A96 DUALLING
INVERNESS TO ABERDEEN

A96 Dualling Programme

Strategic Environmental Assessment
Tier 2 Environmental Report

Appendix F - A96 Dualling Strategic Flood Risk Assessment (SFRA) (shortlisted Improvement Strategy Options

May 2015

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

A96 Dualling Programme Inverness to Aberdeen

Strategic Flood Risk Assessment (SFRA)

Main Report

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A96 DUALLING INVERNESS TO ABERDEEN

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Document history

A96 Dualling Programme

Inverness to Aberdeen

Strategic Flood Risk Assessment (SFRA) Report

Transport Scotland

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Executive Summary

CH2M HILL has been commissioned by Transport Scotland to produce a Strategic Flood Risk Assessment (SFRA), to identify and consider the range of flood risk sources and receptors, across a 15km-wide study area around the A96 trunk road route, between Inverness and Aberdeen in the North East of Scotland.

This Report and the accompanying Appendices represent the outputs of the SFRA process. Findings from this SFRA Report are expected to inform the Strategic Environmental Assessment (SEA) being undertaken for the A96 Dualling Programme, as well as later stages of A96 Dualling design development and environmental assessment.

The SFRA is presented in a series of logical stages, from baseline data gathering and consideration of local flood history information, to presentation of relevant data via Geographical Information Systems (GIS) mapping, and onto consideration of the likely levels of constraint presented by flood risk issues, when applied to a range of potential A96 improvement strategy options.

Baseline data was collated within the aforementioned 15km wide study area around the current A96 route; however, flood risk issues and constraints within alternative improvement strategy options were considered under narrower 2km wide option study extents.

The assessment presents objective analyses on the relative levels of flood risk related constraints around key locations; for example, floodplain extents and the number of properties at risk from flooding within bypass improvement strategy options to the north and/ or south of Forres, Elgin and Inverurie.

The assessment does not make any recommendations on the retention or removal of any option in favour of another. This is due to the fact that, whilst the consideration of flood risk constraints in isolation may suggest one option is highly likely to be constrained by the number of properties at risk of flooding, it may be that a higher number of properties affects the traffic demand to/ from the A96, which could therefore support the further development of an option. Each option will be considered further via the SEA, which will add information on a range of other constraints such as Biodiversity, Historic Environment, Landscape, Population and Human Health. Such additional information will add context to inform decisions based on assessment of engineering, environmental, and traffic and economic issues.

The SFRA therefore presents a straightforward comparison of improvement strategy options against a range of flood risk issues/ constraints, providing colour-coded summary assessment tables for each topic considered.

Where the SFRA identifies that options are likely to be constrained in flood risk terms, it recommends further assessment within the context of other engineering and environmental constraints (including via the SEA), as well as traffic demand, before decisions are reached on the removal of options from further consideration at subsequent stages of the development process.

1 Introduction

1.1 Background to Project

Flooding is a natural process and can happen at any time in a wide variety of locations. The various forms of flooding present a range of different risks, and the magnitude, speed and duration of potential inundation varies greatly. With climate change however; the frequency, velocity, depth, patterns and severity of flooding are forecast to increase, resulting in higher flood risk and potential damage.

CH2M HILL has been commissioned by Transport Scotland to undertake a route-wide Strategic Flood Risk Assessment (SFRA) across the A96 trunk road study area between Inverness and Aberdeen. The SFRA outputs will inform the A96 Dualling Programme Tier 2 Strategic Environmental Assessment (SEA) and Environmental Report.

SFRA normally constitutes a strategic overview of flood risk to a development plan area in order to inform the development planning process. SFRA was recently completed for the A9 Dualling Programme, which was the first application of its kind on a transport infrastructure strategic planning project by Transport Scotland.

The A96 Dualling Programme SFRA will build upon the framework developed for the A9 SFRA, but will be tailored to suit a different study area in terms of topography, urbanisation, flood mechanisms and a range of possible alternative 'improvement strategy options'.

This SFRA Report provides information on the most likely sources of flooding along the A96 Inverness to Aberdeen study area, and serves as a sign-posting document to support the later, more detailed assessment and design stages for the A96 Dualling Programme.

The findings and recommendations of the SFRA are also intended to inform the basis for more detailed flood risk assessment during later A96 Dualling DMRB[1] design and assessment stages.

1.2 Outline Approach

The SFRA study area covers a 15km wide zone around the existing A96 trunk road between Inverness and Aberdeen. The A96 is approximately 160 kilometres (km) long, extending through the local authority areas of Highland, Moray, Aberdeenshire and Aberdeen City; and through a number of towns along the route including Nairn, Forres, Elgin, Keith, Huntly and Inverurie.

Approximately 21km is currently dual carriageway (approximately 1km at Inverness and a further 20km between Inverurie and Aberdeen); hence approximately 140km of the A96 requires dualling, by online/ near online or offline means.

The A96 Dualling Programme SEA is being delivered using a two-tier approach, where Tier 1 considered broad environmental issues to inform the STAG (Scottish Transport Appraisal Guidance) appraisal of strategic alternatives to inform the Strategic Business Case for dualling.

The Tier 2 SEA considers a range of alternative 'improvement strategy options' between Inverness and Aberdeen (e.g. online/ near online dualling and offline bypass strategies). This SFRA will inform and complement the Tier 2 assessments.

[1] DMRB – Design Manual for Roads and Bridges, available online at http://www.standardsforhighways.co.uk/dmrb/

The key aims of the Strategic Flood Risk Assessment (SFRA) are:

- High level identification of areas sensitive to flooding within the A96 study area;
- High level assessment of potential flood risk constraints likely to affect/ be affected by the proposed alternative improvement strategy options; and
- Development of preliminary, strategic mitigation advice to support later, more detailed DMRB assessment and design stages for the A96 Dualling Programme (which will include site specific flood risk assessments).

The SFRA will strategically assess all forms of flood risk: fluvial (rivers), tidal (coastal), surface water (pluvial), groundwater and failure of infrastructure (e.g. reservoirs, aqueducts).

Flood history data has been collected from a range of organisations holding information of relevance to the A96 study area, including:

- Scottish Environment Protection Agency (SEPA);
- Local Authorities; and
- Transport Scotland's A96 Operating Company (BEAR).

1.3 SFRA Scoping Outcome

A SFRA Scoping Report (June 2014) that outlined the assessment scope and approach was submitted to SEPA following an initial review of the available information.

SEPA's response, dated 23 June 2014, is included in Appendix A, which generally confirmed their approval of the proposed approach.

2 Design Manual and Policy Context

2.1 Design Manual for Roads and Bridges (DMRB)

The Design Manual for Roads and Bridges (DMRB) provides a comprehensive system which includes current design standards, advice notes and other published documents relating to the design, assessment, operation, maintenance and improvement of trunk roads and motorways. Transport Scotland collaborates with the other UK overseeing authorities on the application and maintenance of design standards, and in the development of new standards.

DMRB Volume 11, Section 3, Part 10 HD45/09 – Road Drainage and the Water Environment provides guidance on the assessment and management of the impacts road projects may have on the water environment. These include possible impacts on the quality of water bodies, and on the existing hydrology of the catchments through which roads pass.

The DMRB standard considers four principal areas:

i) Effects of routine runoff on surface waters;

ii) Effects of routine runoff on groundwater;

iii) Pollution impacts from spillages; and

iv) Assessing flood impacts.

The DMRB governing principles in relation to flood risk may be summarised as follows:-

> *[sic] Vol 11 Sec 3 Pt 10 HD 45/09*
>
> *1.1 The Government…also attaches great importance to the management of flood risk in the planning process, acting on a precautionary basis and taking account of climate change. To achieve these aims, the Government sets standards for protection of the water environment, makes regulations to prevent its degradation and issues advice on how it can be avoided.*
>
> *1.2 Roads are designed to drain freely to prevent build-up of standing water on the carriageway whilst avoiding exposure to or causing flooding…*

DMRB promotes that route alignments should avoid functional floodplain[2], where possible. Where avoidance is not possible, and dualling encroaches onto the functional floodplain, transport infrastructure must be designed and constructed to (DMRB HD45/09, para 2.37 black box):

i) Remain operational and safe for use in times of flood;

ii) Result in no net loss of floodplain storage;

iii) Not impede water flows; and

iv) Not increase flood risk elsewhere.

[2] The **functional floodplain** is the flood extent up to and including a greater than 1 in 200 year return period (0.5% annual probability) of river or coastal flooding

2.2 National Policy

2.2.1 Scottish Planning Policy (SPP)

The purpose of the Scottish Planning Policy (SPP) is to set out national planning policies which reflect Scottish Ministers' priorities for the development and use of land. The SPP promotes consistency in the application of policy across Scotland whilst allowing sufficient flexibility to reflect local circumstances.

The DMRB makes reference to Scottish Planning Policy 7 (SPP7 – Planning and Flooding) and the flood risk framework in particular. SPP7 was replaced by SPP (paragraph 196 – 211) in 2010, and further revised in June 2014 (paragraphs 254 – 268). The SPP flood risk framework is replicated in Table 2—1.

The A96 is a trunk road linking two of Scotland's cities; therefore, it will be considered in the SFRA as essential infrastructure, with no associated permanent buildings.

Previous A9 Dualling SFRA consultation with SEPA determined that trunk road dualling design will be required to be above the 1 in 200 year return period (0.5% annual probability) event.

It was also agreed that an allowance for climate change ***is not*** a required design criteria, but consideration of long term sustainability for the route ***is*** required, especially at watercourse crossing locations. These same assumptions have been used in defining the flood design criteria for the A96 Dualling.

As the existing A96 route crosses land in all three categories of the SPP flood risk framework, this SFRA considers it unlikely that medium to high flood risk areas can be completely avoided by any A96 Dualling proposal.

Therefore this SFRA aims to identify existing flood risk areas, and flood risk related constraints to the A96 Dualling Programme. The SFRA also proposes an assessment framework for site-specific assessment at later stages of design development, to help ensure that the Dualling Programme will not increase the existing flood risk to receptors.

Table 2—1 [sic] Scottish Planning Policy flood risk framework (2014)

RISK FRAMEWORK
Little or No Risk Annual probability of coastal or watercourse flooding is less than 0.1% (1:1,000 years) • No constraints due to coastal or watercourse flooding.
Low to Medium Risk Annual probability of coastal or watercourse flooding is between 0.1% - 0.5% (1:1,000 - 1:200 years) • Suitable for most development. A flood risk assessment may be required at the upper end of the probability range (i.e. close to 0.5%), and for essential infrastructure and the most vulnerable uses. Water resistant material and construction may be required. • Generally not suitable for civil infrastructure. Where civil infrastructure must be located in these areas or is being substantially extended, it should be designed to be capable of remaining operational and accessible during extreme flood events.
Medium to High Risk Annual probability of coastal or watercourse flooding greater than 0.5% (1:200 years) • May be suitable for: - Residential, institutional, commercial and industrial development within built-up areas provided flood protection measures to the appropriate standard already exist and are maintained, are under construction, or are a planned measure in a current flood risk management plan; - Essential infrastructure within built-up areas, designed and constructed to remain operational during floods and not impede water flow; - Some recreational, sport, amenity and nature conservation uses, provided appropriate evacuation procedures are in place; and - Job-related accommodations, e.g. for caretakers or operational staff. • Generally not suitable for: - Civil infrastructure and the most vulnerable uses; - Additional development in undeveloped and sparsely developed areas, unless a location is essential for operation reasons, e.g. for navigation and water-based recreation, agriculture, transport or utilities infrastructure (which should be designed and constructed to be operational during floods and not impede water flow), and an alternative, lower risk location is not available; and - New caravan and camping sites. • Where built development is permitted, measures to protect against or mange flood risk will be required and any loss of flood storage capacity mitigated to achieve a neutral or better outcome. • Water-resistant material and construction should be used where appropriate. Elevated buildings on structures such as stilts are unlikely to be acceptable.

2.2.2 Flood Risk Management (Scotland) Act 2009

The Flood Risk Management (Scotland) Act 2009 is an Act of the Scottish Parliament to make provision for the assessment and sustainable management of flood risks, including the implementation of European Parliament and Council Directive 2007/60/EC. The Act also makes provisions on local authorities' and SEPA's functions in relation to flood risk management.

Flood risk is the combination of the probability of a flood and of the potential adverse consequences associated with a flood, such as on human health, the environment, cultural heritage and economic activity.

The primary sources of flooding identified in Flood Risk Management (Scotland) Act 2009: Delivering Sustainable Flood Risk Management[3] are:

- Coastal flooding –
  caused by a combination of high tides and storm surge and/ or high wave conditions linked to low pressure weather systems;
- River (fluvial) flooding –
  occurs when the water draining from the surrounding land exceeds the capacity of the watercourse;
- Surface water (pluvial) flooding –
  caused when rainfall water ponds or flows over the ground before it enters a natural or man-made drainage system or watercourse, or when it cannot enter the drainage system because the system has already reached its capacity;
- Sewer flooding –
  occurs when combined sewers are overwhelmed by heavy rainfall.
  Sewer flooding is often closely linked to surface water flooding, and may contain untreated foul water;
- Reservoir flooding and flooding from other infrastructure –
  although unlikely, failure of infrastructure such as dams or canals could result in a large volume of water being released;
- Groundwater flooding –
  occurs when water levels below ground rise above surface levels.

[3] The Scottish Government (2011) Flood Risk Management (Scotland) Act 2009: Delivering Sustainable Flood Risk Management. June 2011

2.3 Regional Plans

High level Strategic Flood Risk Assessments are available for both Aberdeenshire[4] and Aberdeen City[5] councils. These provide an overview of flood risk within each of the council areas.

Key points from the Aberdeenshire SFRA:

- Key sources of flood risk are fluvial and surface water in the northern part of Aberdeenshire.
- Flood prevention schemes:
    - Existing schemes:
      Fettercairn, Inverurie Strathburn and Inverurie Overburn;
    - Works of maintenance or minor improvements to reduce the likelihood of flooding have been carried out in:
      Aboyne, Alford, Banff, Balmedie, Fettercairn, Gardenstown, Inverbervie, Macduff, Marykirk, Peterhead, Philorth and Stonehaven;
    - Flood alleviation works have been carried out in:
      Whinnyfold, Cruden Bay and Alford;
    - Planned flood protection schemes:
      Stonehaven and Huntly.
- Places known to have surface water problems:
  Aboyne, Alford, Boddam, Ellon, Fordyce, Huntly, Inverurie, Lumphanan, Luthermuir, Macduff, Mill of Uras, Newmachar, New Pitsligo, Oldmeldrum, Old Rayne, Portsoy, Peterhead, Portlethen, Rosehearty, Rothienorman, St Cyrus, Stonehaven, Strichen, Tarland and Turriff.
- Community flood action groups operate in:
  Fettercairn, Stonehaven, Portlethen, St Cyrus, Auchenblae, Edzell Woods, Mill of Uras and Huntly.

Key points from the Aberdeen City SFRA:-

- Main high fluvial/ coastal flood risks are along the large watercourses, including the rivers Dee, Don and the Denburn;
- Highlights the potential flood risk due to small watercourses not identified by the SEPA flood map, but may still be vulnerable to localised flooding, particularly where blockages occur;
- Highlights the risk of flooding due to rising groundwater likely to occur in low lying areas underlain by permeable rocks such as chalk, sandstone or localised sands and gravels;
- Risk of flooding due to infrastructure failure is considered low.

The information presented in these documents is represented within this SFRA with a specific focus on the A96 study area.

[4] Strategic Flood Risk Assessment in respect of the Aberdeenshire Council Main Issues Report 2013, http://www.aberdeenshire.gov.uk/planning/plans_policies/StrategicFloodRiskAssessmentinrespectoftheAberdeenshireCouncilMainIssuesReport2013.pdf (Accessed 11 Aug 2014)

[5] Aberdeen City Council, Local Development Plan, Draft Strategic Flood Risk Assessment, http://www.aberdeencity.gov.uk/nmsruntime/saveasdialog.asp?lID=54158&sID=24188 (Accessed 11 Aug 2014)

2.4 Guidance

2.4.1 SEPA

SEPA guidance[6] states that the Strategic Flood Risk Assessment (SFRA) is designed for the purposes of informing the development planning process; primarily to avoid increasing overall flood risk by avoiding areas of flood hazard.

This SFRA builds on this best practice guidance, the precautionary approach promoted in the latest SPP; and the SFRA prepared by CH2M HILL in 2013 for the A9 Dualling Programme.

SFRA normally constitutes a strategic overview of flood risk to a development plan area and should involve the collection, analysis and presentation of all existing available and readily derivable information on flood risk from all sources.

This SFRA will focus on the collection and analysis of available data for the A96 study area between Inverness and Aberdeen.

SEPA's guidance also states that the SFRA should be used to apply a risk-based approach to the identification of land for development and for the development of policies for flood risk management, including surface water management.

Evidence will be included within this document to support decision making processes where alternative improvement strategy options are being considered.

[6] Strategic Flood Risk Assessment – SEPA technical guidance to support Development Planning, available at: http://www.sepa.org.uk/planning/flood_risk/planning_authorities/sfra.aspx

3 SFRA Baseline Information

3.1 Study Area

The A96 Dualling SFRA study area boundary comprises a 15km wide zone, i.e. 7.5km either side of the existing A96; taking into account the wider context of the natural hydrological draining catchment and potential tidal influence. The study area, which is consistent with that being used in the SEA to underpin assessment of alternative improvement strategies, is presented in Figure 3—1.

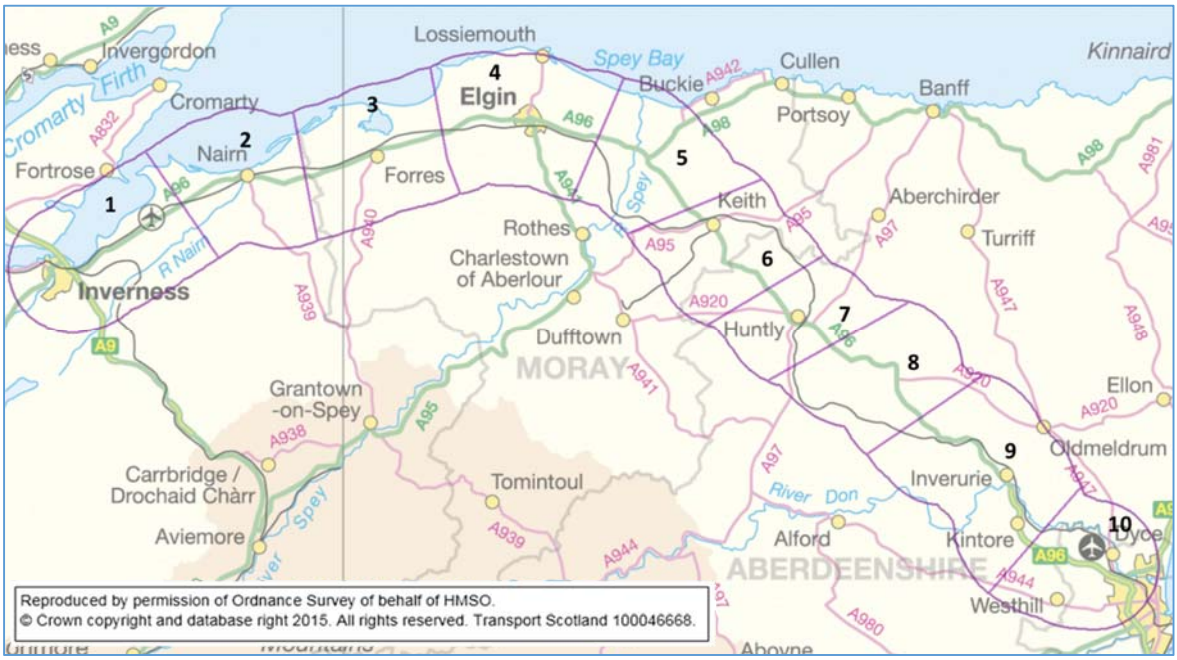


Figure 3—1 A96 SFRA study area and sections.

