on embankments or where structures would be required to cross rivers or minor watercourses.

7.7.30 Alluvial Fan Deposits occur on the Orange route option at Legatesden Farm, where the design proposals include a structure over the River Urie. Alluvial Fan Deposits may contain weak and compressible layers, as well as loose granular material and rock fragments

7.7.31 River Terrace Deposits can also contain layers of weak, compressible clay, silt and peat. These deposits are typically formed of many beds, lenses and channels of material, with a high degree of lateral variability that can results in variable settlement under embankment load. Design proposals indicate the River Terrace Deposits are located beneath the Violet route option at the Tavelty Junction with the existing A96, north of Kintore. The majority of earthworks in this area are embankments with small excavations associated with the attenuation basins.

7.7.32 Glaciolacustrine deposits of the Glen Dye Silts Formation occur on the Violet route option around Lethenty, including beneath the Uryside Junction West with the B9001. Glaciolacustrine deposits may also be present at depth in the valley of the River Don, where they are currently obscured from the surface by more recent alluvial deposits. These deposits are anticipated to comprise very weak and highly compressible laminated silts, clays and sands. Glaciolacustrine clays may also be sensitive to exposure to wet-weather conditions, potentially resulting in poor trafficability during construction. Current proposals indicate that on the Violet route option mainline, glaciolacustrine deposits are located beneath areas where embankments or structures are identified. Although some small cuttings within mapped areas of glaciolacustrine are shown for the diverted local roads and attenuation basins.

7.7.33 The potentially compressible nature of alluvium, peat, river terrace deposits and glaciolacustrine deposits may result in significant settlements beneath embankments, as well as potential slope instability issues during construction if excavations are required. Additionally, cuttings below the groundwater table in these deposits are likely to require temporary works and dewatering. Alluvium, river terrace and glaciolacustrine deposits are also associated with running sands and seepage flows. All of these deposits are unlikely to be able to be reused as engineered fill in construction.

7.7.34 The angle of cut slopes that can be achieved in these deposits will depend on a number of factors, including the height of the slope, groundwater levels and the specific characteristics and geotechnical properties of these materials. If groundwater is at a high-level, slope drainage may be required.

7.7.35 Potential measures to mitigate issues associated with compressible superficial deposits include removal and replacement, staged construction, load transfer platforms and accelerated settlement / consolidation through surcharging and use of band-drains or drainage layers. Where the route option is at-grade or on a low height embankment, it may be feasible to reinforce the subgrade with geotextiles combined with granular material.

7.7.36 The presence of potentially compressible superficial deposits beneath both the Violet and Orange route options will require mitigation measures that may impact on construction programme if remedial works need to be implemented. The applicability of these measures will depend on the construction programme, as well as the extent and properties of these materials. The nature of the compressible deposits would need to be determined through ground investigation at DMRB Stage 3.

7.7.37 Former (no longer operational) landfills are recorded beneath the Orange route option at Kintore Business Park. Infilled ground is also recorded in isolated pockets associated with potentially infilled pits and quarries.

7.7.38 A review of historic mapping has identified a number of former buildings and historic quarries in vicinity of both route options. It is anticipated that made ground and man-made buried obstructions may be present along a greater extent of the route options. It should be noted that the extent of these former pits and quarries is unknown and therefore the area of the route option at risk is unknown at this stage. Potentially contaminated land may also be present in the vicinity of former industrial land-uses such as historic railways, factories and garages. Contaminated land may also be present within current and former farms.

7.7.39 Given the close proximity of the route options to Aberdeen City (a strategic target during the war), a high-level review of the Unexploded Ordnance (UXO) risk has been completed using Zetica UXB risk maps. This preliminary assessment has determined the risk to be low due to a low intensity of bombing. The potential UXO risk will be assessed further during DMRB Stage 3.

7.7.40 Both route options include cuttings in areas of shallow rock, which presents a potential constraint as shallow rock is likely to be more difficult to excavate than shallow superficial deposits. In particular, granite, pegmatites, quartzites and migmatitic rocks are anticipated to be of high intact strength and potentially difficult to excavate without pre-treatment mitigation. Both route options include large cuttings within the Aberdeen Formation which may present slope stability challenges if fissile pelitic rocks are encountered. Geological faults and shear zones are also noted to be mapped within some of the potential cuttings which may result in additional engineering challenges.

7.7.41 Potential measures to mitigate issues associated with cuttings in shallow rock include alternative excavation techniques such as blasting and localised retaining measures, including rock bolting and retaining walls where slope instability is a concern. The scale of these measures is dependent on the rock mass properties which would be determined during the ground investigation in DMRB Stage 3.

7.7.42 A comparison of the ground conditions beneath the mainline of the route options is provided in Table 7.7. This summarises the length of each route option that is underlain by the ground conditions which are considered to be more challenging based on mapped surface geology only.

Table 7.7 Comparison of Ground Conditions

Route Option	Approximate length[1] (m) and proportion of route option centreline underlain by geotechnical hazards						Total (m)
	Artificial Ground [2]	Shallow Rock	Alluvium	Peat	River Terrace Deposits	Glaciolacustrine Deposits	
Violet	50 (<1%)	4,600 (26%)	950 (5%)	300 (2%)	350 (2%)	700 (4%)	6,950 (40%)
Orange	100 (1%)	3,650 (29%)	550 (4%)	300 (2%)	0 (0%)	0 (0%)	4,600 (36%)

[1] Length relates to mainline only
[2] Artificial ground includes BGS Artificial Ground mapping, pits and quarries identified from historic mapping, registered landfill sites, and areas of potentially infilled ground.

7.7.43 The summary of ground conditions underlying each of the route options between Pitcaple and Kintore is based on published information with the following limitations:

- The summary is based primarily on the geology that is mapped at the surface on the BGS 1:50,000 digital superficial geology maps. Other potentially unfavourable ground conditions may be present at depth, however there is insufficient existing ground investigation information to allow ground modelling of the sub-surface strata across the route options.
- 'Shallow Rock' is defined by BGS as areas with less than 1m of superficial deposit cover above bedrock. Rock is also likely to be encountered in deeper cuttings beneath the mapped superficial deposits.
- There is very limited existing published ground investigation data for the majority of the Violet and Orange route options and is generally limited to the existing A96. The ground investigation information which is available does not provide any substantial information on ground conditions or geotechnical properties of the superficial and solid geology, beyond what can be interpreted from geological maps and memoirs. In-situ ground conditions and potential for contamination should be confirmed by an intrusive ground investigation during DMRB Stage 3.
- Landfill is not recorded beneath the route option mainline centrelines, however it is shown to be present beneath approximately 250m of local roads associated with the Orange route option. Landfill beneath local roads is not included in the summary in Table 7.7.
- Unrecorded areas of unfavourable superficial deposits or made ground may be present beneath the route options. The nature, extent and properties of made ground is unknown and will need to be investigated as part of the DMRB Stage 3 ground investigation.

Junctions

7.7.44 A brief qualitative summary of the surface geology for the junctions on the Violet and Orange route options is presented in Paragraphs 7.7.45 to 7.7.51. The engineering considerations relating to ground conditions, discussed in Paragraphs

7.7.28 to 7.7.41 are applicable to the junctions. Ground conditions for the Pitcaple to Kintore route option junctions are shown in Volume 5, Figures 7.18 to 7.22.

Daviot Junction – Violet Route Option

7.7.45 The majority of Daviot Junction is located on glacial till with some of the local road cuttings in areas of mapped shallow rock. The main carriageway through Daviot Junction comprises embankments over glacial till and shallow rock.

Uryside Junction – Violet Route Option

7.7.46 The majority of the Uryside Junction West is located on embankments over alluvium and glaciolacustrine deposits. Uryside Junction East is located on glacial till and shallow rock and includes cuttings through shallow rock.

Tavelty Junction – Violet Route Option

7.7.47 The Tavelty Junction is located above an area of variable ground conditions that includes alluvium, river terrace deposits, glaciofluvial deposits and artificial ground. The connecting road to the existing A96 is partially located above a historic landfill site and the junction local road into Kintore passes through an area of worked ground.

Pitscurry Junction – Orange Route Option

7.7.48 The junction is located at Pitscurry Moss, which is predominantly mapped as an area of peat. The junction also includes some embankments on glacial till and shallow rock.

Drimmies Junction – Orange Route Option

7.7.49 The main carriageway through Drimmies Junction comprises an embankment over glacial till and shallow rock. Some of the junction local roads include small cuttings in shallow rock.

Blackhall Road Junction – Orange Route Option

7.7.50 The Blackhall Road junction predominantly comprises embankments over glacial till and shallow rock. Some of the local roads include small cuttings in glacial till.

Thainstone Junction – Orange Route Option

7.7.51 The main carriageway on the western side of Thainstone Junction comprises a large cutting through glacial till, which transitions to an embankment on glacial till to the east side of the junction. Local roads and slip roads at Thainstone Junction include cuttings and embankments on glacial till and glaciofluvial deposits.

Earthworks Balance

Acceptability of Excavated Material

7.7.52 The majority of cuttings on both route options between Pitcaple and Kintore are formed within areas of glacial till or shallow rock. The cuttings in shallow rock are shown to be formed within several different geological formations comprising multiple lithologies, with likely variation in acceptability to be reused as general engineered fill. Acceptability of materials for reuse can only be confirmed through intrusive ground investigation and laboratory testing, to be completed at DMRB Stage 3, at which point the potential reuse quantities will be assessed.

Acceptability of Excavated Material – Violet Route Option

7.7.53 It is estimated at this stage that between Pitcaple and Kintore, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Acceptability of Excavated Material – Orange Route Option

7.7.54 It is estimated at this stage that between Colpy and Pitcaple, 75% of excavated materials may be acceptable for reuse as general engineering fill.

Unacceptable Material and Contaminated Land

7.7.55 At this stage, it is anticipated that not all of the material generated from the earthworks cuttings will be acceptable for reuse as general engineered fill. However, it may be feasible to reuse some of these materials elsewhere in other works on site through treatment to make a proportion of it acceptable as general engineering fill or in noise or landscaping bunds. Materials that may be unacceptable for reuse in earthworks include:

- Fissile bedrock such as slate and phyllite;
- Weathered bedrock;
- Infilled ground and man-made soils, including Landfill; and
- Natural soils with high moisture content.

7.7.56 In general, excavated bedrock is likely to be acceptable for reuse as general engineering fill if suitably crushed and processed to meet the classification requirements of the Specification for Highways Works. However, existing baseline information suggests that parts of the Aberdeen Formation are formed of slate and phyllite. If encountered in cuttings, these excavated rocks may be difficult to reuse due to the inherently foliated and tabular nature of this material, which may restrict its placement as general engineering fill. These properties should be investigated by a ground investigation at DMRB Stage 3.

7.7.57 Bedrock that has been affected by deep weathering may also be unacceptable for reuse as general engineering fill. Deeply weathered bedrock is likely to contain degraded minerals, potentially resulting in an increased fines content that may make this excavated material unacceptable for use as general engineering fill. The occurrence, extent and properties of weathered bedrock should be determined through means of a ground investigation at DMRB Stage 3.

7.7.58 While most excavated glacial till and glaciofluvial deposits are anticipated to be acceptable for reuse, some of the excavated glacial deposits may be unacceptable, particularly where the fines content exceeds the grading limits of the Specification for Highways Works. Additionally, large cobbles and boulders can be expected within the glacial deposits and this may also restrict its acceptability unless these can be removed by screening.

7.7.59 Potentially contaminated land associated with Landfills and infilling of historic pits and quarries is expected to be encountered beneath both route options. Whilst the nature, extent and properties of these materials is unknown, it is anticipated that they will be generally unacceptable for reuse and may require to be disposed of off-site. Contaminated soils may also be encountered in the vicinity of current and former industrial uses including, but not limited to, railways, factories, garages, tanks and farms. Additional areas of unrecorded infilled ground and potentially contaminated soils may also be encountered on both route options. Contaminated

land and its impact on the scheme is discussed in detail in Volume 2, Part 3, Chapter 19, Geology, Soils, Contaminated Land and Groundwater.

7.7.60 The nature of the glaciolacustrine deposits and river terrace deposits is currently unknown and may comprise a mixture of soft silts and clays, as well as granular sandy layers. The nature, extent and engineering properties of these deposits beneath the preferred route option should be determined through a ground investigation at DMRB Stage 3. Soft silt and clay within these deposits is likely to be unacceptable for reuse as general engineering fill and may require to be disposed of on or off-site. In a natural state, soft compressible glaciolacustrine and river terrace deposits may also be unacceptable for reuse in landscaping and bunds, however disposal volumes could be minimised through ground improvement techniques, the feasibility of which should be investigation at DMRB Stage 3.

Cut / Fill Balance

7.7.61 For the purpose of the earthworks assessment it is assumed that any surplus materials from the Pitcaple to Kintore sections will be available for use within other geographic sections on the scheme and that surplus materials from other route options on the scheme will also be available for use on the Violet and Orange route options.