To support cross-referencing with the A96 Dualling SEA and Preliminary Engineering Studies (PES), the SFRA will refer to 10 SEA/ PES study sections (detailed in Table 3—1) within the context of natural hydrological catchments, explained in the following sections of this report.

It should be noted that designs within A96 Sections 1 & 2 are at a more advanced stage (A96 Inverness to Nairn including Nairn Bypass), and the principal alignment for this part of the A96 Dualling Programme has effectively been determined since Transport Scotland's announcement of a preferred option in its October 2014 DMRB Stage 2 Report[7].

This SFRA report therefore includes information on A96 Sections 1 & 2 for completeness only as these sections have been assessed as part of the Inverness to Nairn (including Nairn Bypass) DMRB Stage 2 Assessment.

[7] A96 Inverness to Nairn (including Nairn Bypass) DMRB Stage 2 Scheme Assessment, available at: http://www.transportscotland.gov.uk/project/a96-inverness-nairn-including-nairn-bypass

Table 3—1 A96 SEA/ PES study area sections

A96 Section Number	From	To	Length of Existing A96 within Section (approx. km)
1*	Inverness	Gollanfield	14.9
2*	Gollanfield	Auldearn	13.0
3	Auldearn	Mains of Burgie	18.3
4	Mains of Burgie	Lhanbryde	20.1
5	Lhanbryde	Keith	16.8
6	Keith	Cairnie/ The Bin	13.8
7	Cairnie/ The Bin	Hillhead	11.2
8	Hillhead	Westhall	16.8
9	Westhall	Blackburn	21.3
10	Blackburn	Aberdeen	7.6

** A96 Sections 1 and 2 are at a more advanced stage of DMRB design development and are not being assessed via SEA/ PES studies.*

3.2 Hydrological Catchments

The SFRA study area traverses six key hydrological catchments (shown in Figure 3—2 and detailed map in Appendix B1), namely, Nairn, Findhorn, Lossie, Spey, Deveron and Urie/ Don.

The Nairn, Findhorn, Lossie, Spey and Deveron catchments generally flow in a north-easterly direction towards the Moray Firth, while the Urie/ Don catchment generally flows in an easterly direction towards the North Sea.

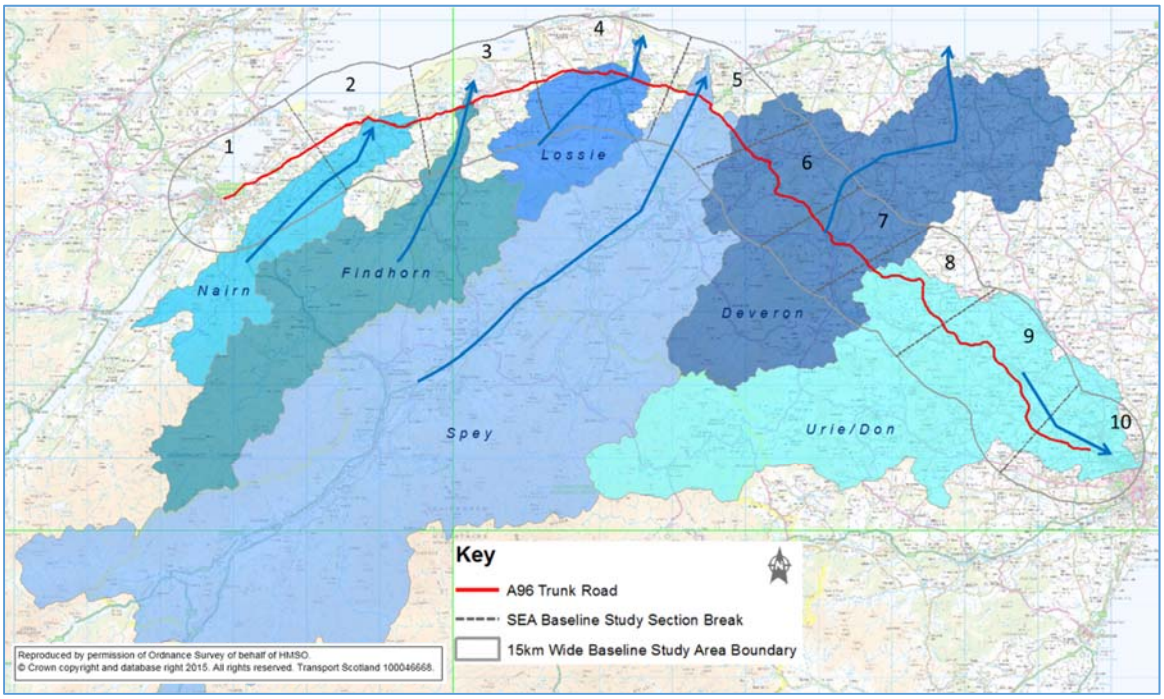


Figure 3—2 Key hydrological catchments

Catchment descriptors for the key hydrological catchments have been extracted from the Flood Estimation Handbook (FEH) CD-ROM and tabulated in Table 3—2.

Table 3—2 Catchment descriptors of key hydrological catchment

Catchment descriptors / Catchment	Area, km²	LDP, km	DPLBAR, km	DPSBAR, m/km	ASPBAR, deg
	Catchment area	Longest drainage path	Mean drainage path length	Mean catchment steepness	Dominant aspect of the catchment slope
Nairn	336	60	30	97	347
Findhorn	787	104	58	117	11
Lossie	271	56	31	74	2
Spey	2948	178	101	154	19
Deveron	1232	104	55	93	74
Urie/Don	1317	138	68	109	94

Source: Flood Estimation Handbook CD-ROM version 3

The Spey catchment is the largest, followed by Urie/ Don and Deveron, which are all in excess of 1,000km². The Spey catchment is also the longest and steepest, with a drainage path of 178km and a mean catchment steepness of 154m/km. The mean catchment steepness indicates the potential for high magnitude velocity flows, resulting in dynamic morphology within the channel.

The A96 crosses the main rivers Nairn, Findhorn, Lossie and Spey as well as several tributaries of the Deveron and Urie/ Don. There are several smaller watercourses outside these key hydrological catchments.

3.3 Tidal Limits

The tidal limits for the Nairn, Findhorn, Lossie and Spey catchments (study area sections 2, 3, 4, and 5 respectively) are all within the study area boundary, indicating that part of these key catchment areas include tidal influence. The normal tidal limits of the key hydrological catchments are presented in Figure 3—3.

The A96 study area sections within the Deveron and Urie/ Don catchments are unlikely to see any tidal influence. The potential tidal effect on the River Don near Aberdeen is not considered in the SFRA, as the A96 is approximately 7km from the River Don tidal limit and is already dualled from Inverurie to Aberdeen. The SFRA is also not considering the River Ness at Inverness as A96 dualling will not extend that far west.

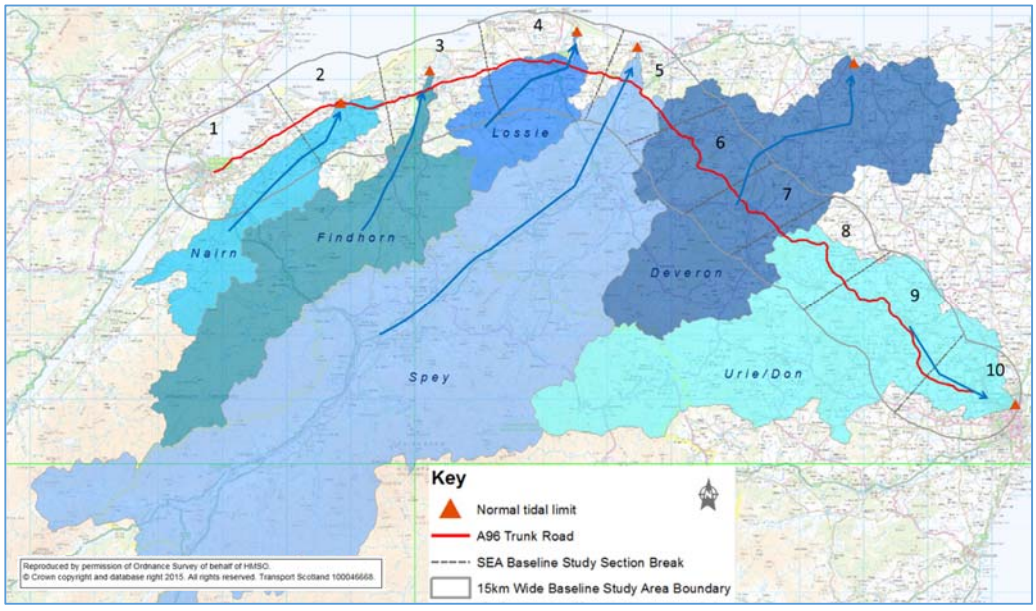


Figure 3—3 SEPA tidal flood extents

3.4 Geology

The British Geological Survey (BGS) solid geology, superficial geology and aquifer classification maps have been reviewed.

3.4.1 Solid Geology

The majority of solid geology within the study area includes variants of sandstone (A96 Sections 1-4) and metamorphic rock (variants of psammite and semipelite – A96 Sections 5-10), with igneous intrusion noted in A96 Sections 1, 2, 5, 6, 7, 9 and 10.

Solid geology underlying the study area is shown in Figure 3—4 and in Appendix B2.

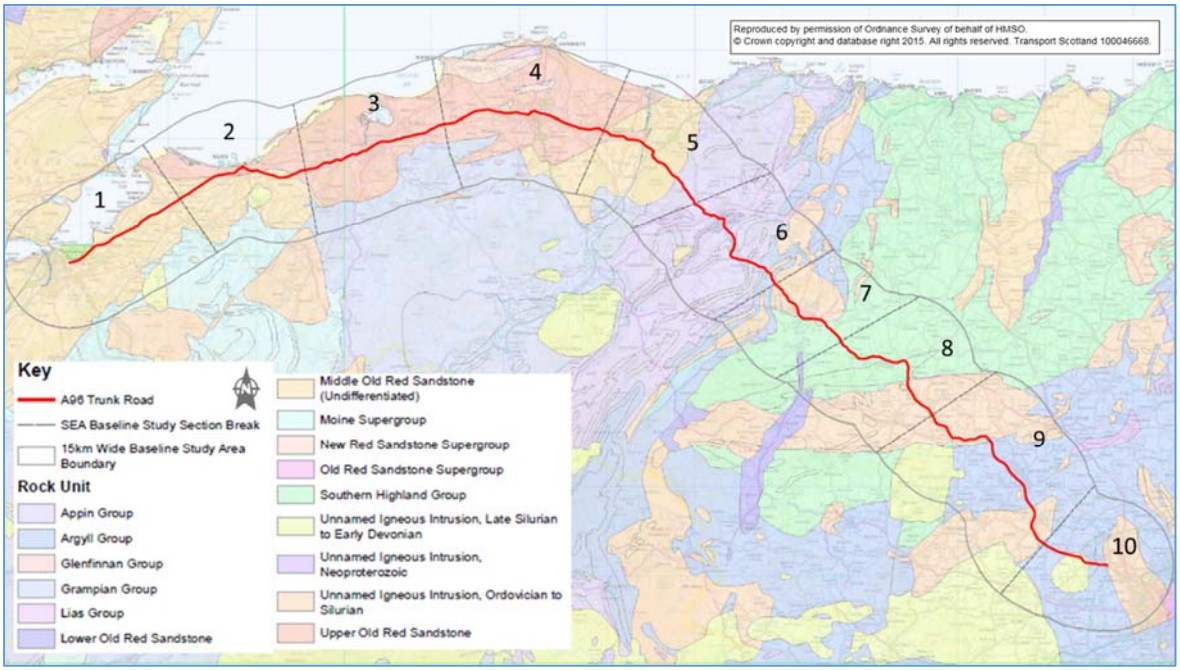


Figure 3—4 Solid geology within the A96 study area

3.4.2 Superficial Deposits

The majority of superficial geology in the study area is glacial sand and gravel and till. Alluvium overlies the bedrock along the major rivers, i.e. the Nairn, Findhorn, Lossie, Spey, Deveron and Urie/ Don.

Along the coastline, blown sand is noted in A96 Sections 2 and 3, with raised marine deposits in A96 Sections 1, 2, 3, 4 and 5.

Several pockets of peat are present within the study area, in particular over areas of higher ground, e.g. between Fochabers and Keith.

The superficial geology for the study area is shown in Figure 3—5 and in Appendix B3.

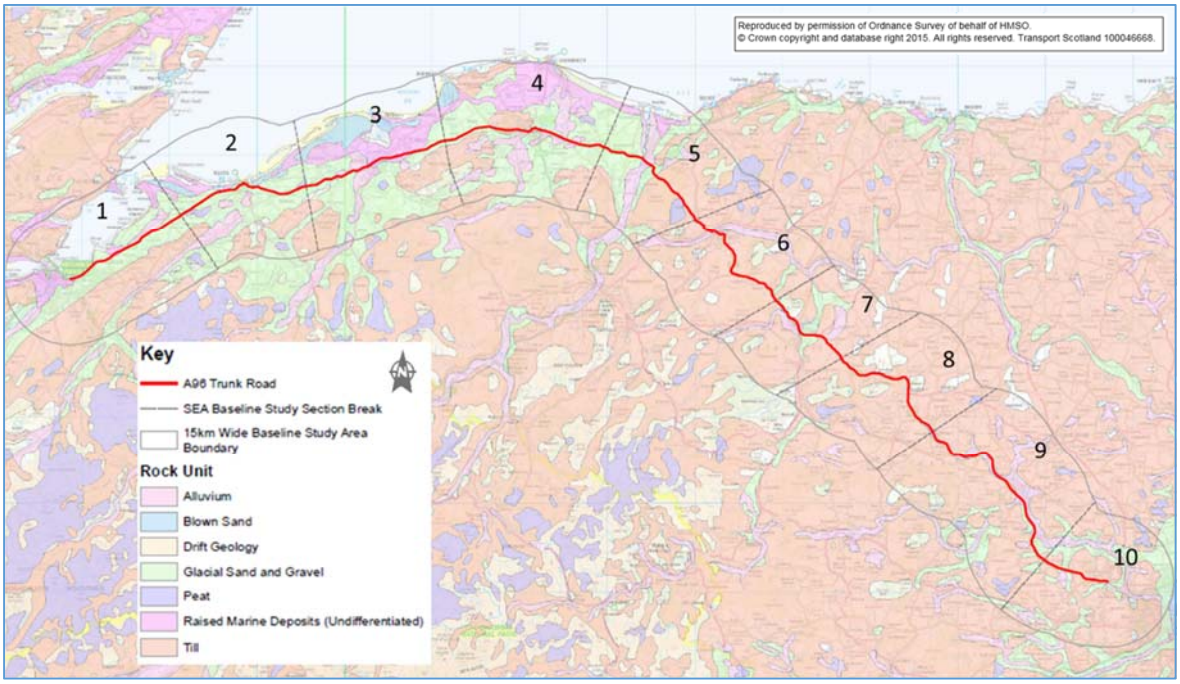


Figure 3—5 Superficial geology within the A96 study area

3.4.3 Aquifers

Review of the aquifer classification map indicates that the hydrogeology of the study area consists of limited aquifers with intergranular flow, where flow is virtually all through fractures and other discontinuities.

The majority of the western part of the A96 study area (Sections 1- 5) is predominantly classified as moderately productive aquifer, while the eastern area (Sections 6- 10) is classified as low productive aquifer.

The aquifer classification for the study area is shown in Figure 3—6 and in Appendix B4.

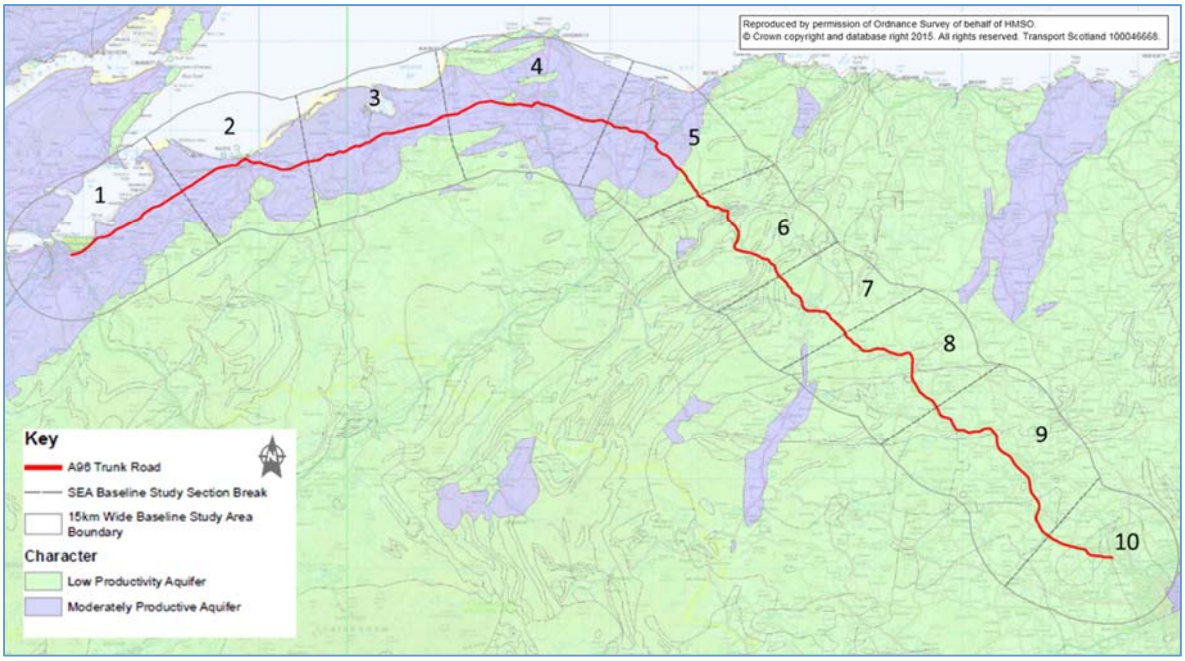


Figure 3—6 Aquifer classification within the A96 study area

3.5 Settlements

The A96 passes through or close to several towns, villages and a large number of individual properties (details in Figure 3—7 and Appendix B5).