7.7.62 Table 7.8 summarises the earthworks volumes for the Violet and Orange route options:

- Bulk Fill Material Required – The bulk earthworks fill volume required for the mainline, local roads, junctions and attenuation basins, including an allowance for capping materials and topsoil;
- Bulk Excavated Material – Total volume of excavated material from the mainline, local roads, junctions and attenuation basins, including an adjustment for capping materials and topsoil;
- Acceptable Excavated Material – The volume of material excavated from each route option which is estimated to be acceptable for reuse within earthworks plus an allowance for treatment of some of the unacceptable material to render it acceptable as general engineering fill;
- Unacceptable Excavated Material – The volume of material excavated from each route option which is estimated to be unacceptable for reuse within earthworks; and
- Acceptable Cut / Fill Balance – The overall balance between the bulk fill requirements and volume of acceptable excavated material on each route option; and
- Total Cut / Fill Balance – The overall balance between the bulk fill requirements and the volume of total excavated material on each route option.

7.7.63 All values have been rounded to the nearest 10,000 m^3.

Table 7.8 Earthworks Volumes (approximate)

Volume	Violet Route Option	Orange Route Option
Bulk Fill Material Required (m^3)	3,390,000	3,670,000
Bulk Excavated Material (m^3)	1,980,000	3,010,000
Acceptable Excavated Material (m^3)	1,740,000	2,640,000
Unacceptable Excavated Material (m^3)	240,000	370,000
Bulk Cut / Fill Balance (m^3)	-1,410,000 deficit	- 660,000 deficit
Acceptable Cut / Fill Balance (m^3)	- 1,650,000 deficit	- 1,030,000 deficit

7.7.64 A negative balance between cut and fill indicates that there is a deficit in the volume of acceptable materials available within the route option and that additional fill materials will therefore need to be imported. A positive balance between cut and fill indicates that the excavation of acceptable materials exceeds the fill requirements for the route option and that construction of the route option will therefore generate a surplus of acceptable fill materials.

7.7.65 Both the Violet and Orange route options have negative cut / fill balance, which means that material will need to be imported from elsewhere on the scheme or from external sources for the construction of earthworks.

7.8 Hydrology and Drainage

Introduction

7.8.1 The effects of the options on the water environment are considered in Volume 2, Part 3, Chapter 20, Road Drainage and the Water Environment. This section provides a summary of the engineering issues related to watercourse crossings and road drainage.

7.8.2 A preliminary assessment of hydrology was made for each route option. Following the selection of a Preferred Option, a detailed review of the hydrology, watercourse crossings and drainage strategy will be undertaken during the DMRB Stage 3 assessment.

7.8.3 Bridge structures are described within Section 7.9. Bridge and culverted crossings of watercourses will be designed and constructed in accordance with the requirements of SEPA, SNH, Aberdeenshire Council and local stakeholders.

Watercourses

7.8.4 A number of watercourses located within the study area are affected by the route options. These are set out below.

Tributary to the River Urie 21

7.8.5 With a catchment area of approximately $1km^2$, this small tributary drains the runoff from the area around Pitscurry Moss to the River Urie.

7.8.6 The Violet route option requires two culverts in this area. The Orange route option follows the line of this watercourse to the confluence with the Urie necessitating three culverts along an 850m length as well as 1.2km of watercourse realignments.

River Urie

7.8.7 The River Urie is a significant watercourse with a catchment area of over 300km² at the confluence with the River Don, south of Inverurie. In the context of the Pitcaple to Kintore geographic section, the Urie has a catchment area of approximately 215 km² once the Burn of Durno joins at Pitcaple.

7.8.8 The Violet route option does not interact with the River Urie. The Orange route option crosses the Urie on a viaduct to the east of Pitcaple. At this location, SEPA flood maps identify a significant associated floodplain greater than 300m wide. Bridge piers are required within the floodplain to support the structure.

Strathnaterick Burn

7.8.9 The Strathnaterick Burn is a tributary to the Urie, with a catchment area of around 5km², draining an area of farmland to the north-west of Inverurie.

7.8.10 The Violet route option does not interact with the Strathnaterick Burn. The Orange route option requires two culverted crossings of the Strathnaterick Burn, as well a 450m realignment of the watercourse

Ides Burn

7.8.11 The Ides Burn is a tributary to the Lochter Burn, which in turn feeds the River Urie. The Ides Burn has a catchment area of approximately 6.7km² collecting runoff from the areas either side of the B9001, south of Daviot.

7.8.12 The Violet route option crosses the Ides Burn requiring three culverts and generally follows its path for around 3km. This necessitates a total of 1.2km of watercourse realignment. The Orange route option does not interact with the Ides Burn.

Lochter Burn

7.8.13 The Lochter Burn is a large tributary to the River Urie and has a catchment area of over 60km². The watercourse drains an area to the north of Inverurie.

7.8.14 The Violet route option crosses the Lochter Burn on a structure in the vicinity of Uryside Junction West. The Orange route option does not interact with the Lochter Burn.

Newmill Burn

7.8.15 The Newmill Burn is a tributary to the River Don and has a catchment area of over 25km². The watercourse drains an area to the east of Inverurie and Port Elphinstone.

7.8.16 Neither the Orange route option nor the Violet route option cross the Newmill Burn, though the Violet route option passes through this catchment and crosses a number of the smaller tributaries. Culverts are required for these crossings.

Densy Burn

7.8.17 The Densy Burn is a small tributary to the River Don with a catchment area of approximately 1.5km². It drains a small area of farmland to the north-east of Kintore.

7.8.18 Although it does not cross the burn, the Violet route option necessitates realignment of the watercourse for approximately 650m. The Orange route option does not interact with the Densy Burn.

River Don

7.8.19 The River Don rises in the Cairngorm Mountains, 75km to the west of Aberdeen and drains an area of over 1,100km² as it passes Kintore.

7.8.20 The Violet route option crosses the River Don to the north of Kintore, on a large structure spanning the associated floodplain, which is around 600m wide at this point. Bridge piers are required within the floodplain to support the structure.

7.8.21 The Orange route option crosses the River Don on a large structure to the west of Port Elphinstone. The river is contained in a steep sided valley at this point and it is envisaged that the structural supports may be positioned outwith the floodplain.

Bridgealehouse Burn

7.8.22 The Bridgealehouse Burn is a tributary of the River Don, draining an area of approximately 6km² between Kemnay and Kintore.

7.8.23 A crossing of the Bridgealehouse Burn under the existing A96 already occurs in a 1.8m x 1.8m box culvert. This would need to be extended to accommodate the Violet route option. The Orange route option does not extend as far as the Bridgealehouse Burn.

7.8.24 Table 7.9 provides a summary of the watercourses affected by each route option.

Table 7.9 Hydrology and Drainage Summary

Watercourse	Violet Route Option	Orange Route Option
Tributary of the River Urie 21	Culvert (2 no.)	Realignment (0.8 km) Realignment (0.4 km) Culvert (3 no.)
River Urie	N/A	Bridge
Strathnaterick Burn	N/A	Culvert (2 no.) Realignment (0.45 km)
Ides Burn	Culvert (3 no.) Realignment (1.2 km)	N/A
Lochter Burn	Bridge	N/A
Densy Burn	Bridge and realignment (0.65 km)	N/A
River Don	Bridge	Bridge
Bridgealehouse Burn	Extend existing culvert and realignment (<0.1 km)	N/A
Other Watercourses	Culvert (9 no.) Bridge (1 no.) Tributary of River Don under River Don crossing. Realignment (0.65 km) & (0.1 km)	Culvert (8 no.) Extend existing culvert (2 no.) Realignment (0.85 km)
Total No. of Interfaces	**24**	**21**

Drainage

7.8.25 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and sized indicatively to assess feasibility. This information has been used to inform the engineering and environmental assessments for each option. The drainage design will be developed further during DMRB Stage 3.

7.8.26 The drainage design will incorporate Sustainable Drainage Systems (SuDS) to both treat and attenuate the runoff prior to discharge to the water environment. A treatment train approach[12] will be applied in accordance with the latest guidance, incorporating SuDS both at source and at the end of a drainage system. This is likely to include a number of components including: filter drains, swales, basins and ponds.

7.8.27 The Scottish Environmental Protection Agency (SEPA) has stipulated that a minimum of two levels of treatment will be required and this will be suitable for most catchments within the scheme extents. In cases where a catchment is to discharge to a particularly small watercourse, a sensitivity check will be carried out and an additional level of treatment may be required. This will be assessed on a case by case basis.

7.8.28 At this stage, it has been assumed that drainage from realigned local roads will generally match the existing drainage regime, most of which is expected to flow over the carriageway edge as it does at present. Where significant new sections of local road are identified, the drainage design criterion is expected to meet current standards, with runoff both treated and attenuated prior to discharge to an appropriate watercourse.

7.8.29 It is considered feasible to drain runoff from both route options to local watercourses with appropriate treatment measures in place. There are no particular engineering issues or differences between the Violet and Orange route options in relation to road drainage.

7.9 Structures

Introduction

7.9.1 Structure locations are shown in Volume 5, Figures 7.1 to 7.7 and are tabulated below for each route option. Further details on major river crossings and other significant structures are also described below. Structures that are named are those considered in more detail and are likely to be 150m in length or greater.

Underbridges

7.9.2 The full width of the mainline, including carriageway and hard strips, shall be continued across the decks of the underbridges. In accordance with DMRB CD 127 (Cross-sections and headrooms, Clause 3.4) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

[12] Treatment train approach is using drainage techniques in series to change the flow and quality characteristics of the runoff in stages, available at: https://www.susdrain.org/delivering-suds/using-suds/suds-principles/management-train.html

7.9.3 It is anticipated that underbridges would generally be of concrete construction with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option would also be considered.

Overbridges

7.9.4 It is anticipated that overbridges would generally be of steel-concrete composite construction, with steel girders supporting a concrete bridge deck.

7.9.5 The full width of the carriageway and hard strips (where provided) would be carried by the overbridges. Verges to both the local road and the A96 mainline would be continued over and under the structure in accordance with DMRB CD 127 (Clause 3.4).

Violet Route Option

River Don and Aberdeen – Inverness Railway Crossing

7.9.6 A number of constraints have been considered as follows:

- The width of the floodplain has been ascertained from SEPA flood mapping and is approximately 545m at this location;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level;
- A minimum vertical clearance of 6.335m will be provided between the railway tracks and the bridge soffit;
- Double track railway line with potential electrification; and
- Compatibility with Tavelty Junction.

7.9.7 At this stage it is considered that the bridge would comprise a multi-span viaduct with a length of 760m. It is anticipated that the bridge would be of composite steel beam and concrete construction. It is planned that all bridge piers would be located outside of the river channel.

7.9.8 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.9.9 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

7.9.10 The underbridges required are as detailed in Table 7.10.

Table 7.10 Violet Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB - U77C	U77C Mackstead – Daviot Road	15	26
UB - Daviot Junction	Daviot Junction	14	53

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB - Lochter Burn	Lochter Burn and Lethenty Access	135	97
UB - B9170	B9170 Inverurie – Old Meldrum -Methlick - New Deer Road	120	42
UB - B993	B993 Whiterashes - Inverurie - Kemnay - Tillyfourie - Millbank - Torphins Road	14	43
UB – local access	Ashlea Grange / Codwells / Isaacstown / Burnside Access	7	26
UB - C68C	C68C Heatherwick Road and Densy Burn	19	46
UB- River Don Crossing	River Don and associated floodplain and a tributary, Aberdeen – Inverness Railway	760	42
Tavelty Junction (North)	Tavelty Junction North	14	42
Tavelty Junction (South)	Tavelty Junction South	14	42

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

7.9.11 The overbridges required are as detailed in Table 7.11.

Table 7.11 Violet Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB - C69C	C69C Inverurie – Old Bourtie Road	56	14
OB - C67C	C67C Kinmuck Road	58	14
OB - C113C	C113C Forest Road / Townhead Road	37	14

Retaining Structures

7.9.12 The retaining structures required in the current Violet route option are as detailed in Table 7.12.

Table 7.12 Violet Route Option Retaining Structures

Name	Retained feature	Approximate Length (metres)
RS-1	Route option mainline above Overdon Care Home access road	70
RS-2	Residential area – Lochburn Brae, Kintore, north of Forest Road OB	200
RS-3	Residential property – Corhill, south of Forest Road OB, west of A96	100
RS-4	Residential area – Castleview Place, Kintore south of Forest Road OB	200

7.9.13 The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on land, ecology and communities.

Orange Route Option

River Urie / Aberdeen – Inverness Railway Crossing

7.9.14 A number of constraints have been considered as follows:

- The width of the floodplain has been ascertained from SEPA flood mapping and is approximately 350m at this location;
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level;
- A minimum vertical clearance of 6.335m will be provided between the railway tracks and the bridge soffit; and
- Double track railway line with potential electrification.

7.9.15 At this stage it is considered that the bridge would comprise a multi-span arrangement with a length of approximately 730m. It is anticipated that the bridge would be of composite steel beam and concrete construction. It has been assumed that no supports would be placed in the river channel.