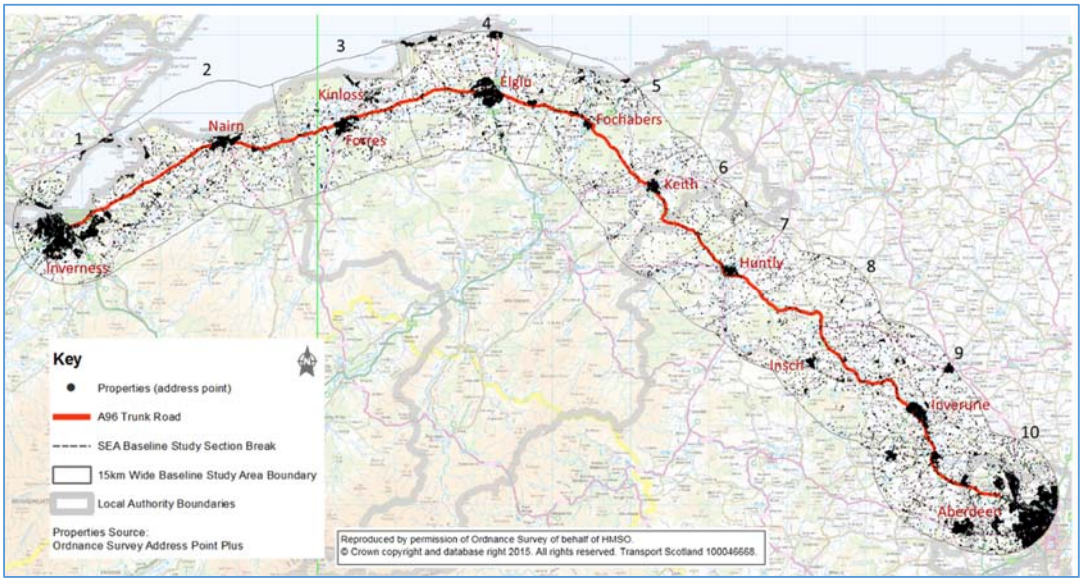


Figure 3—7 Properties within the A96 study area and surround

Key settlements within the 15km study area, including those offline from the A96, but which have potential to be affected by options involving offline dualling, are identified in Table 3—3. Review of Ordnance Survey AddressBase point data estimated a total of 126,257 properties within the study area. The majority of properties are within the key settlements, including Inverness, Nairn, Forres, Elgin, Keith, Huntly, Inverurie and the western edge of Aberdeen.

Table 3—3 Settlements within the A96 study area

A96 Section	Total # properties* within study area	Towns/ Villages	On**/ off the A96
1	20,509	Inverness (part)	On
2	3,822	Nairn	On
3	4,903	Forres	On
		Kinross	Off
4	11,468	Elgin	On
		Burghead	Off
		Lossiemouth	Off
		Lhanbryde	On
5	2,141	Fochabers	On
6	2,482	Keith	On
7	2,114	Huntly	On
8	1,745	Insch	Off
9	9,209	Inverurie	On
		Oldmeldrum	Off
		Kemnay	Off
		Kintore	On
10	67,864	Blackburn	On
		Dyce	On
		Westhill	Off
		Aberdeen (part)	Off
TOTAL	126,257		

** Properties = OS AddressBase points* *** On = A96 crossing towns/ villages*

3.6 Agricultural land

The land capability for agriculture classification information prepared by the Macaulay Institute (now the James Hutton Institute) was reviewed.

This distribution of agricultural land is shown in Figure 3—8 and detailed in Appendix B6.

The large majority of the current A96 route crosses land of mixed agriculture, with pockets of improved grassland in in each of the Sections.

There are also areas of arable agriculture, the most extensive of which are crossed by the existing A96 route in Sections 3, 4, 8, 9 and 10.

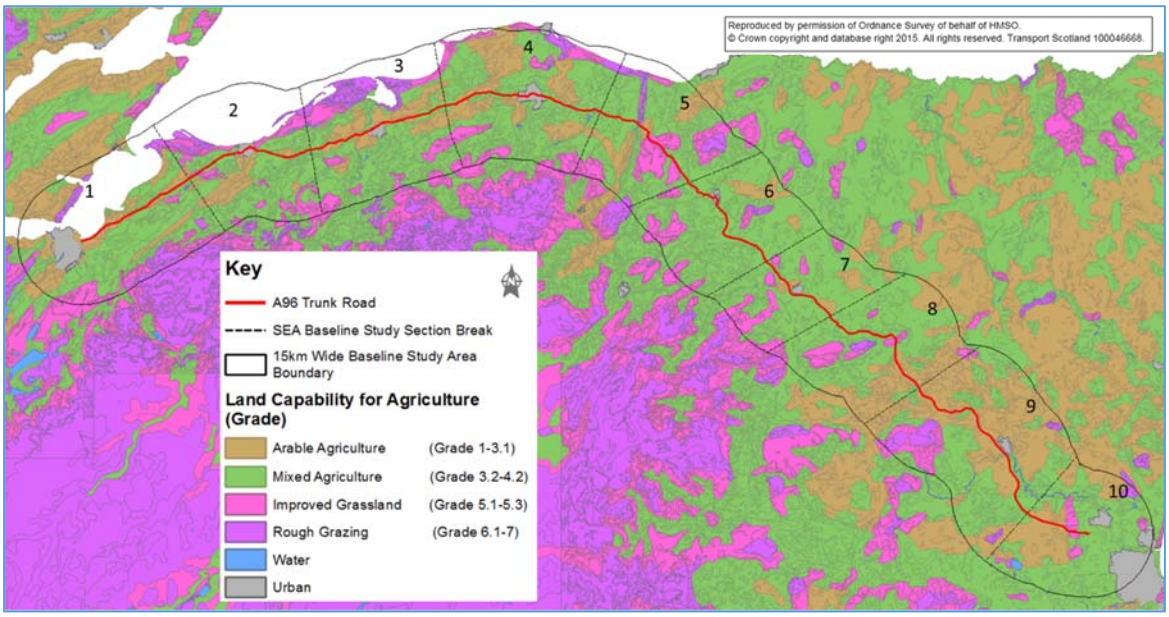


Figure 3—8 Land capability for agriculture classification within the A96 study area and surroundings

4 Existing Flood Risk

4.1 Identification of Flood Risk

Flood risk is considered as a function of probability (likelihood) of flood hazard and the consequences (impact) of flooding on receptors (see Figure *4—1*). The likelihood of a flood is estimated in terms of probabilities per annum.

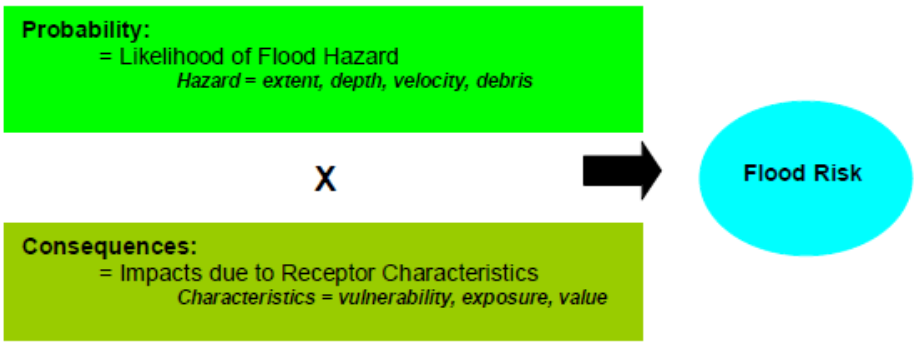


Figure 4—1 [sic] Components of definition of 'flood risk'
Source: SEPA strategic flood risk assessment technical guidance, 2012

Flood risk, within the context of the Scottish Planning Policy (SPP) risk framework and being applied for the A96 Dualling framework, is based on a greater than 1 in 200 year return period (0.5% annual probability) of river flooding.

Functional floodplains convey and store flood water during times of flood. Floodplain extents are defined by the probability of a flood event. For the purposes of this SFRA, a functional floodplain is the flood extent of a greater than 1 in 200 year return period (0.5% annual probability) of river flooding.

The following sub-sections of this Chapter review the likely sources and potential receptors of existing flood risk within the A96 study area.

4.2 SEPA Flood Maps

The latest SEPA Flood Maps (2014) have been obtained to inform the SFRA. Understanding of flooding sources and flood impact receptors is improved by the additional information provided by these updated maps, as compared with the Indicative River and Coastal Flood maps of 2006 (see Table 4—1).

Table 4—1 SEPA flood maps information

	SEPA INDICATIVE RIVER AND COASTAL FLOOD MAP (2006)	SEPA FLOOD MAPS (2014)
Source of flood risk	Shows flooding from: • Rivers • Sea	Shows flooding from: • Rivers • Sea • Surface water
Scenario/ Likelihood	Shows 1 likelihood for flood extent • medium likelihood flooding (1 in 200 year return period)	Shows 3 likelihoods for flood extent, depth and velocity • High (1 in 10 year return period) • Medium (1 in 200 year return period) • Low (1 in 1000 year return period or 200 year plus climate change for surface water)
Type of information	Shows • Flood extent • Flood defences	Shows • Flood extent • Flood depth (where available) • Flood velocity (where available) • Flood defences • Impacts of flooding • Groundwater map – areas where groundwater contributes to flooding • Natural flood management – areas where there is an opportunity for natural flood management techniques

Source: SEPA Flood maps information – What's new (http://www.sepa.org.uk/flooding/flood_maps.aspx)

The updated flood maps present the flood extents of individual sources of flooding independently, but do not account for the possible interactions between sources of flooding and/ or any resulting combined impact.

The flood maps do not take account of flooding from small watercourses where the catchment area draining to the watercourse is less than 3km^2. Neither do the flood maps take account of the influences of engineering structures such as bridges, culverts and weirs.

The medium likelihood of flooding, or the 0.5% annual probability (or 1 in 200 year return period), is used throughout this SFRA in line with the SPP risk framework for A96 dualling (see Section 2.2.1) to provide a high level assessment of flood risk.

4.3 Flood History

Flood history information has been obtained through information requests to SEPA, Local Authorities and Transport Scotland's operating company (trunk road management and maintenance organisation), BEAR Scotland.

Information received to date on historical flood incidents within the study area is presented in Figure 4—2 and detailed in Appendix B7.

The collated flood history does not just relate to the A96 alone, being a mixture of historic recorded events, including recent events resulting from surface water and snowmelts, and back to the Muckle Spate of 1829.

The frequency of reported flood incidents are noted to be mainly within more urbanised locations, i.e. Inverness (Section 1), Nairn (Section 2), Forres (Section 3), Elgin (Section 4), Keith (Section 6), Huntly (Section 7), Inverurie (Section 9) and Aberdeen (Section 10).

The data should be interpreted carefully as it represents recorded incidents rather than all incidents (for example, more incidents affecting public infrastructure/ assets are likely to be recorded than on other land uses).

BEAR Scotland provided flood incident information specific to the A96, which identified 70 separate flood incidents from February 2009 to May 2014, resulting from flooding from a mixture of sources including surface water, blocked gullies and snowmelt.

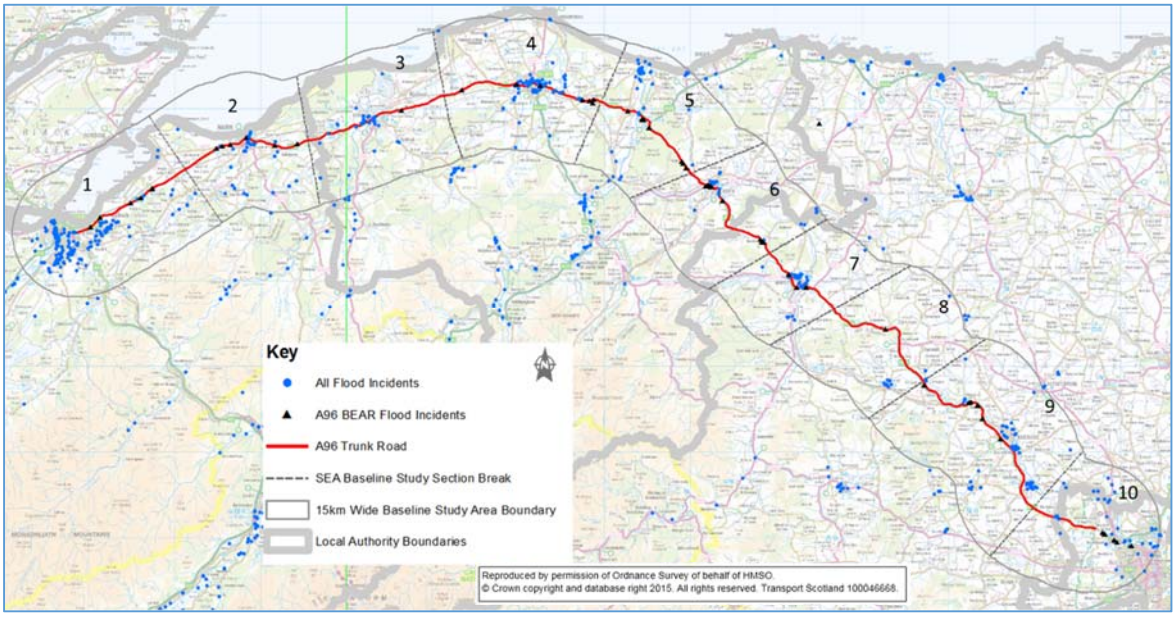


Figure 4—2 Flood history

4.4 River (Fluvial) Flooding

The fluvial flood maps for the study area are presented in Figure 4—3.

Locations along the current route of the A96 that lie within SEPA's 1 in 200 year return period fluvial flood extent are highlighted in Figure 4—3. Most of these locations are where the A96 crosses a watercourse, noted at 91 locations.

There are however two significant lengths of the existing A96 which lie within the SEPA flood maps and are associated with the road crossing the floodplain. These are located close to the two urban areas of Forres (A96 Section 3) and Elgin (A96 Section 4).

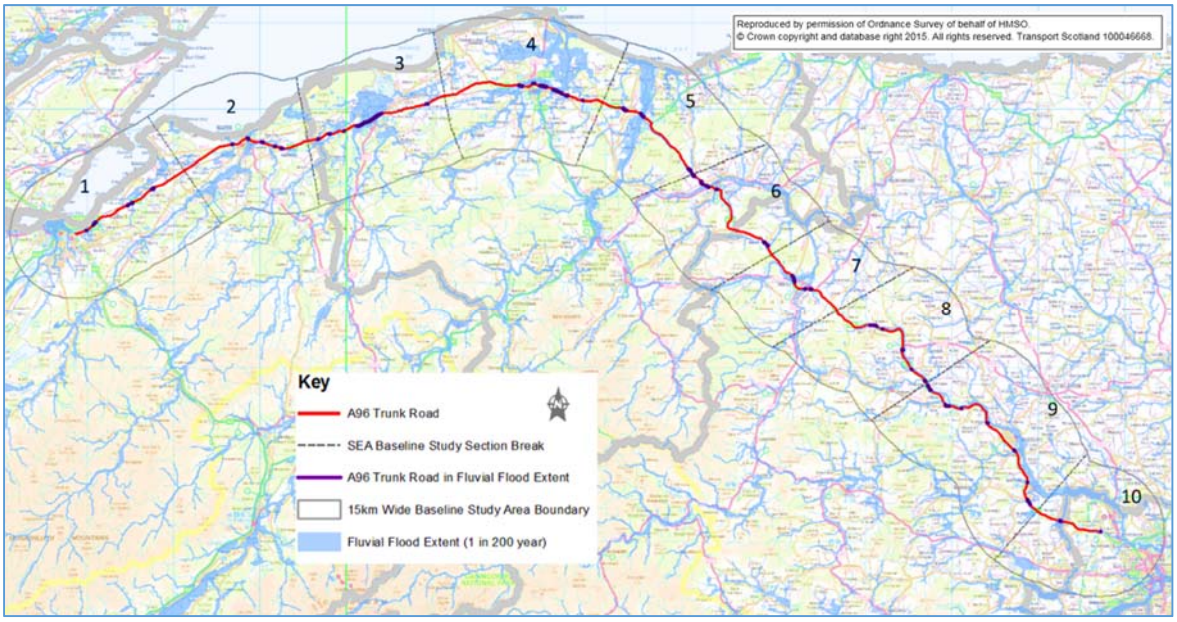


Figure 4—3 Fluvial floodplain within the A96 dualling study area

4.4.1 Water Crossings

The watercourses crossed by the current A96 range from very large rivers to unnamed small watercourses. A review of the 91 watercourse crossings was undertaken based on structures (bridges/ culverts) information provided by Transport Scotland and review of the OS 1:10,000 map.

The hydrological catchment area of the watercourses at the crossing points has been estimated using the Flood Estimation Handbook[8].

Review of the existing water crossings indicated ~70% of the water crossings are over small hydrological catchment areas of <10km^2.

It should be noted that as the SEPA flood maps only include catchment areas greater than 3km^2, there may be existing flood risk from smaller watercourses not highlighted by the flood maps.

Table 4—2 Existing watercourse crossings on the A96

Catchment size, km^2		Number of water-crossings	Number of water-crossings within flood map
≤0.5	Very small	22	13
0.5 to 9.9	Small	41	25
10 to 49	Medium	17	17
50 to 99		3	3
100 to 499	Large	5	4
>500	Very large	3	3

[8] FEH CD-ROM v3, which provides a digital data set of UK catchments that drain an area greater than 0.5km^2

4.4.2 Flood Prevention/ Alleviation Schemes

A review of existing and proposed flood prevention/ alleviation schemes within the study area has been undertaken. Known schemes are listed in Table 4—3 with locations shown in Figure 4—4.

Flood prevention/ alleviation schemes are under construction at both Elgin and Forres, with another proposed for Huntly. It is possible that these schemes may change the existing flood risk to the road carriageway in these areas.

Table 4—3 Flood prevention schemes within the A96 study area

<table>
<tr><th colspan="2">THE HIGHLAND COUNCIL</th></tr>
<tr><td colspan="2">River Ness Flood Alleviation Scheme
To protect 800 homes and 200 businesses in Inverness
Watercourses: River Ness
Phase 1
In construction
Scheme involves diversion of utilities, flood wall between Bank Street and Huntly Street
Phase 2
In construction
Scheme involves flood wall between Friars Bridge and river mouth
Watercourse: River Ness</td></tr>
<tr><th colspan="2">MORAY COUNCIL</th></tr>
<tr><td>Elgin Flood Alleviation Scheme
In construction
Designed to 1 in 200 year return period flood
To protect ~650 properties and 180 commercial properties
Majority of defences in the town of Elgin
Watercourses: Tyock Burn, Linkwood Burn, River Lossie</td><td>Elgin Waterside Street Flood Protection Scheme
Completed in 1988
Watercourse: River Lossie

Tyock Burn Flood Prevention Scheme
Completed in 1967
Scheme involved embankment & river widening
Watercourse: Tyock Burn</td></tr>
<tr><td>Forres (River Findhorn & Pilmuir) Flood Alleviation Scheme
In construction
Designed to 1 in 200 year return period flood
To protect 1,000 homes and businesses
Scheme involve raising vertical alignment of existing A96
Watercourses: River Findhorn</td><td>Forres (Burn of Mosset) Flood Alleviation Scheme
Completed in 2009
Designed to 1 in 100 year plus climate change
To protect over 800 properties
Watercourse: Burn of Mosset</td></tr>
<tr><td colspan="2">Lhanbryde Flood Alleviation Scheme
Completed in 2005
To protect 44 properties (residential & business)
Scheme involved flood storage, flood walls and channel improvement
Watercourse: Lhanbryde Burn</td></tr>
<tr><th colspan="2">ABERDEENSHIRE COUNCIL</th></tr>
<tr><td>Inverurie (Strathburn & Overburn) Flood Prevention Scheme
1978
Watercourse: Over Burn, Strath Burn</td><td>Overburn Culvert, Inverurie Flood Prevention Scheme
2001
Scheme involved installation of new box culvert
Watercourse: Over Burn</td></tr>
<tr><td colspan="2">Proposed Huntly Flood Protection Scheme
Design to 1 in 200 year plus climate change
Scheme involves embankment, 2 flood attenuation areas
Watercourse: River Deveron</td></tr>
</table>

Source: The Highland Council; Aberdeenshire Council; Scottish Flood Defence Database; Scottish Government website; Royal Haskoning (2014) A96 Preliminary Engineering Services – Preliminary Assessment of Flood Risk

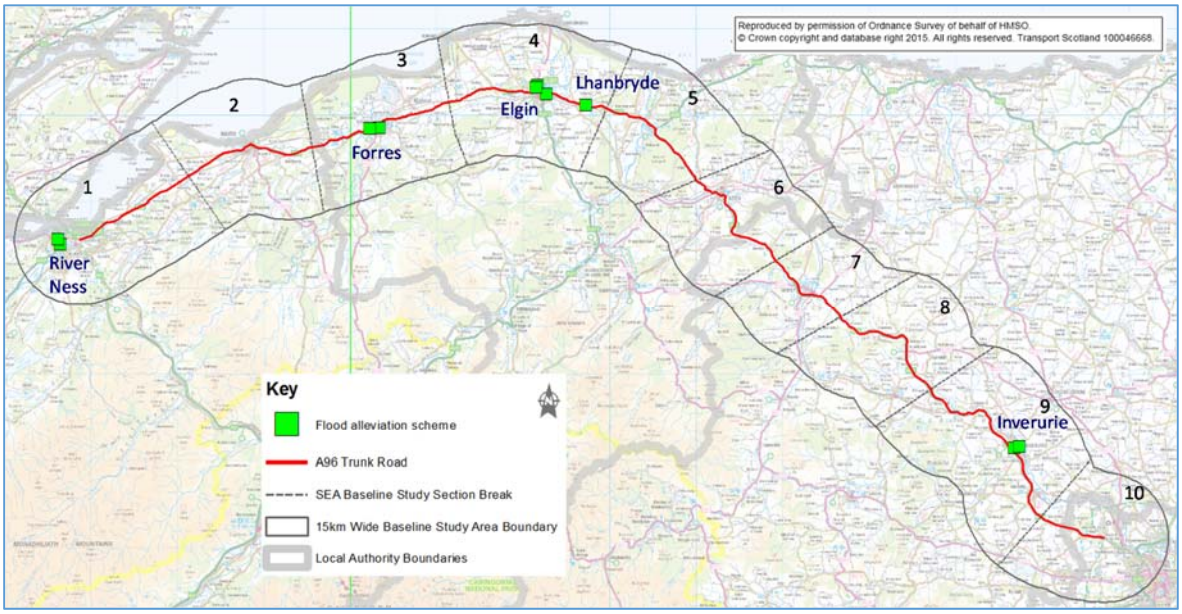


Figure 4—4 Locations of flood prevention schemes within A96 study area

4.5 Coastal Flooding

The coastline within the study area (A96 Sections 1, 2, 3, 4, 5) is at risk of coastal flooding, and sea water intrusion within the Findhorn and Lossie catchments results in a wider area at risk of flooding from the sea.

The current routing of the A96 does not lie within the 0.5% annual probability (200 year return period) coastal flood extent, as shown in Figure 4—5.

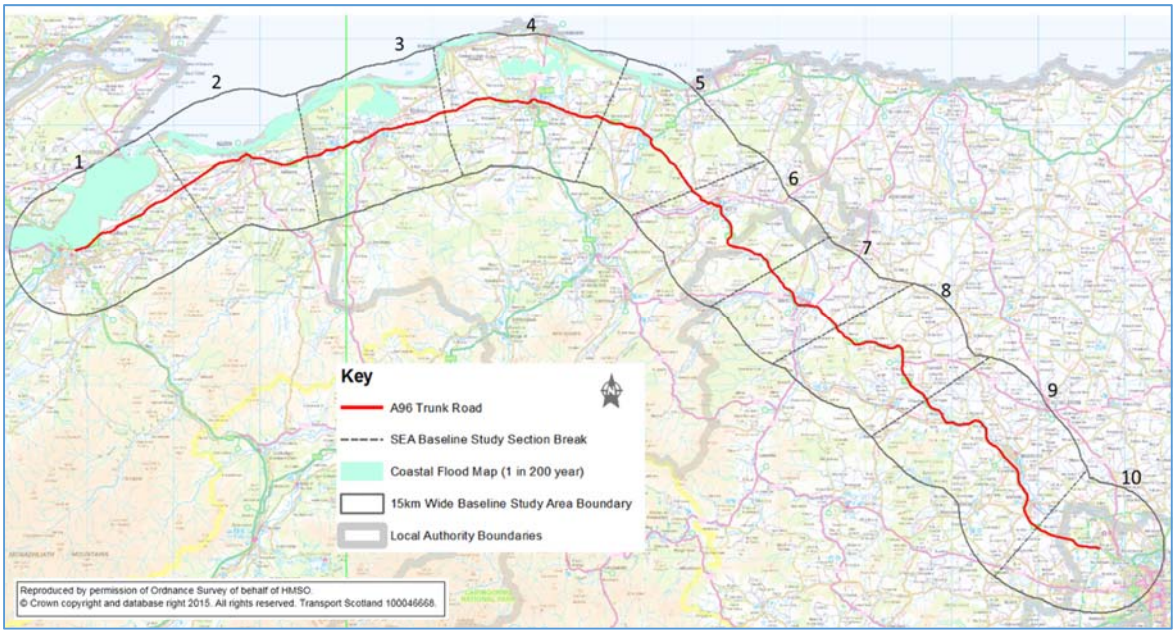


Figure 4—5 Coastal floodplain within A96 study area

4.6 Surface Water (Pluvial) Flooding

Flooding caused by surface water runoff in an undrained area, or across a saturated, frozen or impermeable surface, sometimes referred to as 'pluvial' flooding, may also flood a road surface.

In typical carriageway design, surface water runoff from the drainage catchment area surrounding the road is collected by roadside filter drains or open ditches. Therefore the incidence/ risk of surface water flooding on the A96 ties in closely with road drainage efficiency.

During heavy rainfall, drainage systems may become overwhelmed, preventing surface water runoff from draining through the usual routes.

The SEPA surface water flood map is shown below in Figure 4—6.

The SEPA surface water flood maps identify a number of areas, along the whole of the current A96, which could be at risk from surface water flooding. These are generally more predominant across low lying areas.

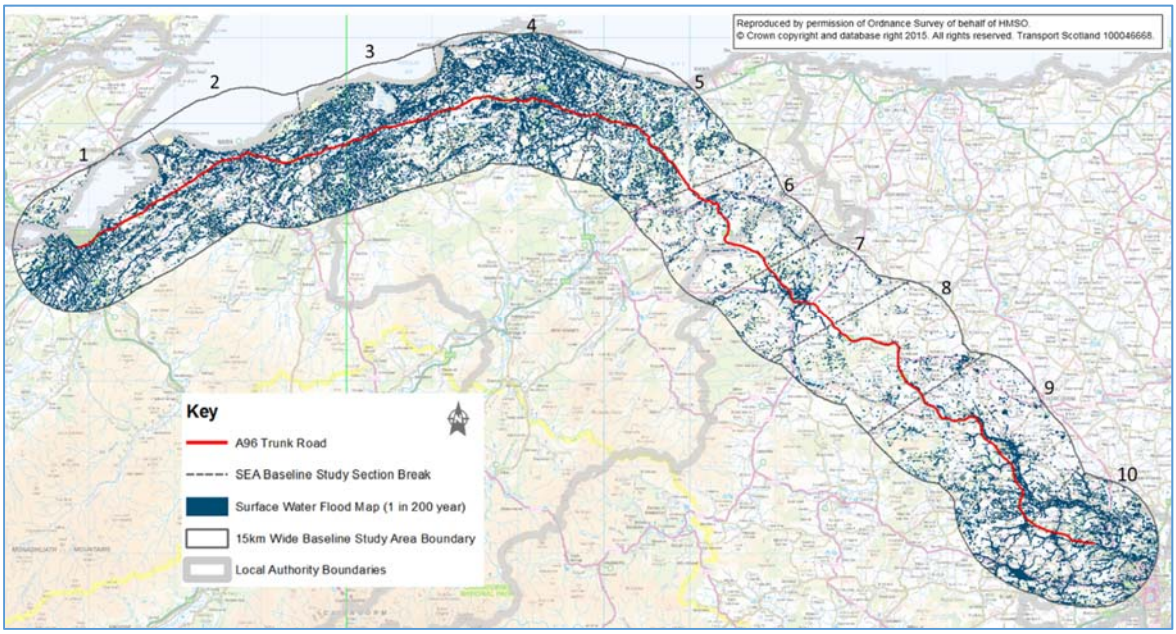


Figure 4—6 Surface water flood extent within A96 study area

The surface water flood map combines information on rainfall and sewer model outputs; as such, much of the low lying areas are shown at risk of surface water flooding in a 1 in 200 year return period event.

The flood history data discussed in Section 4.3, confirms that stretches of the existing A96 and surrounding areas have experienced surface water flooding.

4.7 Groundwater Flooding

The SEPA groundwater flood map (Flood Maps 2014) shows areas where groundwater could contribute to flooding, or where there has been evidence of groundwater flooding.

The flood map also takes account of aquifer productivity, groundwater flooding associated with rivers and historic records of flooding.

Figure 4—7 shows that A96 Sections 1, 2, 3, 4, 5, 9 and 10 have areas potentially at risk of groundwater contributing to flooding. In particular, A96 Sections 3, 4 and 5 are shown to have areas potentially at risk in proximity to the existing route, with a significant area at risk in A96 Section 4.

During this SFRA no records of groundwater flooding have been identified within the study area.

The Aberdeen City SFRA noted that rising groundwater potentially contributes to increased flood risk (in Section 10).

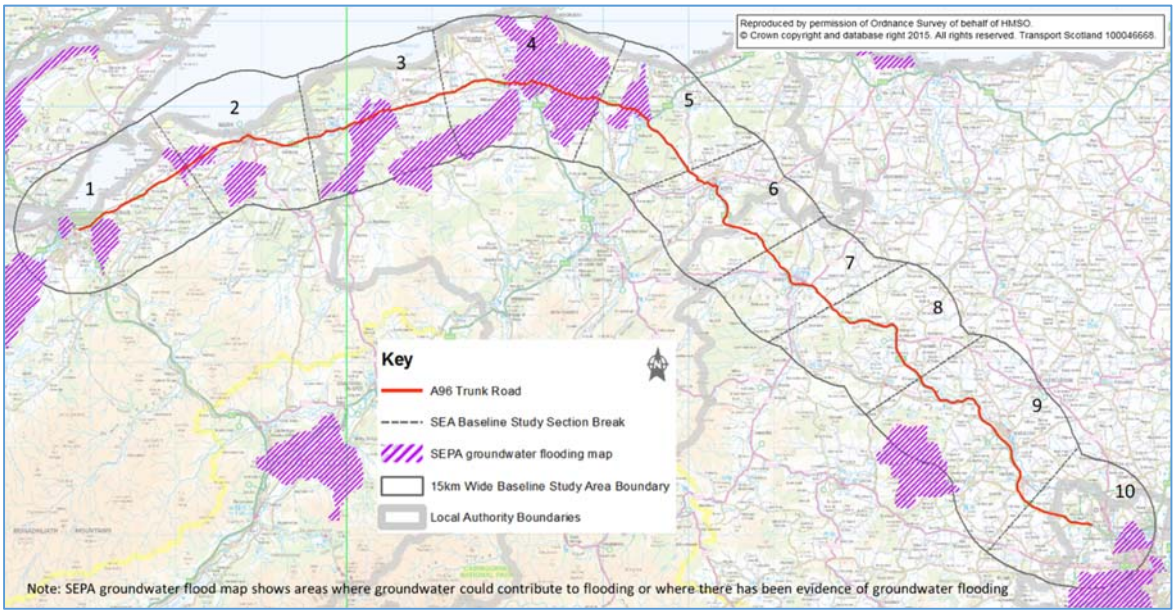


Figure 4—7 SEPA groundwater flood map showing areas where groundwater could contribute to flooding

4.8 Sewer Flooding

It is likely that where the existing A96 passes through any urban area there may be a risk of flooding from sewers. There is no report of sewer flooding in the flood history records reviewed.

Detailed sewer network drawings have not been reviewed as part of the SFRA due to the extent of the A96 study area being considered.

4.9 Flooding from Failure of Infrastructure

An additional potential source of flooding is from failure of water infrastructure, such as reservoirs, aqueducts and high pressure main water pipes. Failure of these infrastructure types is considered highly unlikely; however, a failure event could result in a large amount of water being released very quickly, posing a significant flood risk to downstream assets.

A review of the A96 study area found that there are no large reservoirs within the area that pose an existing potential flood risk to the A96. There are three water supply reservoirs which have been identified lying to the south of the study area.

- Glenlatterach Reservoir:
  Located on a tributary of the River Lossie, approximately 10km south of Elgin.
- Clunas Reservoir:
  Located on a tributary of the Muckle Burn, approximately 5km west of Forres.
- Romach Reservoir:
  Located over 7.5km to the south east of Forres, on a tributary of the Blackburn, which in turn joins the River Lossie upstream of Elgin.

Any breach or failure of these features, however low the likelihood, given the large distances is considered to pose a limited flood risk to the A96.

4.10 Potentially Vulnerable Areas

Potentially vulnerable areas (PVAs) were identified by SEPA as part of the National Flood Risk Assessment under the Flood Risk Management (Scotland) Act 2009. The PVA fact sheets were reviewed, and the PVAs that lie within the A96 study area are summarised in Table 4—4 with collated data sheet details included as Appendix D to this Report.

The PVAs provide a broad overview of existing flood risk in populated locations within the study area. PVAs are found in each of the A96 Sections, except Section 8, indicating that large numbers of properties/ settlements within the A96 study area are presently vulnerable to flooding.

Some of the key details extracted from the PVA fact sheets are summarised as follows:

- Frequent flooding is reported in Inverness, Nairn, Huntly, Inverurie and Pitmachie;
- The main known sources of flooding for the majority of PVAs are river and surface water; except at Nairn and Lossiemouth/ Burghead where the main source of flooding is from the sea;
- River is the main source of flooding in Nairn, Forres, Elgin, Keith, Huntly, Inverurie and Aberdeen;
- Potential for groundwater flooding is noted in A96 Sections 3, 4 and 10.

Table 4—4 Summary of potentially vulnerable areas along the A96 route

A96 Section	PVA	Location	Presence of small water courses	Reports of flooding	Known source of flooding			Groundwater flooding potential
					River	Surface water	Coastal	
1	01/20	West of Inverness	Yes	Frequent 1993 - 2007	50%	49%	1%	Very low to low
1	01/19	Inverness Airport	Yes	Frequent 2005	47%	53%	0%	Very low to low
1	01/21	Inverness, Oldtown of Leys	Yes	Frequent 1644 - 2008	53%	20%	27%	Low to moderate
2	01/17	Nairn	Yes	Recent report of flooding	26%	28%	46%	Low to moderate
2	01/18	Nairn	Yes	Frequent 1999 - 2005	0%	89%	11%	Very low to low
2	05/08	Nairn	Yes	Frequent 1782 - 2005	57%	41%	2%	Very low to low
3	05/06	Forres	Yes	Infrequent 1829 – 2002 (*existing defences offer some protection)*	77%	23%	0%	Moderate to high
4	05/01	Lossiemouth, Burghead	Yes	*Unknown**	0%	25%	75%	Low to moderate
4	05/03	Lhanbryde	Yes	Infrequent	73%	22%	5%	Moderate to high
4	05/02	Lossiemouth	Yes	Infrequent	27%	43%	30%	Very low to low
4	05/07	Forres	Yes	Infrequent	64%	34%	0%	Moderate to high
4	05/05	Elgin, New Elgin	Yes	Infrequent	86%	14%	0%	Moderate to high
5	06/01	West of Buckie	Yes	Infrequent 1953 - 1999	29%	64%	7%	Very low to low
5	05/04	Spey Bay	Yes	Infrequent 1892 to 1985	55%	36%	9%	Very low to low
6	06/06	Keith	Yes	Infrequent 1852 - 2009	66%	34%	0%	Low to moderate
7	06/10	Huntly	Yes	Frequent 1829 - 2009	72%	28%	0%	Low to moderate
9	06/13	Inverurie	Yes	Frequent 1968 - 2010	65%	35%	0%	Low to moderate
9	06/11	Pitmachie	Yes	Frequent 1864 - 2010	47%	53%	0%	Very low to low
10	06/18	Aberdeen, Cults, Kincorth	Yes	Infrequent	56%	25%	19%	Moderate to high
10	06/15	Aberdeen, Danestone	Yes	Infrequent	66%	34%	0%	Low to moderate
10	06/17	Westhill	Yes	*Unknown**	16%	84%	0%	Low to moderate

**Information from reports of flooding frequency not included in PVA sheets*

5 SFRA of A96 Improvement Strategy Options

5.1 Introduction

For the purposes of this SFRA, it is assumed that the proposed A96 Dualling will be developed within a 15km wide study area, i.e. within 7.5km either side of the existing A96.

The preliminary assessment stage of the A96 Dualling Programme Tier 2 SEA process resulted in a shortlist of alternative 'improvement strategy options' to be considered in more detail. These are shown in Figure 5—1 and detailed in Appendix C1:

Option B (red lines)	online/ near online option which includes north and/or south bypass options around Forres, Elgin and Inverurie;
Option C (grey line)	an offline option to the west of the existing A96, from Huntly to south of Inverurie;
Option D (green line)	an offline option to the north of Inverurie, between Hill of Skares and Pitcaple; and
Option N (purple line)	an offline option representing an alternative, longer bypass to the south of Forres and Elgin.

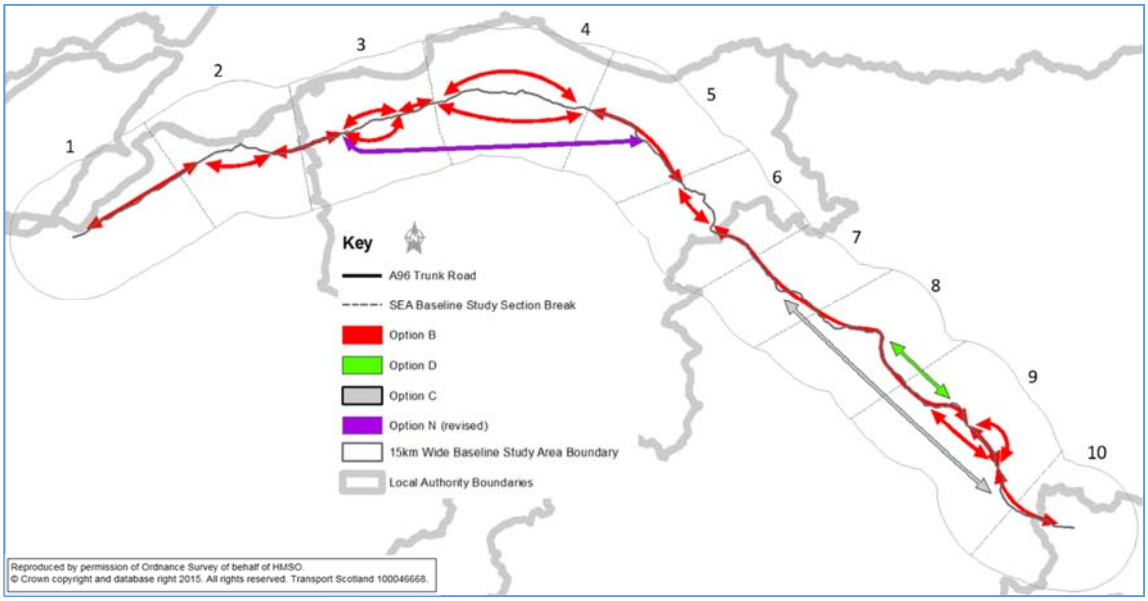


Figure 5—1 A96 Dualling Improvement Strategy Options

Given the broad strategic nature of the alternative 'improvement strategy options' being considered under the Tier 2 SEA, this chapter of the SFRA is intended to inform the SEA options assessment.