7.9.16 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.9.17 Structure type and span configurations will be developed further during DMRB Stage 3.

River Don / C116C Crossing

7.9.18 A number of constraints have been considered as follows:

- The width of the floodplain has been assumed based on SEPA flood maps – approximately 70m;
- The existing C116C would be realigned to pass below this structure; and
- A minimum freeboard of 0.6m will be provided between the bridge soffit and the predicted maximum flood level.

7.9.19 At this stage it is considered that the bridge would comprise a multi-span viaduct arrangement with a length of approximately 555m. It is anticipated that the bridge would be of composite steel beam and concrete construction. It has been anticipated at this stage that no supports would be placed in the river channel and the floodplain will be avoided where possible.

7.9.20 At this stage it has been assumed that all foundations for the structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.9.21 Structure type and span configurations will be developed further during DMRB Stage 3.

Underbridges

7.9.22 The underbridges required are as detailed in Table 7.13.

Table 7.13 Orange Route Option Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)*
UB – River Urie Crossing	River Urie, associated floodplain, existing A96, Aberdeen-Inverness railway, U83C	730	26
UB - Drimmies Junction	Drimmies Junction	14	37
UB - Blackhall Road Junction	Blackhall Road Junction	15	43
UB – River Don	River Don, floodplain, C116C	555	37
UB - Thainstone Junction (West)	Thainstone Junction West	14	26
UB - Thainstone Junction (East)	Thainstone Junction East	14	26

* Difference in widths to accommodate visibility splays and junction slip roads where required

Overbridges

7.9.23 The overbridges required are as detailed in Table 7.14.

Table 7.14 Orange Route Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB – Pitscurry Junction	Orange route option mainline	60	14
OB - C76C	C76C Whiteford – Fingask Road	42	14

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
OB - U120aC	U120aC Mains of Balquhain - Netherton - Dubston Road.	67	14
OB - B993	B993 Whiterashes - Inverurie - Kemnay - Tillyfourie - Millbank - Torphins Road	50	14

Retaining Structures

7.9.24 At this stage, it is anticipated that no significant retaining structures would be required for the Orange route option. The need for retaining structures will be assessed further during DMRB Stage 3 to mitigate the impact of the new road corridor on land, ecology and communities.

Ancillary Structures

7.9.25 Both route options would require the provision of a number of ancillary structures such as culverts and may require accommodation underpasses and overbridges.

Culverts

7.9.26 Culverts are anticipated to be required for watercourse crossings.

7.9.27 Culvert structures are anticipated to comprise either large diameter pipes, precast concrete boxes or proprietary arch units. Culverts will be subject to further design development during DMRB Stage 3.

7.9.28 Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

7.9.29 The requirement for accommodation structures will be considered during DMRB Stage 3.

Vehicular Containment and Pedestrian Restraint over Structures

7.9.30 Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB CD 377 Requirement for road restraint systems) and will be developed during DMRB Stage 3.

7.10 Utilities

Introduction

7.10.1 There are a significant number of buried and overhead public and private utility services between Pitcaple and Kintore including:

- Telecommunications – BT Openreach overhead and underground network and communications masts;

- National Grid – large diameter high pressure gas pipelines and associated above ground installations;
- SGN – high pressure gas pipelines and associated above ground installations, medium pressure and low pressure gas pipelines;
- GTC – medium and low pressure gas infrastructure;
- SSE – high voltage and low voltage overhead and underground electricity infrastructure;
- Scottish Water supply network;
- Scottish Water wastewater network;
- Wind turbines; and
- Street Lighting – areas of the existing road network that feature street lighting and will therefore include underground power cables in the vicinity of the lighting.

7.10.2 Public utilities have been identified and key utilities are shown in Volume 5, Figures 2.20 to 2.24.

7.10.3 In accordance with the New Roads and Street Works Act (1991), C2 notices were issued to each of the utility providers to provide details of their networks within the study area. This enabled potential clashes between route options and utility infrastructure to be identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with major utility infrastructure.

7.10.4 Where it has not been possible to avoid a clash with major utility apparatus, initial consultation has been undertaken with the relevant providers and outline diversion costs have been identified.

Telecommunications

7.10.5 Telecommunications infrastructure is present across most of the area between Pitcaple and Kintore. The key elements of the network are identified below.

BT Openreach Underground Network

7.10.6 This utility is located throughout this area. Underground ducts and cables run adjacent to the existing A96 and some local roads. This utility is more concentrated within densely populated areas such as Inverurie.

BT Openreach Overhead Network

7.10.7 This utility is located throughout this area. Overhead cables run adjacent to local roads and provide connections to properties.

Communication Masts

7.10.8 Communication masts are located at several locations between Pitcaple and Kintore. These are owned and operated by a number of different organisations.

Interfaces

7.10.9 Table 7.15 summarises the number of interfaces with the telecommunications networks for each option.

Table 7.15 Interfaces with Telecommunications Networks

Route Option	BT Underground	BT Overhead	Communication Masts	Total Interfaces
Violet	13	7	0	**20**
Orange	21	5	1	**27**

7.10.10 The Violet route option has a lower number of interfaces with the BT Openreach network when compared with the Orange route option. It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

7.10.11 The Violet route option does not impact on existing communication masts, while one interface has been identified for the Orange route option.

Gas

High Pressure Gas Pipelines – National Grid

7.10.12 National Grid high pressure gas infrastructure is present between Pitcaple and Kintore.

7.10.13 A 1050mm diameter high pressure gas pipeline runs through this area from north-east to south-west. It runs from the north of Oldmeldrum and crosses the existing A96 to the south of Drimmies.

7.10.14 South and east of Inverurie, 900mm diameter and 1200mm diameter pipelines run in parallel through this area from north-east to south-west, crossing the existing A96 to the north of the existing Tavelty Junction at Kintore.

7.10.15 These pipelines are nationally strategic infrastructure.

7.10.16 **Above Ground Installations – National Grid**

7.10.17 An Above Ground Installation (AGI) is present on the 1050mm diameter at Balhalgardy to the north of Inverurie. An AGI is positioned on the 900mm diameter pipeline to the north of Hogholm Farm.

National Grid Interfaces

7.10.18 Table 7.16 summarises the number of interfaces with National Grid assets for each route option.

Table 7.16 Interfaces with National Grid Gas Infrastructure

Option	High Pressure Gas Pipeline	Above Ground Installation	Total
Violet	6	0	**6**
Orange	3	0	**3**

7.10.19 The Violet route option has a higher number of interfaces with the National Grid network compared to the Orange route option. There is no impact on Above Ground Installations for either route option.

High Pressure Gas Pipelines - SGN

7.10.20 A 219mm high pressure SGN gas pipeline enters this area from the south-west and terminates at an AGI which is positioned to the east of Thainstone roundabout. This pipeline is strategic infrastructure.

Above Ground Installations - SGN

7.10.21 An SGN AGI is present to the east of Thainstone roundabout.

Medium Pressure Gas Pipeline - SGN

7.10.22 This utility is present between Pitcaple and Kintore. From the Thainstone roundabout it runs south adjacent to the existing A96. It also runs to the north through Inverurie and to Oldmeldrum.

Low Pressure Gas Pipeline - SGN

7.10.23 SGN low pressure infrastructure is confined to the settlements of Oldmeldrum, Inverurie, Kemnay and Kintore.

SGN Interfaces

7.10.24 Table 7.17 summarises the number of interfaces with SGN assets for each option.

Table 7.17 Interfaces with SGN Gas Infrastructure

Option	High Pressure Pipeline	Above Ground Installations	Medium Pressure Pipeline	Low Pressure Pipeline	Total Interfaces
Violet	0	0	4	0	**4**
Orange	1	0	4	0	**5**

7.10.25 The Orange route option has one crossing of an SGN high pressure pipeline and both route options interface with medium pressure infrastructure on four occasions. There are no interfaces with above ground installations or low pressure pipelines.

7.10.26 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Medium Pressure Pipeline - GTC

7.10.27 GTC have medium pressure gas infrastructure in place adjacent to Thainstone roundabout.

Low Pressure Pipeline - GTC

7.10.28 Low pressure GTC gas pipelines are located within residential and commercial areas between Pitcaple and Kintore.

GTC Interfaces

7.10.29 The Orange route option has two interfaces with GTC medium pressure assets in the Thainstone area but there are no interfaces with low pressure infrastructure. The Violet route option has no interfaces with medium or low pressure infrastructure.

Electricity

7.10.30 SSE electricity transmission and supply infrastructure is present between Pitcaple and Kintore. The key elements of the network are identified below.

275kV Overhead Lines

7.10.31 Two SSE 275kV overhead lines run from north-west to south-east between Pitcaple and Kintore. They pass to the west of Inverurie before terminating at Kintore substation. 275kV transmission lines are nationally strategic infrastructure.

33kV Overhead Lines

7.10.32 This utility is located throughout this area with lines to the east, west and south of Inverurie.

33kV Underground Cables

7.10.33 This utility is present within this area and is generally concentrated within and around built up areas.

11kV Overhead Lines

7.10.34 This utility is present throughout this area.

11kV Underground Cables

7.10.35 This utility is present within this area and is generally concentrated within and around built up areas.

Low Voltage Overhead Lines & Underground Cables

7.10.36 These utilities are present throughout the area between Pitcaple and Kintore with LV cables more concentrated in built up areas.

Interfaces

7.10.37 Table 7.18 summarises the number of interfaces with SSE assets for each option.

Table 7.18 Interfaces with SSE Electricity Infrastructure

Option	275kV Line	33kV Line	33kV Cable	11kV Line	11kV Cable	Low Voltage	Total Interfaces
Violet	0	2	1	17	6	11	**37**
Orange	2	5	6	17	12	7	**49**

7.10.38 The Violet route option has a lower number of interfaces with the SSE network when compared with the Orange route option. The Orange route option also interfaces with 275kV transmission infrastructure at two points and it has a greater impact on the 33kV network.

7.10.39 It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Water and Wastewater

7.10.40 Scottish Water infrastructure is present between Pitcaple and Kintore, the key elements of the network are identified below.

Water Network

7.10.41 The Scottish Water freshwater supply network is present between Pitcaple and Kintore. Raw water mains are also present.

Wastewater Network

7.10.42 The Scottish Water sewer network between Pitcaple and Kintore is concentrated within the settlements of Oldmeldrum, Inverurie, Kemnay and Kintore. Rising mains are also present within built up areas and a rising main also runs between Inverurie and Kintore.

Interfaces

7.10.43 Table 7.19 summarises the number of interfaces with water assets for each option.

Table 7.19 Interfaces with Scottish Water Freshwater Supply Infrastructure

Option	Water Mains	Raw Water Mains	Total Interfaces
Violet	15	1	**16**
Orange	14	1	**15**

7.10.44 Both route options have a similar number of interfaces with freshwater assets. However, it should be noted that the diameter of assets impacted on the Violet route option is typically higher than that on the Orange route option. The water supply network in this area is fed from the east of Inverurie.

7.10.45 Table 7.20 summarises the number of interfaces wastewater assets for each option.

Table 7.20 Interfaces with Scottish Water Wastewater Infrastructure

Option	Gravity Pipe	Rising Main	Total Interfaces
Violet	0	1	**1**
Orange	0	1	**1**

7.10.46 Both route options have no interfaces with the gravity sewer network and one interface with the rising main network. The interface on the Violet route option is with the Inverurie - Kintore rising main. It should be noted that each interface varies in length. This assessment only considers the total number of interfaces as each interface will result in potential disruption to the network.

Wind Turbines

7.10.47 There are a number of private wind turbines between Pitcaple and Kintore.

Interfaces

7.10.48 The Violet route option has one interface with a private wind turbine while the Orange route option has no interfaces.

7.11 Non-motorised Users (NMUs)

7.11.1 The term Non-Motorised Users (NMUs) is used to describe pedestrians, cyclists and equestrians.

7.11.2 Existing NMU routes within the study area are described in Volume 1, Part 1, The Scheme (Chapter 2, Existing Conditions) and in Volume 5, Figures 2.17 to 2.19. The effects of the route options on all travellers, including NMUs, are considered in Volume 2, Part 3, Environmental Assessment (Chapter 12, People and Communities) where the impacts of the route options are assessed.

7.11.3 One of the scheme objectives is to facilitate active travel in the A96 corridor. There are opportunities to enhance NMU facilities associated with each route option and these have been assessed at a high level during this DMRB Stage 2 assessment.

7.11.4 These opportunities are where there is the potential to improve NMU connectivity along the route option and maintain connectivity across existing NMU routes within the study area which, in turn, enables better NMU connections between communities.

Pitcaple to Kintore

7.11.5 Along this geographical section there are several existing NMU routes which create opportunities to enhance connectivity.

7.11.6 The Violet route option affects three core paths and two existing local routes and the Orange route option affects six core paths and three existing local routes. Each of these routes will be maintained or alternative provision will be made with the potential for enhancements to be incorporated.