Each option is considered at a 2km-wide scale, i.e. each arrow shown above should be read as a broad, 2km wide study area (not shown to scale in the above figure).

5.1.1 Exclusions

Dualling proposals for A96 Sections 1 and 2 are at a more advanced stage in the DMRB design process, under the A96 Inverness to Nairn (including Nairn bypass) Scheme.

The DRMB Stage 2 Scheme Assessment Report included an assessment of Hydrology and Flood Risk. The assessment was carried out over a 500m area around the proposed route options, to inform the selection of a preferred option, which was announced by Transport Scotland in October 2014 (see Section 3.1).

Therefore this chapter of the SFRA excludes A96 Sections 1 and 2, and focuses on the assessment of the improvement strategy options across A96 Sections 3 to 10.

5.2 Typical Nature of Dualling Works

The A96 Dualling Programme is expected to deliver a complete dual carriageway route from Inverness to Aberdeen. In some locations dualling will follow close to, or adjacent to, the existing trunk road alignment and it is expected that bypasses will be developed around key towns such as Forres, Elgin and Inverurie.

SFRA considers that given the likely nature of works associated with A96 Dualling road infrastructure (e.g. junctions, underpasses, water crossings, drainage, etc.), these are potentially vulnerable as receptors of flood risk. However, these also have the potential to alter the existing hydrological regime and flood risk extents around the road infrastructure and other sensitive receptors.

Table 5—1 below provides an overview of the typical types of works, including introduction of new infrastructure, the modification/ upgrading of existing infrastructure and the potential effects on various flood risk related aspects.

Table 5—1 Typical A96 Dualling works and potential effect on flood risk

Construction element	Proposed works	Proposed works that may change existing flood risk	Potential effects				
			Change in hydrological catchment	Loss of floodplain	Increased flood level	Increase flood risk	
						upstream	downstream
Carriage-way	Dualling road alignment (new road)	New road alignment and associated drainage	✓	✓	✓	✓	✓
		Road alignment on embankments within functional floodplain		✓	✓	✓	✓
	Dualling road alignment (widening existing)	Land raising of existing road level to be above the 0.5% flood level		✓	✓	✓	✓
Water-crossing (bridge, culvert)	New	New structures within functional floodplain or limiting conveyance		✓	✓	✓	✓
	Modify (incl. replacement & extension)	Enlarge existing water-crossing to increase conveyance		n/a	n/a	n/a	✓
Temporary works	New (temporary)	Stockpiling, temporary structures, offices etc.		✓	✓	✓	✓

Potential flood risk related effects of A96 Dualling include:

- Changes in hydrological catchment areas;
- Loss of functional floodplain;
- Increased flood level/ afflux at water-crossings;
- Change of existing flood risk (e.g. frequency and magnitude of flooding) upstream and downstream of dualling works.

A96 Dualling may also present temporary effects on flood risk during the construction phase. Temporary works/ compounds placed within the functional floodplain could potentially affect local flood risk, and should therefore be avoided wherever possible.

5.3 SFRA Constraints Assessment Approach

The following assessment sections of this Chapter consider the relative flood risk effects associated with A96 Dualling improvement strategy options from two perspectives:

1. A96 Dualling infrastructure as a ***receptor*** of flood risk
   The assessment compares the likely levels of risk across each improvement strategy option, treating A96 Dualling as a potentially vulnerable receptor to all sources of flooding (fluvial, coastal, surface water, groundwater, etc.). These flood risk 'sources' are therefore assessed as potential constraints to dualling within each option study area. See Section 5.5.
2. A96 Dualling infrastructure as a ***source*** (cause) of increased flood risk to sensitive receptors.
   The assessment compares the likely levels of risk across each improvement strategy option, adopting the view that A96 Dualling has the potential to cause a change to existing flood risk; that is, it could alter the current flood risk extent with consequent effects on (existing and new) receptors. These flood risks 'receptors' are also considered as potential constraints to dualling. See Section 5.6.

Given the broad, 2km wide, scale of each improvement strategy option study area, the assessment of relative levels of flood risk constraint is presented against the following categorised approach:

Very likely – A96 Dualling within the improvement strategy option extent is ***very likely*** to be constrained by the particular flood risk (source or receptor) being assessed.
Early design planning for appropriate mitigation measures will be required, as it is unlikely that the flood risk constraint can be avoided.

Likely – A96 Dualling is ***likely*** to be constrained by the particular flood risk (source or receptor) being assessed. However, early design planning may determine avoidance measures to reduce the level of mitigation required.

Possible – A96 Dualling is ***possibly*** constrained by the particular flood risk (source or receptor) being assessed; however, avoidance may be possible within the option study area.

Unlikely – A96 Dualling is ***unlikely*** to be constrained by the particular flood risk (source or receptor) being assessed, as there is significant avoidance potential within the option study area.

Figure 5—2 outlines the colour-coded key used throughout the assessment of each flood risk constraint, across each A96 Dualling improvement strategy option study area.

Figure 5—2 Colour key for A96 Dualling SFRA assessment of likely levels of flood risk constraint

5.4 'Schematic' Presentation of SFRA Constraints Assessments

Table 5—2 is a schematic representation of the A96 Dualling improvement strategy options as mapped in Figure 5—1 above.

Table 5—2 'Schematic' presentation of A96 Dualling SFRA of improvement strategy options assessment

A96 Section	3			4	5	6		7	8	9			10
Improvement strategy option	B west	B north	B east	B north	B	B west	B east	B	D	D			B
		B south		B south					B	B west	B north east		
											B inner	B east	
		N		N	N			C	C	C	B south		

5.5 Assessment of Constraints (A96 Dualling as the *receptor*)

This section of the SFRA considers the relative levels of flood risk constraint within each improvement strategy option study area. It compares each particular source of flood risk across each option 'segment' within each A96 Section, including:

- Fluvial functional floodplain (1:200 year extent);
- Fluvial flood risk – small watercourses;
- Coastal functional floodplain (1:200 year extent);
- Surface water flooding;
- Groundwater flooding;
- Sewer flooding;
- Flooding due to failure of water infrastructure;
- Water crossings.

5.5.1 Fluvial Functional Floodplain (1:200 year extent)

Some sections of the existing A96 route are located within the 1:200 year fluvial functional floodplain (see Section 4.4). The various improvement strategy options cross fluvial floodplains, most notably around and through Forres (A96 Section 3) and Elgin (A96 Section 4), see Figure 5—3 and detailed in Appendix C2.

It is considered that A96 Dualling construction within functional floodplains will require mitigation and compensatory storage measures, to ensure no increase in flood risk to other areas/ receptors. From a flood risk management viewpoint, it is better to avoid development within a fluvial floodplain; however, given that a number of A96 Dualling improvement strategy options cross a range of river catchments, this particular assessment aims to provide an objective overview on the likely level of fluvial floodplain constraints within each option study area.

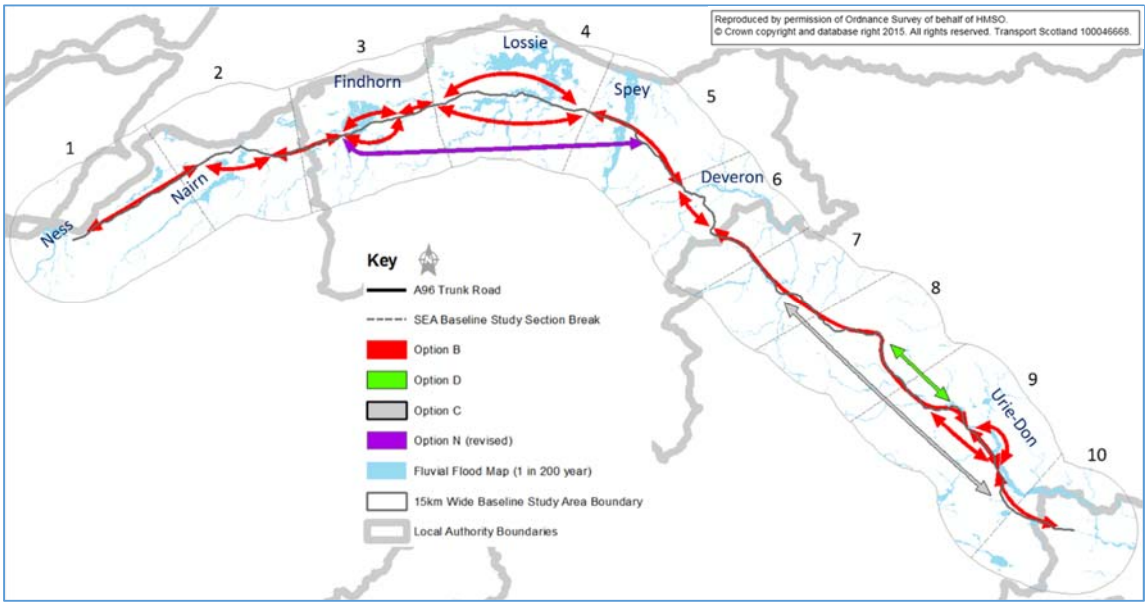
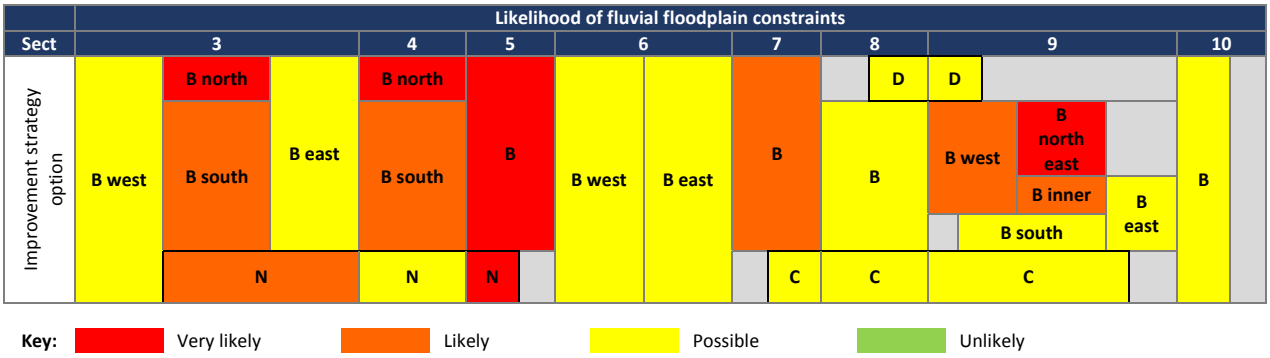


Figure 5—3 A96 Dualling improvement strategy options on fluvial floodplain constraints

Table 5—3 Fluvial floodplain as a constraint to A96 Dualling



A96 Section 3	
B west – ***possible*** constraints crossing Muckle Burn floodplain (tributary of Findhorn) B north – ***very likely*** constraints crossing widespread River Findhorn and Burn of Mossat floodplain B south – ***likely*** constraints crossing Burn of Mossat floodplain	B east – ***possible*** constraints crossing small tributaries of Burn of Mossat floodplain N – ***likely*** constraints crossing River Findhorn and well-defined Burn of Mossat floodplains
A96 Section 4	
B north – ***very likely*** constraints crossing widespread River Lossie floodplain B south – ***likely*** constraints crossing Black Burn, River Lossie and Leanoch Burn associated floodplains	N – generally at a higher elevation compared to Options B north and B south; ***possible*** constraints crossing smaller tributaries of Black Burn, River Lossie and Leanoch Burn
A96 Section 5	
Very likely constraints to both Option B and Option N, as each crosses the River Spey floodplain ranging between 600m to 1,400m wide – one of the largest river systems in Scotland	
A96 Section 6	
B east – ***possible*** constraint crossing the Loan Burn and River Isla floodplains, which are well defined within a valley B west – ***possible*** constraint crossing the Burn of Cairnie floodplain, which is constrained within a steep valley	
A96 Section 7	
B – ***likely*** constraint crossing the River Deveron and Water of Bogie floodplain	C – generally at a higher elevation compared to Option B; ***possible*** constraint crossing Water of Bogie floodplain
A96 Section 8	
Each of Options D, B and C are ***possibly*** constrained crossing floodplains of River Urie tributaries, which are defined in valleys	
A96 Section 9	
B west – ***likely*** constraint crossing floodplains where Gadie Burn joins River Urie B northeast – ***very likely*** constraints crossing Urie floodplain B south – ***possible*** constraint crossing Don floodplain B inner – ***likely*** constraint crossing Don floodplain	B east – ***possible*** constraint crossing minor watercourses floodplain C – ***possible*** constraint crossing floodplains of Gadie Burn, River Don and minor watercourse D – ***possible*** constraints crossing minor watercourses floodplain
A96 Section 10	
B – this section of the A96 is already dualled. ***Possible*** constraint for improvement works crossing Bucks Burn.	

5.5.2 Fluvial flood risk – small watercourses

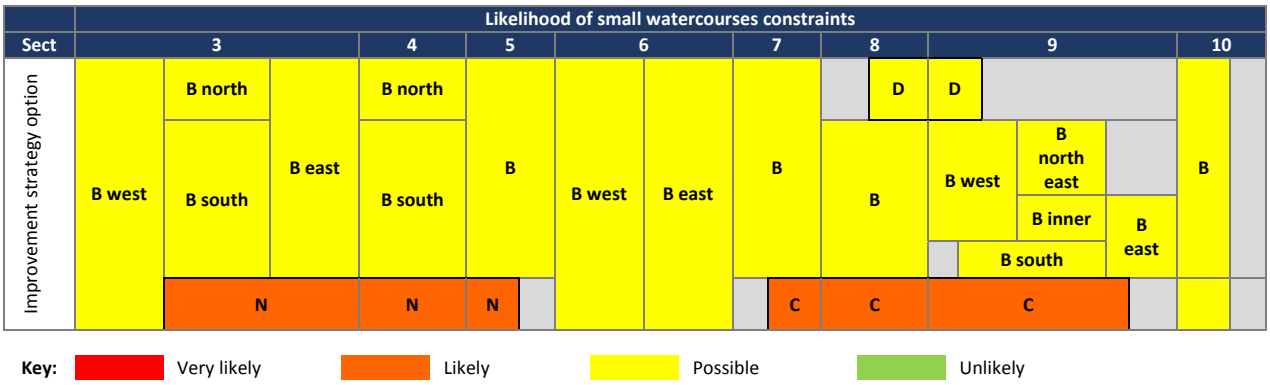
A96 Dualling should also be considered to be at risk of local flooding from small watercourses. However, existing flood risk for most small watercourses is not indicated within the SEPA Flood Map (2014). In addition, some small watercourses may not be identified within the Flood Estimation Handbook (FEH) digital catchment area.

SFRA review of watercourse crossings along the existing A96 found that approximately 25% have very small watercourse catchments of <0.5km² (i.e. 22 out of 91, see Table 4—2).

In terms of SFRA constraints assessment, all improvement strategy options have the potential to encounter small watercourses; therefore, this issue is generally assessed as being a ***possible*** constraint to dualling across all A96 Sections.

However, as areas within Option C and Option N are located at higher elevations, they are considered more ***likely*** to encounter a greater number of small catchments (see Table 5—4). In all cases, where small watercourses prove unavoidable, further local assessment will be required to inform culverted crossing capacity and design.

Table 5—4 Small watercourses as a constraint to A96 Dualling



5.5.3 Coastal Floodplain (1:200 year extent)

It is considered that A96 Dualling construction within the coastal floodplain will increase the risk of flooding from the sea (including sea water level, tidal surge and wave action), and will require mitigation and protection measures, to ensure no increase in flood risk to other areas/ receptors.

From a flood risk management viewpoint, it is better to avoid development within the coastal floodplain; however, given that a number of A96 Dualling improvement strategy option extents cross into the coastal floodplain (A96 Sections 3 and 4), this particular assessment aims to provide an objective overview on the likely level of coastal floodplain constraints within each option study area. See Figure 5—4, Appendix C3 and Table 5—5.

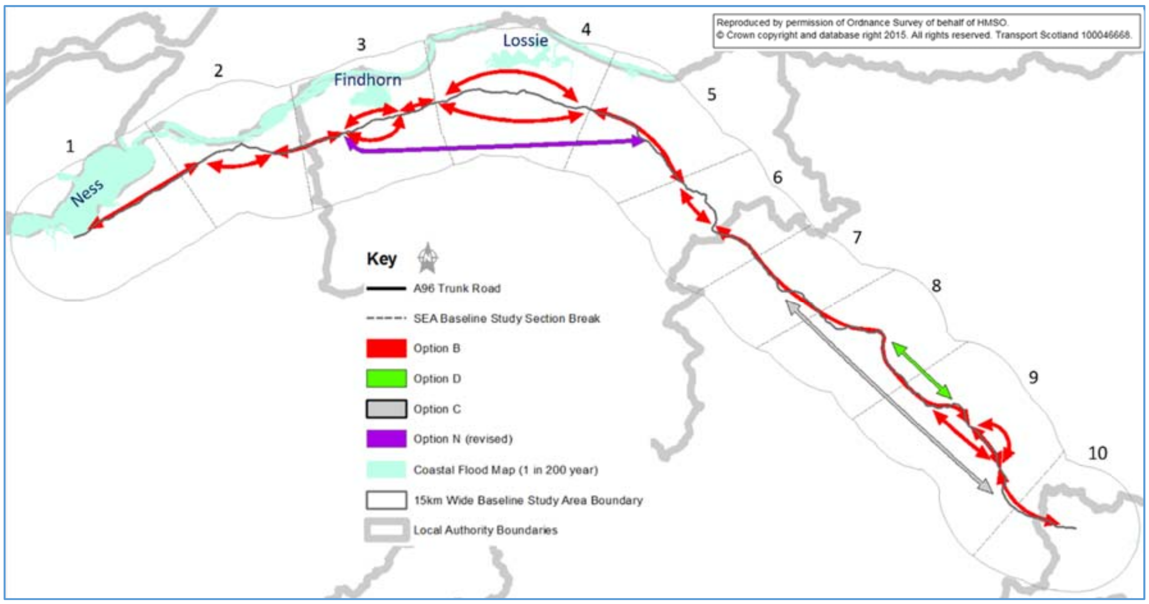


Figure 5—4 A96 Dualling improvement strategy options on fluvial floodplain constraints

Table 5—5 Coastal floodplain as a constraint to A96 Dualling

	Likelihood of coastal floodplain constraints												
Sect	3			4	5	6		7	8	9			10
Improvement strategy option	B west	B north	B east	B north	B	B west	B east	B	D	D			B
		B south		B south					B	B west	B north east		
											B inner	B east	
											B south		
		N		N	N			C	C	C			

Key: Very likely (red); Likely (orange); Possible (yellow); Unlikely (green)

A96 Section 3
B north – ***likely*** to be constrained by coastal flooding in River Findhorn, north of Forres
A96 Section 4
B north – ***possibly*** constrained by coastal flooding in River Lossie, north of Elgin

5.5.4 Surface Water Runoff (Pluvial flood risk)

The SEPA (1 in 200 year return period) surface water flood risk map shows that surface water flooding is an issue across all A96 Sections; most notably in the low lying areas such as A96 Sections 3, 4 and part of A96 Sections 5, 9 and 10 (see Figure 5—5 and Appendix C4).