7.11.7 There are also further opportunities to provide better NMU access between existing communities and local destinations.

7.11.8 The Orange route option is considered to have more opportunity to improve NMU facilities based on the greater number of the existing NMU routes and settlements in its vicinity.

7.11.9 NMU facilities will be considered further during design development of the Preferred Option during DMRB Stage 3.

7.12 Health and Safety Considerations

7.12.1 Key health and safety risks and challenges during construction, use, maintenance and demolition are reported here to inform the assessment and any future design development. Important health and safety considerations which informed the development of the option development are also noted below.

7.12.2 The design will be subject to further consideration of issues relating to construction, use, maintenance and demolition throughout its development. Further consideration of construction phasing and maintenance of existing access arrangements during the construction period will be undertaken during DMRB Stage 3. A constructability audit will also be undertaken. It should be noted however that the detail of phasing and traffic management adopted during construction will be the responsibility of the appointed contractor to determine.

Construction Phasing and Constructability

7.12.3 The Violet and Orange route options tie into adjacent route options to the west at offline locations and are predominantly offline throughout their lengths. There are locations where the route options cross existing routes, including the existing A96. At these locations, it may be necessary to utilise temporary diversions to facilitate construction works and minimise disruption to road users. This may include temporary road provision adjacent to the works to allow construction of bridges over or under the existing routes.

Violet Route Option

7.12.4 There are a number of elements which pose particular health and safety and constructability challenges for the Violet route option, namely:

- Construction of embankment above an area of peat at Pitscurry Moss;
- Large, deep cuttings in rock across a number of locations;
- Construction of Daviot Junction at the interface with the B9001 and C76C and the adjacent Ides Burn and floodplain;
- Construction of Uryside Junction West on compressible ground, including the structure over the Lochter Burn, at the interface with the B9001;
- Crossing National Grid high pressure gas main (Uryside);
- Crossing of National Grid high pressure gas mains (Balbithan);
- Construction of the River Don crossing and the Aberdeen to Inverness Railway line;
- Construction of Tavelty Junction at the interface of the existing A96;
- Demolition and replacement of Forest Road overbridge and adjacent retaining structures; and
- Widening of the existing A96 eastbound between Tavelty and Gauchhill junctions.

Orange Route Option

7.12.5 There are a number of elements which pose particular health and safety constructability challenges for the Orange route option, namely:

- Construction of Pitscurry Junction, located in an area of peat;
- Construction of the River Urie crossing including bridging the existing A96; Aberdeen to Inverness Railway line and realigned access road;
- Construction of Drimmies Junction at the interface with the C120C;
- Interface with National Grid high pressure gas main;
- Construction of Blackhall Road Junction at the interface with the C116C and Newbigging Access;
- Construction of the River Don crossing;
- Interface with SSE 275kV overhead lines at two locations;

- Interface with SGN high pressure gas main, south of Thainstone Business Park;
- Construction of Thainstone Junction at the interface with the existing A96;
- Long and deep cuttings in rock at number of locations;
- Construction over areas of landfill; and
- Eastern tie-in to the existing A96.

7.13 Resilience

Winter Resilience

7.13.1 The existing A96 between Pitcaple and Kintore has not had any recorded snow closures over the last eight years. It ranges in altitude from 85m AOD at Pitcaple to approximately 60m AOD at Kintore.

7.13.2 The Violet and Orange route options traverse higher ground to the east and west of Inverurie. The Violet route option reaches 130m AOD and the Orange route option reaches 115m AOD. Met Office data for 1981 to 2010 has been consulted and both route options are subject to similar snowfall.

7.13.3 Data upon typical wind speeds for the Pitcaple to Kintore section of the existing A96 has been reviewed. Typical wind speeds are consistent with inland and non-exposed low altitude routes[13].

7.13.4 Both the Violet and Orange route options will require drainage to be implemented to intercept runoff from adjacent areas to reduce the risk of ice formation on the road.

7.13.5 The winter resilience of the scheme will be considered in further detail during DMRB Stage 3.

Operational Resilience

7.13.6 A new dual high quality dual carriageway is less likely to be subject to an incident which blocks one or both carriageways in comparison to the existing A96. Higher geometrical standards, segregation of oncoming traffic, safe overtaking opportunities and grade separated junctions are key factors which will reduce the likelihood and severity of accidents on the new dual carriageway.

7.13.7 Both the Violet and Orange route options retain the existing A96 between Pitcaple and Inverurie Roundabout at Port Elphinstone. This can act as an emergency diversion route for both route options subject to connections made by adjacent route options. The Orange route option has three connections to the existing A96 while the Violet route option has only one connection with the existing A96 at Tavelty Junction.

7.13.8 Emergency diversion routes for the Violet route option would stretch from Tavelty Junction along the existing A96 through Inverurie to Carden (for a Brown route option connection) or Kellockbank (for a Pink route option connection). Orange route option junction locations at Drimmies, Blackhall Road and Thainstone allow for the use of shorter lengths of the existing A96 in an emergency scenario.

[13] Refer to High Wind Strategy and National Wind Management Guidelines, Transport Scotland, 2009.

7.13.9 The A96 Scheme Resilience Strategy[14] states that purpose built emergency access roads linking with the local road networks are not anticipated at this time. However, this will be reviewed at DMRB Stage 3.

7.13.10 Other operational resilience features which will be considered during DMRB Stage 3 design development are emergency crossovers, emergency turnaround areas (ETAs) and other maintenance access requirements.

Climate Change Resilience

7.13.11 Climate change resilience considers the predicted ability of the new A96 to manage and mitigate the consequences of climate change influenced extreme weather events upon road users. This includes both the immediate weather events and consequential incidents such as landslips and flooding. Consideration of climate change resilience and adaptation mitigation is outlined in Volume 2, Part 3, Chapter 21, Climate.

7.14 Engineering Assessment Summary

7.14.1 A summary is provided below for each engineering issue, which identifies if one route option is considered more or less favourable.

Mainline Alignment

7.14.2 Both route options have been designed to meet DMRB standards without Departures from Standard or relaxations at this stage.

Junction Layouts

7.14.3 All junctions have been designed to fully meet DMRB standards without Departures from Standard or relaxations at this stage.

Local Roads and Accesses

7.14.4 Effects on local roads and accesses are summarised in Table 7.21.

Table 7.21 Local Road and Access Treatment Summary

Local road or access treatment	Violet Route Option	Orange Route Option
B – Bridge to be provided over or under A96 allowing continuation of local road. Includes realignment of existing road as required to connect to the bridge.	8	6
J – Road to be diverted / connected to a new A96 grade separated junction	9	5
R – Realignment or amendment of a public road or existing access to a private property.	9	15
Total No of local roads and accesses affected	**26**	**26**

[14] A96 Dualling Preliminary Engineering Services, Scheme Resilience Strategy, May 2015 – Rev 3, Transport Scotland.

7.14.5 Local roads and accesses would retain connectivity with the existing A96 and other local roads. The effects are similar for both route options.

Topography and Land Use

7.14.6 The Orange route option generally has larger cuttings and embankments than the Violet route option, which features extended sections of at-grade road or embankment from Pitcaple to around Keith Hall. Both options contain long viaduct crossings of the River Don and floodplain.

7.14.7 The Orange route option has a further viaduct crossing, of the River Urie and floodplain and also encroaches into LDP land associated with development at Crichie, south-west of Inverurie.

7.14.8 Overall, the violet route option generally has smaller cuttings and embankments, although these extend over a longer distance and is therefore only slightly more favourable than the Orange route option.

Geotechnics and Earthworks

7.14.9 Both route options pass through areas of compressible ground including peat and also areas of alluvium, glaciolacustrine deposits and infilled ground.

7.14.10 The lengths of the route options potentially affected by ground conditions which are considered to be more challenging (based on mapped surface geology only) are given in Table 7.7. The Violet route option passes through more areas of potential challenging ground conditions than the Orange route option. Both route options have significant lengths through areas of shallow rock, however the Violet route option has longer lengths through areas of compressible soils such as alluvium and glaciolacustrine deposits. There are some areas of landfill beneath local roads within the Orange route option.

7.14.11 Both route options require significant import of material from elsewhere on the scheme or from external sources to achieve an earthworks balance. The Violet route option requires import of 1,650,000m^3 and the Orange route option requires import of 1,030,000m^3 of bulk fill material.

7.14.12 The Orange route option is more favourable since it has less potential for challenging ground conditions and it requires less imported fill material from elsewhere on the scheme or from external sources.

Hydrology and Drainage

7.14.13 A preliminary assessment of hydrology was made for each option and both designs were developed to minimise flooding impacts.

7.14.14 Both options require a bridge over the River Don; the Orange route option also requires a bridge over the Urie whilst the Violet route option requires a bridge over the Lochter Burn. Both options require a similar number of culverts.

7.14.15 Both the Violet and Orange route options require four watercourse realignments. The overall length and complexity of the realignments required are considered comparable. Both route options are considered to perform similarly with regards works affecting existing watercourses.

7.14.16 A preliminary drainage design has been carried out to identify catchment areas and potential outfalls. Potential locations for attenuation basins have been identified and indicatively sized to assess feasibility and no engineering issues have been identified for either route option.

7.14.17 Overall, the Violet and Orange route options perform similarly in terms of hydrology and drainage.

Structures

7.14.18 Table 7.22 provides a summary of the structures required for each route option.

Table 7.22 Structures Summary

Type of Structure	Violet Route Option	Orange Route Option
Major Bridges	1	2
Railway Bridges	1*	1*
Underbridges (total)**	10	6
Overbridges (total)**	3	4
Retaining Structures	4	0
Total	**17**	**10**

* Railway crossings coincide with “Major Bridges”, River Don (Violet) and River Urie (Orange) crossings
** Total includes major bridges and railway bridges

7.14.19 The Orange route option has an additional major river crossing compared to the Violet route option. However, the Violet route option has a greater number of structures and the single major crossing is larger and more complex than those on the Orange route option. Overall, the Orange route option is considered more favourable.

Utilities

7.14.20 The comparative interfaces of the options are summarised in Table 7.23.

Table 7.23 Utilities Summary

Utility	Violet Route Option	Orange Route Option
Telecommunications	20	27
Gas	10	10
Electricity	37	49
Water and Wastewater	17	16
Private Wind Turbines	1	0
Total	**85**	**102**

7.14.21 The utilities that pose the most significant constraint between Pitcaple and Kintore are the National Grid High Pressure Gas Network and SSE 275kV overhead transmission lines.

7.14.22 Nationally strategic high pressure gas mains are present in this area and interface with both the Violet and Orange route options. The Orange route option interfaces with the SGN 219mm (once) and National Grid 1050mm high pressure gas mains (three interfaces) The Violet route option has a total of six interfaces with the 1050mm, 900mm and 1200mm National Grid gas mains.

7.14.23 The Orange route option interfaces with strategic 275kV SSE electricity transmission lines at two locations while the Violet route option does not.

7.14.24 Both route options have the same overall number of interfaces with strategic infrastructure. The Violet route option has fewer utility interfaces overall in comparison to the Orange route option.

7.14.25 The Violet route option is favoured due to the potential additional complexity of the interfaces with SSE 275kV transmission lines on the Orange route option.

Non-motorised Users

7.14.26 Along this geographical section there are several existing NMU routes which create opportunities to enhance connectivity.

7.14.27 The Violet route option affects three core paths and two existing local routes and the Orange route option affects six core paths and three existing local routes. Each of these routes will be maintained or alternative provision will be made with the potential for enhancements to be incorporated.

7.14.28 There are also further opportunities to provide better NMU access between existing communities and local destinations.

7.14.29 The Orange route option is considered to have more opportunity to improve NMU facilities based on the greater number of the existing NMU routes and settlements in its vicinity.

Health and Safety Considerations

7.14.30 There are a number of elements which pose particular health and safety and constructability challenges and both route options contain significant construction interfaces. The Violet route option presents ten such challenges whereas the Orange route option presents twelve.

7.14.31 The Violet route option has a complex construction interface with the existing A96 at the eastern extent of the route option. This includes the River Don / Aberdeen Inverness Railway line crossing, Tavelty Junction re-modelling and demolition and replacement of Forest Road overbridge, in close proximity and largely on the line of the existing A96. The Orange route option interface with the existing A96 is less onerous. Overall, the Orange route option is considered more favourable in terms of health and safety and constructability challenges.

Resilience

7.14.32 Both the Violet and Orange route options would be expected to perform similarly from a winter resilience perspective since they both pass through similar areas of higher ground exhibiting similar records of snowfall. Both route options are expected to require similar levels of winter maintenance activities and mitigation.

7.14.33 Both the Violet and the Orange route options are expected to provide high levels of operational resilience. However, the Violet route option only connects with the existing A96 for emergency diversion at Tavelty. The Orange route option has proposed junctions at Drimmies, Blackhall Road and Thainstone, providing more diversion and emergency access options.

7.14.34 In terms of overall resilience, the Orange route option is considered to be more favourable due to its proximity to the existing A96.

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