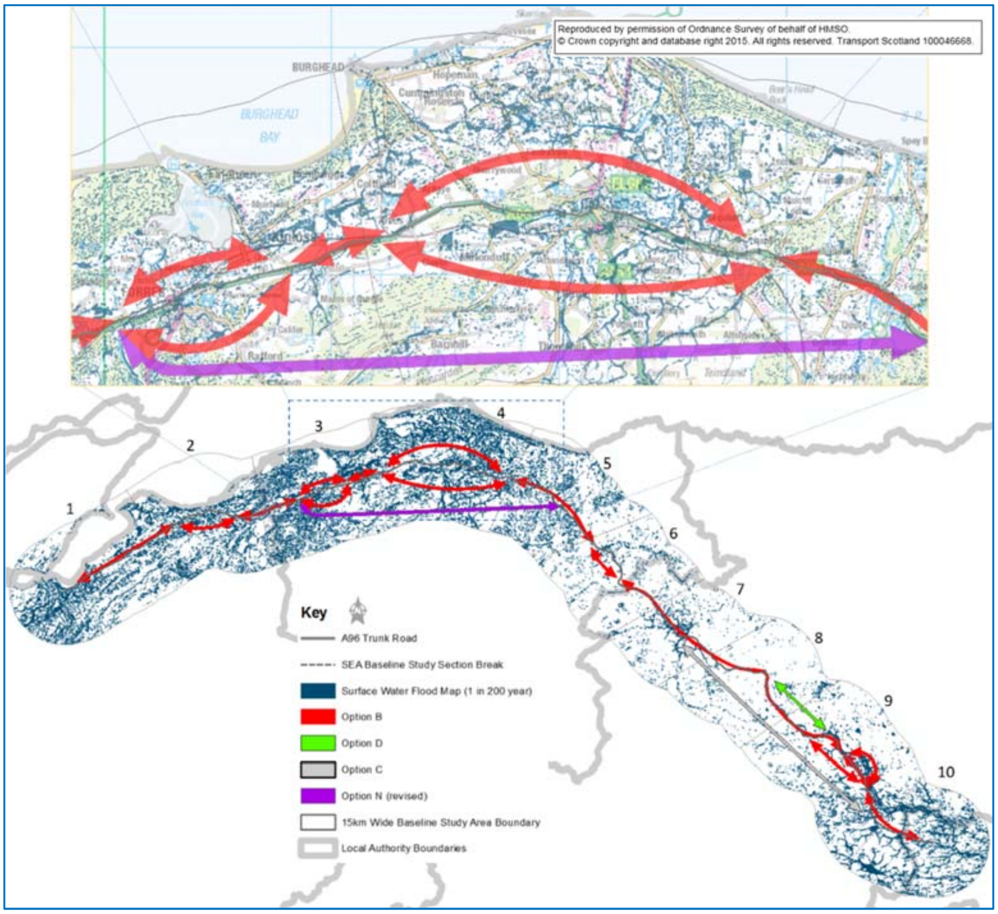


Figure 5—5 A96 Dualling improvement strategy options on surface water flood risk constraints

The potential for surface water flood risk will vary across local circumstances (e.g. topography), as well as in relation to the design of the road (e.g. vertical alignment and corresponding low points).

Table 5—6 Surface water flooding as a constraint to A96 Dualling

	Likelihood of surface water flood risk constraints							
Sect	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Improvement strategy option	B west; B north; B south; B east	B north; B south	B	B west; B east	B	D; B	D; B west; B north east; B inner; B south; B east	B
	N	N	N					
					C	C	C	

Key: Very likely | Likely | Possible | Unlikely

ch2m

A96 flood incidents recorded by the trunk road network operating company indicate that causes of flooding on the A96 are generally related to low lying ground and drainage efficiency.

SFRA therefore considers that A96 Dualling improvement strategy options are likely to be at greater possible risk of surface water flooding across low lying areas, with lower risk considered across higher ground. The risk of surface water flooding is considered to present minimal differentiation between improvement strategy options.

5.5.5 Groundwater

SEPA Flood Maps identify areas where groundwater could contribute to flooding; however, no records of groundwater flooding have been identified under SFRA data collection. The likelihood of groundwater contributing to flooding is therefore considered ***possible*** for improvement strategy options crossing the areas highlighted by the SEPA Flood maps, i.e. improvement strategy options in Section 3, 4 and 5 (see Figure 5—6, Appendix C5 and Table 5—7).

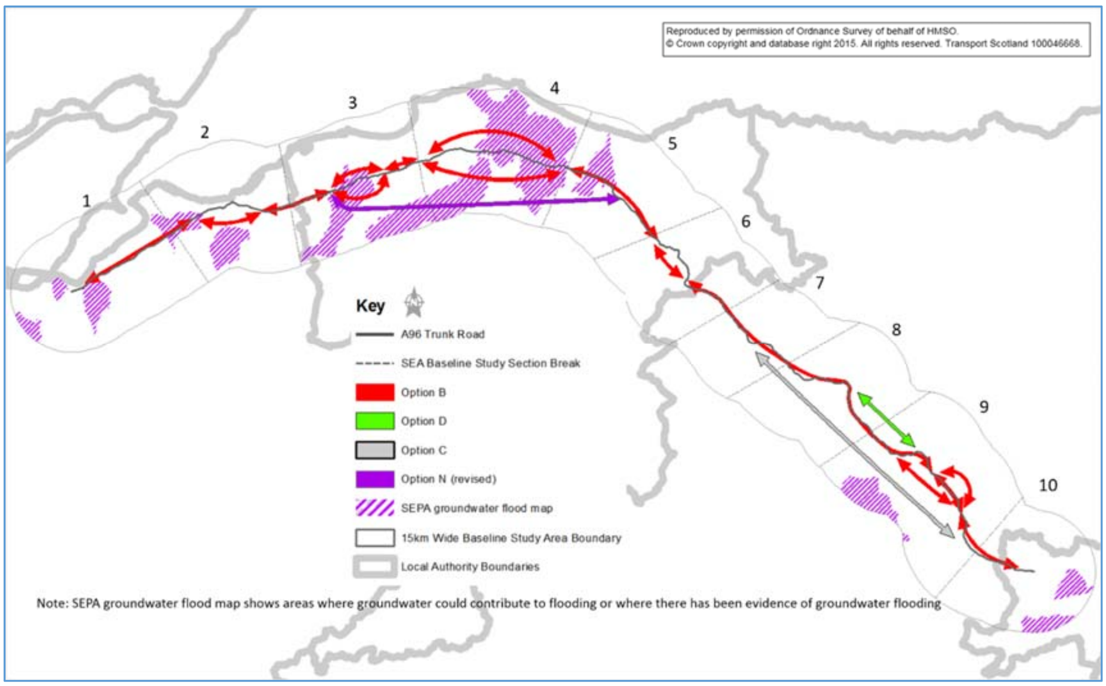


Figure 5—6 A96 Dualling improvement strategy options on groundwater flood risk constraints

Table 5—7 Groundwater flooding as a constraint to A96 Dualling

	Likelihood of groundwater flood risk constraints												
Sect	3			4	5	6		7	8	9			10
Improvement strategy option	B west	B north	B east	B north	B	B west	B east	B	D	D			B
		B south		B south					B	B west	B north east		
											B inner	B east	
										B south			
		N		N	N			C	C	C			

Key: Very likely (red) · Likely (orange) · Possible (yellow) · Unlikely (green)

ch2m

5.5.6 Sewer Flooding

Sewer flooding is not considered a constraint in the assessment of improvement strategy options. Any existing risk of sewer flooding is likely to remain unchanged by A96 Dualling. No records of sewer flooding have been identified under SFRA data collection

It is recommended that sewer maps and potential of sewer flooding is reviewed in site specific flood risk assessments at more detailed DMRB design stages.

5.5.7 Flooding due to Failure of Infrastructure

Three reservoirs were identified in Section 4.9 above, and the risk of flooding as a result of failure of infrastructure will remain unchanged by A96 Dualling. Therefore, flooding due to failure of infrastructure is not considered as a constraint in the assessment of improvement strategy options.

5.5.8 Water Crossings

Water crossings are the key features of road infrastructure that interact closely with watercourses. A96 Dualling may involve extending, or replacing, existing culverts where dualling takes places in proximity to the existing carriageway, as well as the possible construction of new bridges and culverts in the more 'offline' stretches of new road.

Water crossings may involve bridges (including bridge abutments), embankments and culverts that, without sensitive design, could change the existing hydrological regime (river flow rate, velocities, flow paths and time to peak flow), which in turn could change flood mechanisms (flood level, time to peak flood level and flood flow paths) upstream and downstream of the water crossing and thereby, potentially the shape and/ or extent of the flood envelope.

Bridge embankments and abutments have the potential to divert flood water, changing the flood flow path and flooding pattern. A new water crossing may cause a restriction to flow within the channel, resulting in a change of flood levels upstream, known as afflux.

A water crossing could potentially increase flood risk to A96 Dualling road infrastructure itself, as well as presenting change in flood risk to other flood sensitive receptors hydrologically influenced by the watercourse. Hence, a watercrossing can be both a flood receptor as well as source of flood risk.

Figure 5—7 presents the A96 Dualling improvement strategy options across the existing river network and fluvial floodplain. The likelihood of water crossing constraints (both as receptor and source) are highlighted and summarised in Table 5—8 below.

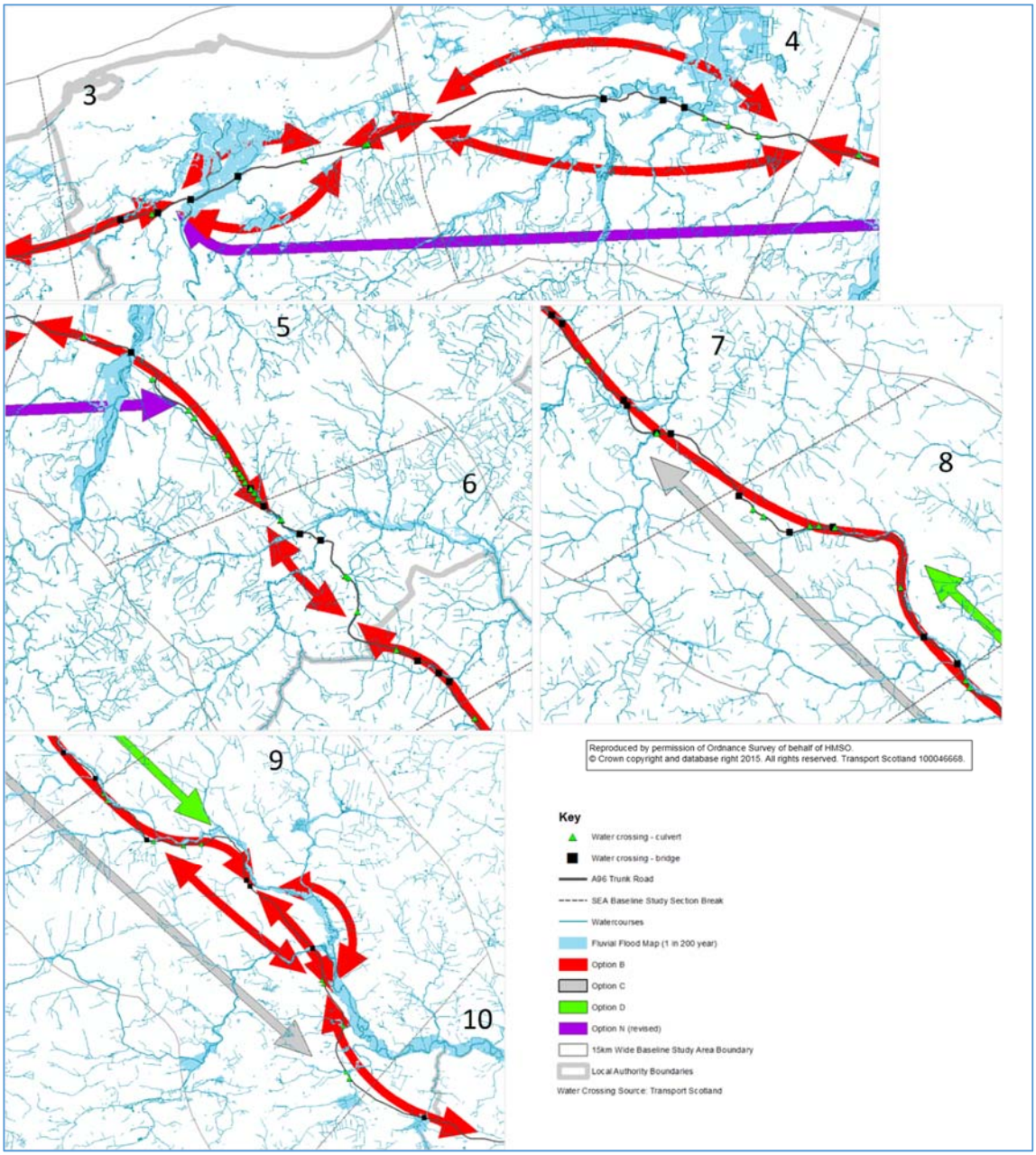
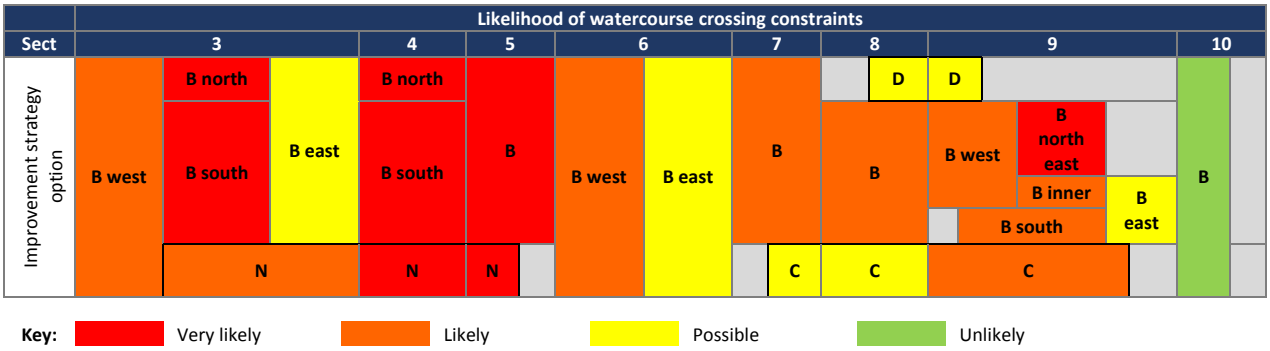


Figure 5—7 A96 Dualling improvement strategy options on water crossing constraints

Table 5—8 Water crossings as a constraint to A96 Dualling



A96 Section 3	
B west – ***likely*** to be constrained by Muckle Burn, a tributary of the River Findhorn B north – ***very likely*** to require a new crossing of the River Findhorn with a larger hydrological catchment and larger river flows B east – ***possibly*** constrained by Kinloss Burn tributaries B south – ***very likely*** to cross the River Findhorn and Burn of Mosset (or its tributaries)	N – ***likely*** to be constrained by a number of watercourses; however, these may comparatively smaller than the B north and B south options
A96 Section 4	
B north – ***very likely*** requires new crossings of the River Lossie downstream of the existing A96 crossing with larger river flows B south – ***very likely*** to be constrained by multiple tributaries of the River Lossie	N – ***very likely*** to require a number of new watercourse crossings; however, these may be comparatively smaller than the B north and B south options
A96 Section 5	
Both Options B and N will be constrained by major bridge crossing requirements over the River Spey that spans a hydrological catchment in excess of 2,800km^2 (***very likely***)	
A96 Section 6	
B west – ***likely*** to be constrained by crossing the Loan Burn and River Isla B east – ***possible*** constraints in terms of crossing smaller watercourses	
A96 Section 7	
B – ***likely*** to be constrained by crossings of the River Deveron and River Bogie	C – ***possibly*** constrained by crossing watercourses at higher elevation with smaller catchment sizes
A96 Section 8	
B – ***likely*** to be constrained by new/ upgraded crossing requirements as the existing A96 roughly follows the River Urie, crossing a number of tributaries	C – ***possibly*** constrained by crossing smaller watercourses at higher elevation D – ***possibly*** constrained by crossing smaller watercourses
A96 Section 9	
B west – ***likely*** to be constrained by new/ upgraded crossing requirements as the existing A96 roughly follows the River Urie, crossing a number of tributaries B south/ B inner – ***likely*** to be constrained by a new River Don crossing B northeast – ***very likely*** to be constrained by crossings of the Rivers Urie/ Don B east – ***possibly*** constrained by smaller tributaries of the River Don	C – ***likely*** to be constrained by crossing tributaries of the River Urie and River Don D – ***possibly*** constrained by crossing smaller watercourses
A96 Section 10	
B – this section of the A96 is already dualled Road improvement works are ***unlikely*** to be significantly constrained by water crossings	

5.6 Assessment of Constraints (A96 Dualling as a *source* of change)

This section of the SFRA considers the relative levels of constraint, across each option 'segment' within each A96 Section, with a particular focus on the potential flood receptors that could be affected by A96 Dualling, including:

- Properties;
- Scheduled monuments;
- Flood prevention schemes;
- Agricultural land.

5.6.1 Properties

Section 3.5 of this report highlighted the populated settlements within the study area. Properties data were overlaid with SEPA flood maps to identify the number of properties at risk of fluvial and coastal flooding within the 15km wide A96 study area (see Figure 5—8 and Appendix C6).

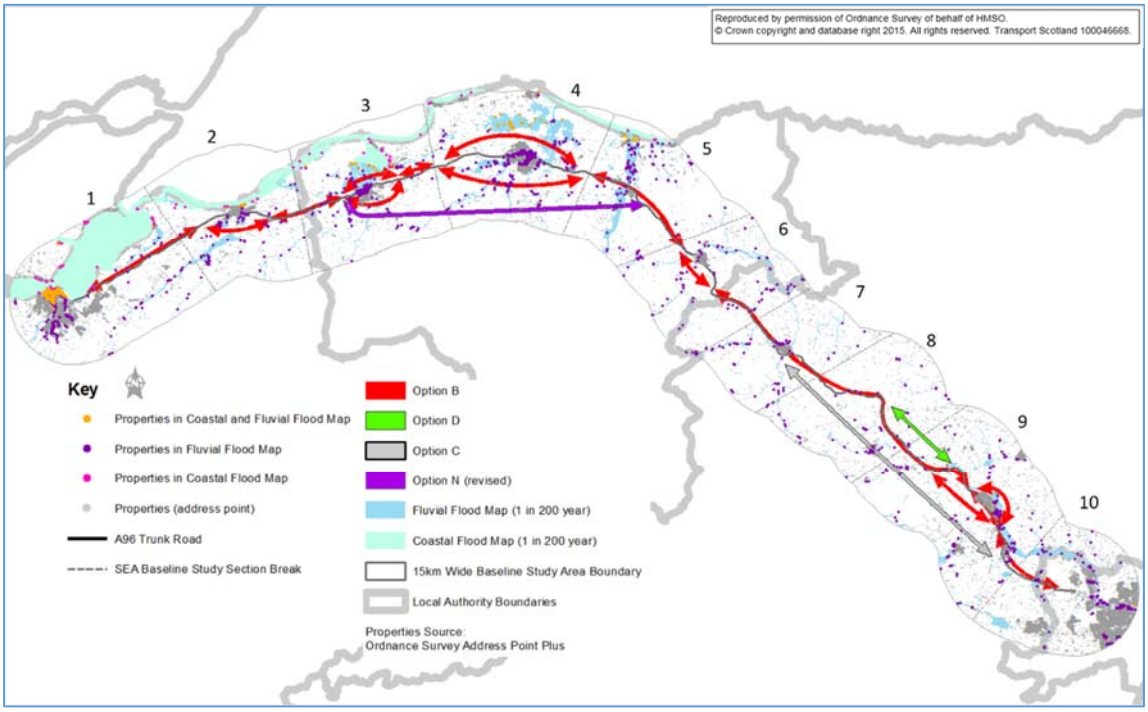


Figure 5—8 A96 Dualling improvement strategy options on settlements and properties constraints

The overlay analysis identifies a total of 5,358 and 1,167 properties identified within the fluvial and coastal floodplains respectively, and a total of 977 within both the fluvial and coastal floodplains (see Table 5—10).

The DMRB includes a classification method that attributes 'high' importance where there is anywhere between one and 100 residential properties within a potentially affected floodplain, and 'very high' where there are in excess of 100 properties (see Table 5—9).

When applying this DMRB classification to the number of properties within the floodplain across each of the A96 Dualling study sections, flood risk to properties is identified to be of high and very high importance across all sections (see Table 5—10).

Properties at risk of flooding/ within the floodplain should therefore be considered as key sensitive receptors, and potential constraints, to A96 Dualling.

Table 5—9 [sic] Estimating the importance of water environment attributes (flood risk)

Importance		Criteria	Typical Examples for Flood Risk
Very High		Attribute has a high quality and rarity on regional or national scale	Floodplain or defence protecting more than 100 residential properties from flooding
High		Attribute has a high quality and rarity on local scale	Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium		Attribute has a medium quality and rarity on local scale	Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low		Attribute has a low quality and rarity on local scale	Floodplain with limited constraints and a low probability of flooding of residential and industrial properties

Source: DMRB HD45/09 Table A4.3 abridged

Table 5—10 Properties within functional floodplains (within 15km wide study area)

A96 Section	Towns/ Villages	Total number of properties* within 15km wide study area	Total number of properties* within study area and within functional floodplain					
			Fluvial		Coastal		Both Fluvial & Coastal	
1	Inverness (part)	20,509	1,873		965		837	
2	Nairn	3,822	244		84		76	
3	Forres	4,903	836		60		19	
	Kinross							
4	Elgin	11,468	966		37		29	
	Burghead							
	Lossiemouth							
	Lhanbryde							
5	Fochabers	2,141	127		16		11	
6	Keith	2,482	96		n/a		n/a	
7	Huntly	2,114	87		n/a		n/a	
8	Insch	1,745	110		n/a		n/a	
9	Inverurie	9,209	267		n/a		n/a	
	Oldmeldrum							
	Kemnay							
	Kintore							
10	Blackburn	67,864	752		5		5	
	Dyce							
	Westhill							
	Aberdeen (part)							
TOTAL		126,257	5,358		1,167		977	

** Properties = OS AddressBase points*
Note: A96 Section 1 and Section 2 (highlighted in yellow) are not considered further in this assessment

Table 5—11 summarises a further stage of analysis, highlighting the number of properties identified within the fluvial and coastal floodplain extents, and also within the 2km wide improvement strategy option extents (see also Figure 5—9 and Appendix C7 and C8).

Table 5—11 Properties within functional floodplains (within improvement strategy option extents)

A96 Section	Option/ Segment	Total number of properties* within 2km wide study areas	Total number of properties* within study area and within functional floodplain					
			Fluvial		Coastal		Both Fluvial & Coastal	
3	West Option B	73	13		n/a		n/a	
	Forres Option B North	896	176		2		2	
	Forres Option B South	820	29		0		0	
	Forres Option N	237	27		0		0	
4	Elgin Option B North	1104	54		17		17	
	Elgin Option B South	589	43		n/a		n/a	
	Elgin Option N	169	11		n/a		n/a	
5	West Option B	899	19		n/a		n/a	
	East Option B	42	1		n/a		n/a	
	West Option N	68	9		n/a		n/a	
6	Option B	203	11		n/a		n/a	
7	Option B	1514	44		n/a		n/a	
	Option C	91	2		n/a		n/a	
8	West Option B	40	5		n/a		n/a	
	East Option B	102	10		n/a		n/a	
	West Option C	37	1		n/a		n/a	
	East Option C	784	51		n/a		n/a	
	East Option D	71	2		n/a		n/a	
9	West Option B	191	5		n/a		n/a	
	Inverurie Option B North	2761	141		n/a		n/a	
	Inverurie Option B inner	4815	119		n/a		n/a	
	Inverurie Option B South	1408	34		n/a		n/a	
	West Option C	138	11		n/a		n/a	
	Inverurie Option C	488	14		n/a		n/a	
	West Option D	222	3		n/a		n/a	
10	Option B	796	29		n/a		n/a	
TOTAL		13,743	745		19		19	

** Properties = OS AddressBase points*

A96 Dualling could potentially alter the existing flood risk of properties, either through changes to catchment hydrology and/ or changes to the storage capacity of the floodplain. Potential impacts can be classified as:

- Adverse impact:
  - Increasing magnitude of flood risk to properties already at risk of flooding
  - Causing additional properties to fall within an altered functional floodplain extent
- Beneficial impact:
  - Decreasing magnitude of flood risk to properties already at risk of flooding

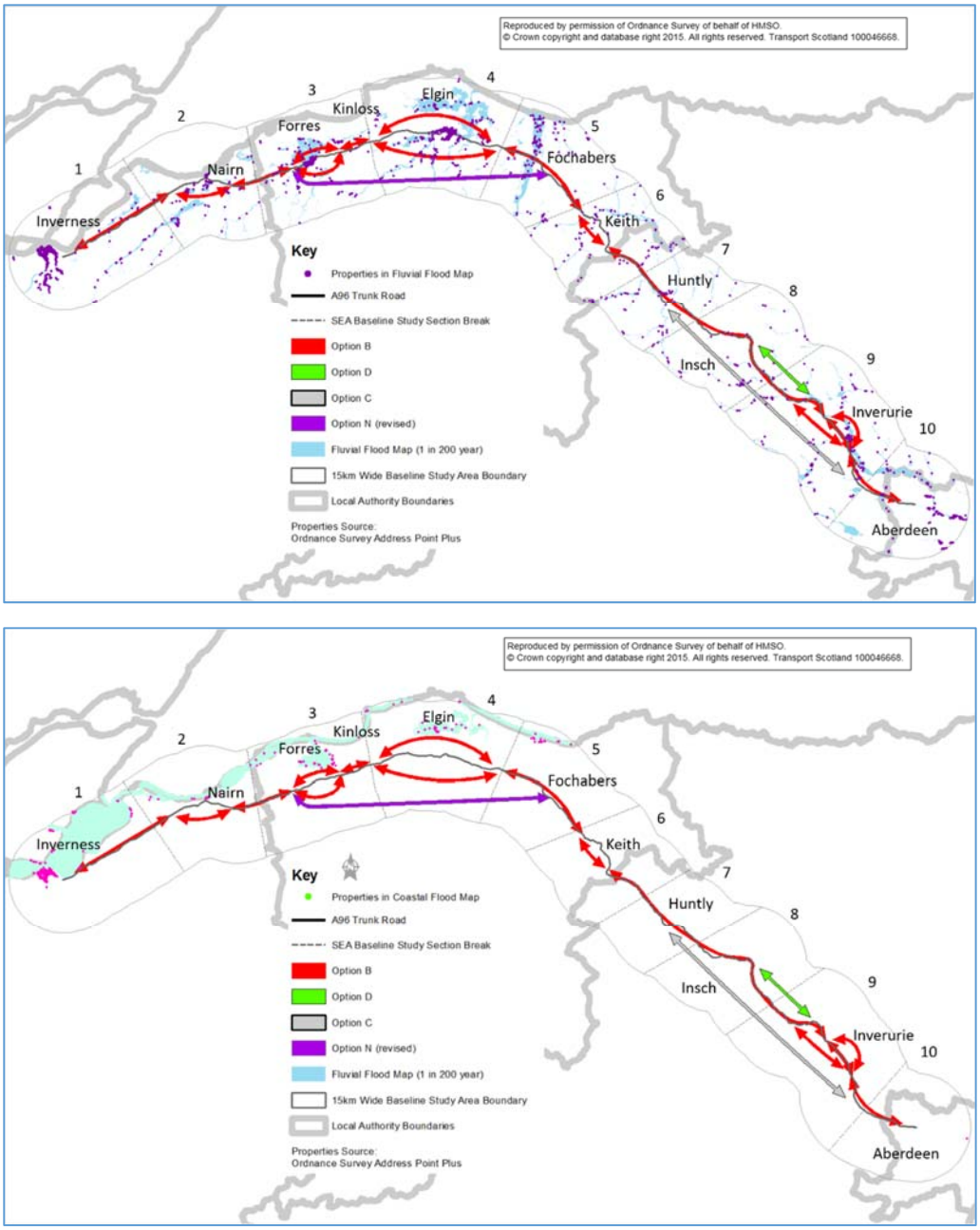
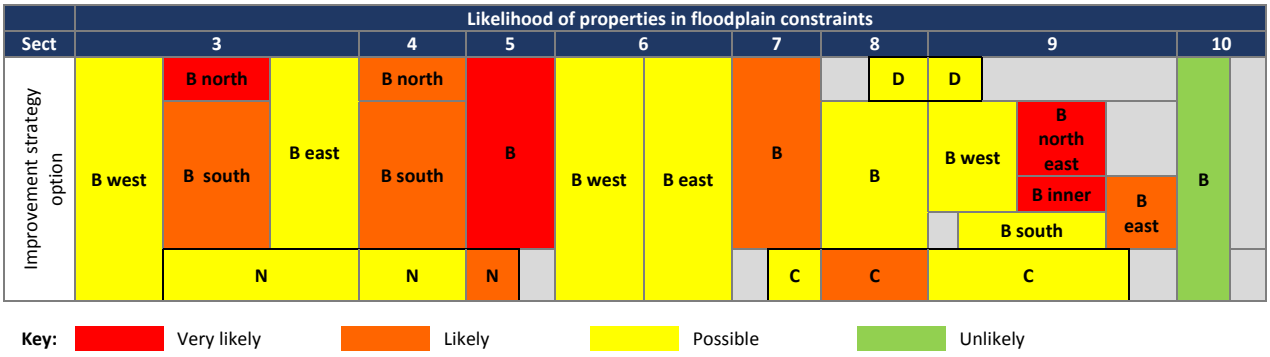


Figure 5—9 A96 Dualling improvement strategy options on: properties within fluvial flood map zones (upper figure), and coastal flood map zones (lower figure)

Table 5—12 below considers the relative levels of constraint between each improvement strategy option, based on the number of properties within the fluvial and/ or coastal floodplains and also within the 2km wide options study areas.

The basis for assessment is that the higher the number of properties within an option extent and within a floodplain extent, the greater the likelihood that the potential for changing flood risk to properties will present a constraint to A96 Dualling within that option area.

Table 5—12 Properties as a constraint to A96 Dualling



A96 Section 3	
B west – ***possibly*** constrained by a number of properties within the fluvial floodplain B north – ***very likely*** to be constrained by large number of properties around Forres and Kinloss within the fluvial (~176) and coastal (~2) floodplains B south – ***likely*** to be constrained by properties within the fluvial floodplain (~29) B east – ***possibly*** constrained by a number of properties already within the fluvial floodplain	N – ***possibly*** constrained by properties within the River Findhorn fluvial floodplain (~27)
A96 Section 4	
B north – ***likely*** to be constrained by high number of properties in and around Elgin that are already in the fluvial (~54) and coastal (~17) floodplains B south – ***likely*** to be constrained by properties in and around Elgin that are already in the fluvial floodplain (~43)	N – ***likely***; however, will be less constrained by properties in the fluvial floodplain (~11) as located further away from the urban area
A96 Section 5	
Both B and N will need to cross the River Spey which may influence a large number of properties already within the fluvial floodplain. B is considered to be more constrained (***very likely***) than N (***likely***) given the greater number of properties within the 2km wide option extents (Option B ~899 properties and ~19 in floodplain vs. Option N ~68 properties and ~9 in floodplain)	
A96 Section 6	
B west – ***likely*** to be constrained by properties within the River Isla floodplain, although the current A96 crossing is not considered to be a cause of flooding to properties B east – ***likely*** to be constrained by limited number of properties within fluvial floodplain	
A96 Section 7	
B – ***likely*** to be constrained by the properties already at risk of flooding in Huntly (~44)	C – ***possible***; comparatively less constrained than Option B with limited numbers of properties in the floodplain (~2)
A96 Section 8	
B and D – ***possible***; both pass through areas with limited number of properties at risk of fluvial flooding (Option B ~15, Option D ~ 2)	C – ***likely*** to be constrained by the large number of properties already within the fluvial floodplain (~52). Considered the most constrained of the 3 options
A96 Section 9	
B inner and B northeast – ***very likely*** constrained due to large number of properties within the fluvial floodplain B east – ***likely*** to be constrained by properties within the River Don floodplain (~141 properties combined B east and northeast)	B west (~5), B south (~34), C (~25), and D (~3) – ***possibly*** constrained by properties in floodplain
A96 Section 10	
The A96 is dualled throughout this section Any road improvement work is ***unlikely*** to significantly alter existing flood risk of properties (~29)	

5.6.2 Scheduled Monuments

A96 Dualling could potentially alter the flood risk to Scheduled Monuments already at risk of flooding, or by causing additional monuments to fall within an altered functional floodplain extent. Figure 5—10 outlines the locations of Scheduled Monuments within the 15km wide study area, highlighting those located in fluvial/ coastal floodplain extents (see Appendix C9).

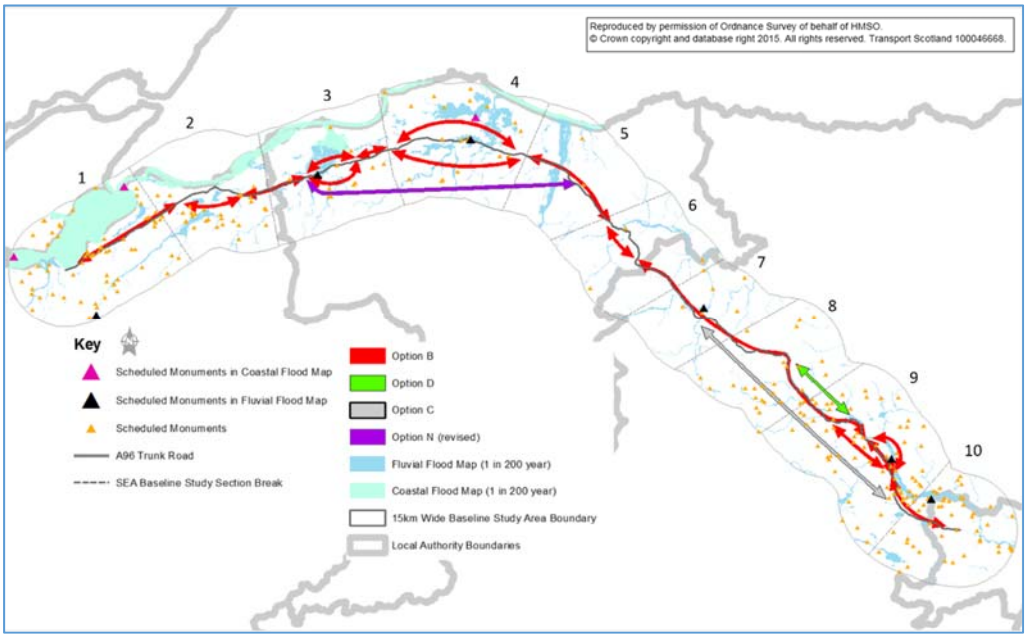


Figure 5—10 A96 Dualling improvement strategy options on Scheduled Monuments constraints

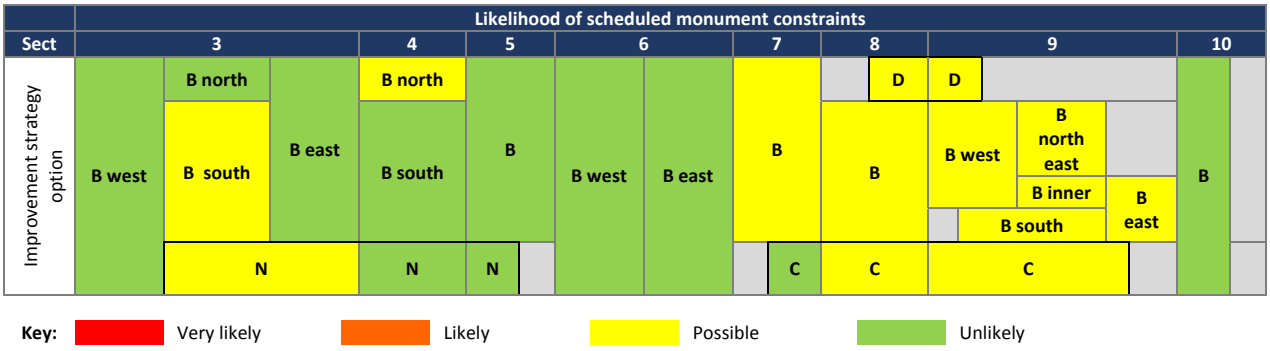
There are nine scheduled monuments identified in the 1:200 year coastal/ fluvial flood risk extents within the 15km wide study area. SFRA considers that four of these monuments, in proximity to the improvement strategy option extents, should be considered as possible flood risk constraints (as receptors) to A96 Dualling (see Table 5—13).

Table 5—13 Scheduled monuments located within functional floodplain

A96 Section	Coordinates		Scheduled monument name	Area, km^2	Local Authority	Floodplain	Potential flood receptor due to A96 Dualling?
	X	Y					
1	272812	839660	An Bathach, promontory fort	0.15	Highland	Fluvial	Unlikely
1	261918	847440	Coul Point, crannog (formerly Carn Dubh)	0.80	Highland	Coastal	Unlikely
1	276492	856750	Fort George	33.95	Highland	Coastal	Unlikely
3	302051	858310	Greshop Farm, enclosures	4.45	Moray	Fluvial	Possible
4	322302	862932	Elgin, Pans Port and precinct wall	0.04	Moray	Fluvial	Unlikely
4	323029	865867	Spynie Palace	3.06	Moray	Coastal	Possible
7	353168	840663	Huntly Castle	3.31	Aberdeenshire	Fluvial	Possible
9	378020	820620	Inverurie Cemetery, four symbol stones	0.01	Aberdeenshire	Fluvial	Possible
10	383251	815287	Kinaldie Home Farm, canal bridge	0.01	Aberdeen	Fluvial	Unlikely

Table 5—14 considers the likelihood of Scheduled Monuments presenting flood risk constraints to each improvement strategy option across each A96 Section.

Table 5—14 Scheduled Monuments (in the floodplain) as a constraint to A96 Dualling



A96 Section 3	
B west, B north and B east – ***unlikely*** to be constrained by Scheduled Monuments in the floodplain	B south and N – ***possibly*** constrained by Scheduled Monument already in the River Findhorn floodplain
A96 Section 4	
B north – ***possibly*** constrained by Spynie Castle within the coastal floodplain	B south and N – ***unlikely*** to be constrained by Scheduled Monuments in the floodplain
A96 Section 5	
Unlikely to be constrained by Scheduled Monuments in the floodplain	
A96 Section 6	
Unlikely to be constrained by Scheduled Monuments in the floodplain	
A96 Section 7	
B – ***possibly*** constrained by Huntly Castle within the fluvial floodplain	N – ***unlikely*** to be constrained by Scheduled Monuments in the floodplain
A96 Section 8	
B, C & D – no Scheduled Monuments identified within the floodplain; however, there are a number located near the floodplain that could ***possibly*** present constraints to A96 Dualling in terms of changing flood risk	
A96 Section 9	
Large number of Scheduled Monuments located near the River Urie/ Don floodplain, which could ***possibly*** present constraints to any of the A96 Dualling improvement strategy options in this section	
A96 Section 10	
A96 in this section is already dualled Road improvement works will be ***unlikely*** to significantly alter existing flood risk of scheduled monuments	

5.6.3 Flood Prevention/ Alleviation Schemes

A96 Dualling improvement strategy options could involve the introduction of new carriageways, or changes in the elevation of the existing route, that subsequently alter the flow path of water during flood events, and potentially alter the effectiveness of flood alleviation (or prevention) schemes that are currently operational, or will be operational, within the study area.

Flood prevention/ alleviation schemes within the A96 study area are generally located near to the existing A96 at populated locations (see Figure 5—11). SFRA therefore considers flood prevention/ alleviation schemes as potentially sensitive flood risk receptors to A96 Dualling options.

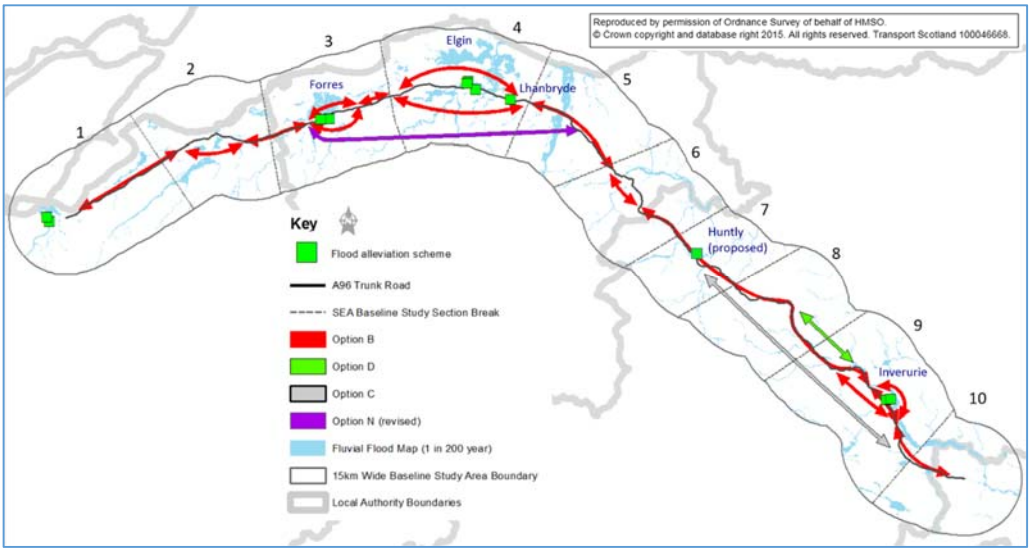


Figure 5—11 A96 Dualling improvement strategy options on flood alleviation scheme constraints

It should be noted that a number of improvement strategy options appear to bypass the flood alleviation schemes. However, in A96 Sections 3 and 4, it is considered that Option B south could present a greater risk of altering the existing flood flow path/ storage patterns immediately upstream of flood schemes in Forres and Elgin.

Dualling within Option N across these areas would be located further upstream and is considered less likely to alter the flow path/ storage patterns immediately upstream of the prevention/ alleviation schemes, recognising however that upstream changes would still be possible.

It is considered that downstream improvement strategy options are less likely to present changes that would affect upstream alleviation/ prevention schemes; however, it is recognised that afflux conditions should be considered a possibility.

Given the factors noted above, Table 5—15 considers the likelihood of A96 Dualling presenting a change in risk to flood prevention/ alleviation schemes, and therefore considers these as constraints to each improvement strategy option. It is recommended that the flood flow path/ storage mechanisms of the prevention/ alleviation schemes is taken into consideration in future site-specific flood risk assessments.

Table 5—15 Flood alleviation schemes as a constraint to A96 Dualling

	Likelihood of flood prevention/ alleviation scheme constraints																			
Sect	**3**			**4**		**5**	**6**		**7**		**8**		**9**						**10**	
Improvement strategy option	**B west**	**B north**	**B east**	**B north**		**B**	**B west**	**B east**	**B**			**D**	**D**						**B**	
		B south		**B south**							**B**		**B west**	**B north east**						
														B inner	**B east**					
														B south						
		N		**N**		**N**				**C**	**C**		**C**							

Key: Very likely | Likely | Possible | Unlikely

5.6.4 Agricultural Land

A96 Dualling could potentially increase flood risk to surrounding arable agricultural land, resulting in loss of land and/ or crops of commercial value. Under the Flood Risk Management Act, potential loss of commercial value due to increased flood risk should be minimised. SFRA therefore considers arable agricultural land as a potentially sensitive flood risk receptor to A96 Dualling, as presented in Figure 5—12 (and detailed in Appendix C10).

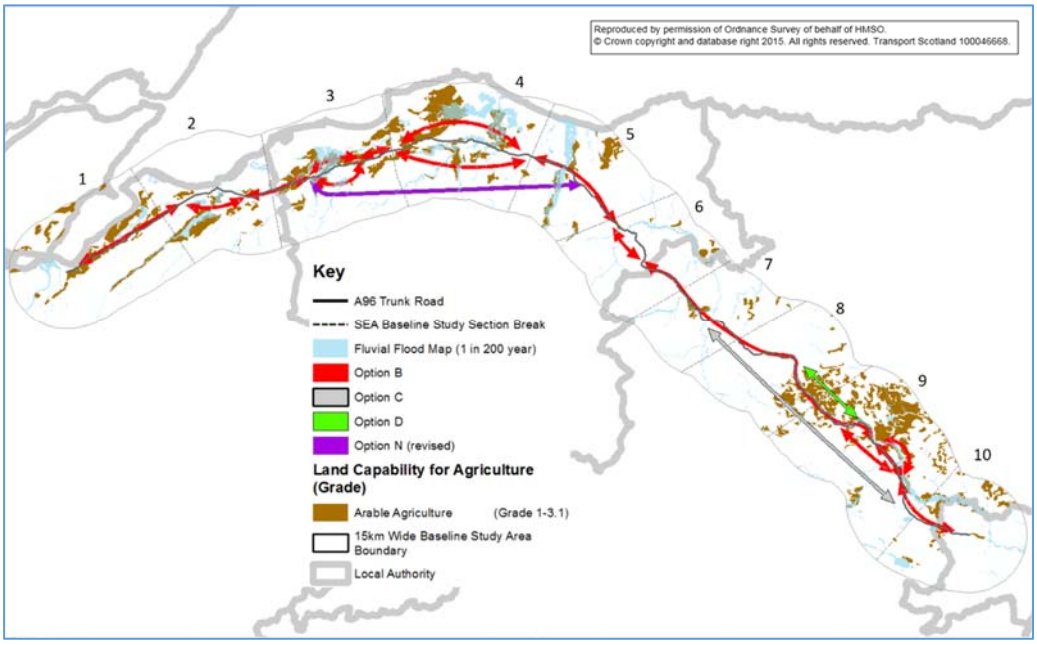


Figure 5—12 A96 Dualling improvement strategy options on arable agricultural land constraints

Table 5—16 considers the likelihood of change in flood risk to arable agricultural land, as a result of A96 Dualling, and thereby potential constraints to improvement strategy options.

Table 5—16 Arable agricultural land (changing flood risk) as a constraint to A96 Dualling

	Likelihood of arable land constraints																			
Sect	**3**			**4**		**5**		**6**		**7**		**8**		**9**						**10**
Improvement strategy option	B west	B north	B east	B north		B		B west	B east	B		B	D	D	B west	B north east	B east	B inner	B south	B
		B south		B south																
		N		N		N				C		C			C					

Key: Very likely | Likely | Possible | Unlikely

Improvement strategy options which are ***likely*** to be constrained by potentially increasing risk to arable land already within the functional floodplain include B north (Section 3), B north and B south (Section 4), Option B in Section 7, and B west and B northeast around Inverurie (Section 9).

Options are ***possibly*** constrained in Section 3 (B south, B East, N), Section 5 (both options cross the Spey), Section 8 (good arable land, but less floodplain constraint) and Section 9 (B south, B east, D).

5.7 Temporary Works

A96 Dualling could present temporary effects on flood risk during the construction phase. Temporary works/ compounds may potentially affect local flood risk if they are placed within the functional floodplain. The following are potential risks:

- Land required temporarily during construction may be within a functional floodplain, including land for storage of materials, site compounds, etc.;
- Temporary diversion of watercourses during construction of water-crossings, including creation of new temporary channels;
- Temporary water crossings for:
  - Construction vehicles/ workers;
  - General road users including the A96 traffic;
- Temporary paved surfaces or roofed areas of site compounds may increase the rate of runoff;
- Temporary bunding or material stockpiles may alter runoff from upstream areas (temporary alteration of drainage catchment).

This SFRA is unable to consider temporary features associated with A96 Dualling construction any further, as there is no way to identify where such features may be required at this stage.

Temporary features and their subsequent effects on local flood risk must be considered in detail through the later DMRB design and environmental assessment stages; however, it must also be recognised that temporary site compound locations may only be identifiable at the construction stage. As such, construction contractors will be expected to confirm any site specific flood risk implications and subsequent requirements with the relevant authorities.

5.8 March 2015 Addendum – SEPA Feedback

In their March 2015 response to this SFRA Report (see Appendix E), SEPA noted that:

"…it should be borne in mind that all receptors in the catchment downstream of the road, not just in the 'study corridor' have the potential to be adversely affected.
Cumulative impacts of piecemeal reduction of areas of flood plain can be passed on downstream affecting all vulnerable locations from that point onwards in the catchment.
These impacts are likely to be indiscernible individually, but cumulatively can have an effect and be extremely difficult to assess.
That is a significant reason why the avoidance of flood risk in the first instance is the most sustainable approach to flood risk management."

6 Discussion on SFRA Findings

This Chapter of the Report presents an overview of the SFRA constraints assessment, outlining how the findings will inform the A96 Dualling Programme Strategic Environmental Assessment, and the later stages of the DMRB design and environmental assessment process.

6.1 Summary of Constraints Assessment

A collated summary of the flood risk constraints analysis schematics, from the previous Chapter, are presented in Table 6—1 (potential flood sources) and Table 6—2 (potential flood receptors).

At the broadest level of consideration, the following key points can be drawn from the analyses:

- There are extensive functional floodplains and numerous watercourse crossing requirements (major and minor watercourses) across A96 Sections 3, 4 and 5, and all improvement strategy options will be constrained to some degree;
    - Bypass options to the north of Forres and Elgin (B North in Sections 3 and 4) are the most significantly constrained in terms of fluvial and coastal floodplain extents;
    - Bypass options to the south of Forres and Elgin (B south in Sections 3 and 4) are also significantly constrained by fluvial floodplains, and will also likely to have to consider potential effects on local flood prevention/ alleviation schemes;
    - Offline Option N runs across A96 Sections 3, 4 and 5 and is constrained by fluvial floodplains in each section; however, given that this option is generally further upstream in each catchment, fluvial floodplains may not be as widespread across each section;
    - Other environmental, engineering, and traffic and economic factors must be considered in the selection of a preferred option as, for example, it is unlikely that Option B North can be discounted on the basis of floodplain extent/ constraints if the majority of A96 traffic comes to/ from the north of Elgin or Forres;
- In terms of properties within functional floodplain and improvement strategy option extents:
    - Option B North around Forres (A96 Section 3) stands out as significantly constrained with c.900 properties within the 2km wide option study area and, of those, c. 176 within the fluvial floodplain (2 are also within the coastal floodplain);
      Option B South around Forres has c. 820 properties within the 2km wide option extent, but of those only c. 29 properties are also within the functional floodplain extent;
    - Option B North around Elgin (A96 Section 4) has c.1100 properties within the 2km wide option extent, of which c. 54 are within the functional floodplain (17 of which are also in the coastal floodplain);
      Option B South around Elgin has c. 590 properties within the 2km wide option extent, and c. 43 properties within the functional floodplain;
    - The number of properties within the floodplain are very similar between B North (54) and B South (43) in A96 Section 4; however, the total number of properties in B North (c.1100) may mean that traffic demand is greater and further analysis is required to determine which option would be preferable;
    - Option N across A96 Sections 3, 4 and 5 contains fewer properties within both the option extent and functional floodplain, so it may present lower levels of flood risk constraint; however, this would have to be considered in the context of other engineering/ environmental constraints and traffic demand analyses;

Table 6—1 Summary of constraints assessment – potential flooding sources

Sect	3	4	5	6	7	8	9	10
Fluvial floodplain	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B
Water crossing	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B
Small watercourses	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B
Coastal floodplain	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B
Surface water flooding	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B
Groundwater flooding	B west; B north; B south; B east; N	B north; B south; N	B; N	B west; B east	B; C	D; B; C	D; B west; B north east; B inner; B south; B east; C	B

Key: Very likely; Likely; Possible; Unlikely

Table 6—2 Summary of constraints assessment – potential flooding receptors

(Summary continues…)

- A96 Section 5 requires a major crossing for the River Spey, whether it is via Option B or Option N. The location of the crossing would be a critical consideration under either option due to Natura (nature conservation sites designated at a European level) and the potential flood risk implications to surrounding (hydrologically influenced) properties;
- A96 Section 6 is the least constrained area in flood risk terms; however, later DMRB stages of design development and route options assessment will need to carefully consider watercrossings and property flood risk implications at the local level;
- A96 Section 7 includes Huntly, which has proposals for a local flood alleviation/ prevention scheme. The 2km wide extent for Option B in this area includes over 1500 properties, with around 44 also in the floodplain extent. There are also a number of major and minor watercourse crossing constraints to be considered.

Option C could potentially compare favourably in this area (e.g. only 2 properties in the floodplain), but this would have to be considered in the context of other engineering/ environmental constraints and traffic demand analyses;

- A96 Section 8 has comparatively low levels of fluvial floodplain constraint, but does still present a number of major and minor watercourse crossing constraints.
  Option C in this area has a higher number of properties at risk of flooding than Option B (c. 52 vs c. 15), with potentially fewer major watercourse crossing constraints, but potentially more minor watercourse constraints.
  Option D in this area appears to perform relatively well in terms of floodplain extents and properties at risk (e.g. only 2 properties in floodplain extent);
- Across A96 Sections 7, 8 and 9, Option C compares favourably against the corresponding 'segments' of Options B and D in some aspects (e.g. total fluvial floodplain extent), but not in others (e.g. properties at risk in Section 8, major watercourse crossing constraints in Section 9 and minor watercourse crossings across all three sections).
  Although there are positives in certain sections, Option C must be considered and compared, as a whole, across the three A96 Sections, including other engineering/ environmental constraints and traffic demand;
- Across A96 Sections 8 and 9, Option D compares favourably against the corresponding 'segments' of Options B and C, across each of the aspects considered by this SFRA. However, Option D must also be considered, as a whole, within the context of other engineering and environmental constraints, as well as traffic demand.
- A96 Section 9 around Inverurie presents a range of issues in terms of floodplain extents and properties at risk:
  - Option B Northeast and Option B inner (widening option for existing A96) are constrained by watercourse crossings (Urie and/ or Don), floodplain extents, a flood alleviation/ prevention scheme within the option extents and relatively high numbers of properties at risk of flooding; however, the higher number of properties may lead to greater traffic demand and the options must be considered within that context;
  - The other options in A96 Section 9 (including B West, B South, C and D) are generally comparable across the range of SFRA topics considered.
    B West, B South and Option C may present some greater constraint issues in terms of major/ minor watercourse crossings. Option D performs consistently across all topics.
  - Selection of a preferred option around Inverurie must be informed by consideration of other engineering/ environmental constraints and traffic demand analyses.
- A96 Section 10 is already dualled between Inverurie and Aberdeen, and any upgrade works are expected to be within the current footprint and unlikely to exacerbate existing flood risk.
- Surface water and groundwater flooding issues are not considered to present any significant differentiation between improvement strategy options at this level of assessment;

- Although the SFRA considered flood risk to arable agricultural land and to scheduled monuments; when considered within the context of floodplain extents and properties at risk, these issues do not present significant further differentiation between improvement strategy options at a 2km wide level of assessment. They are considered more likely to provide differentiation between options at a more defined (i.e. narrower) scale of assessment.

6.2 Next Steps – Strategic Environmental Assessment (SEA)

Given the range and 2km wide study boundary scale of A96 Dualling improvement strategy options, the SFRA cannot recommend the removal or retention of any option in isolation. Therefore the SFRA findings will be considered as one element of analysis within the A96 Dualling Strategic Environmental Assessment (SEA), providing the detailed evidence for the assessment of flood risk issues within the 'Water and Flooding' topic in the SEA.

The SEA will consider each of the improvement strategy options across a range of environmental topics and constraints, including Biodiversity, Soils and Geodiversity (including designated conservation sites), Population and Human Health, Landscape (sensitivity) and Air Quality, as well as Water and Flooding.

This SFRA report will be submitted to SEPA for consultation comment on its findings, and any feedback will be considered before finalisation of the SEA Environmental Report (ER).

SEPA are invited to provide feedback on the findings of the SFRA, particularly in terms of the assessment approach applied, and any comments on the relative merits, constraints or issues across the improvement strategy options that should be considered in context by the SEA.

A four-week consultation period on the SFRA is proposed, to enable the consideration of SEPA's feedback in time for the finalisation of the SEA ER, targeted for the end of March 2015.

6.3 Next Steps – Overview on DMRB Levels of Assessment

This SFRA has been undertaken within the context of a Design Manual for Roads and Bridges (DMRB) Stage 1 assessment. DMRB is the national manual for road design guidance, standards and procedures, which outlines a three-stage design development and assessment process:

- Stage 1 (DMRB1) – assessment of alternative improvement strategy options which, in terms of the A96, will inform the identification of emerging preferred dualling strategies.
  Requires desk based collation and assessment of relevant engineering and environmental constraint information. The SFRA and SEA will provide the basis for the DMRB1 environmental constraints assessment for the A96 Dualling Programme.
  Engineering constraints are being considered via a separate 'Preliminary Engineering Services (PES)' workstream.
- Stage 2 (DMRB2) – route option assessments within emerging preferred study area options to inform the identification of emerging preferred route option(s).
  Includes further comparative assessments between route options, across a range of DMRB defined criteria, with more detailed assessments required where complex/ conflicting constraint issues are identified (see 6.3.1 below).
- Stage 3 (DMRB3) – detailed design development and assessment (including Environmental Impact Assessment and site-specific Flood Risk Assessments) to confirm and develop the preferred route alignment to a level of detail sufficient to progress to Road Orders and procurement (see 6.3.2 below).

Site specific flood risk assessments for individual A96 dualling projects will be undertaken in accordance with DMRB guidance, as more localised detail becomes available at each relevant design stage. The overarching flood risk design principle is that the A96 Dualling Programme achieves no change in overall levels of flood risk.

6.3.1 DRMB Stage 2

Scoping

A scoping exercise will be undertaken to determine the level of assessment required. An assessment will be required if the answer to any of the following questions is 'yes':

a) Will the project affect an existing watercourse or floodplain?

b) Will the project change the natural/ existing land drainage catchments?

c) Does any element of the project extent fall within the SEPA 2014 Flood Maps (medium likelihood of flooding)?

d) Will earthworks result in the potential for sediment being carried to watercourses?

Where none of scenarios noted above are likely, a flood risk assessment will not be considered essential. If there is any doubt, an assessment should be carried out.

Simple Assessment

The simple assessment is a desk-based qualitative assessment considering the following factors:

- Identification of receptors sensitive to flood risk;
- Hydrological assessment of design flows and drainage paths (existing and proposed) using standard Flood Estimation Handbook (FEH) methods;
- Estimate culvert conveyance capacity (existing and proposed).

Where the simple assessment identifies that proposed dualling works are unlikely to present adverse impacts on flood risk, no further assessment will usually be required.

At locations where sensitive receptors are identified and/ or A96 Dualling is a potential source of change in flood risk, a detailed assessment may be required. Detailed assessments are usually undertaken at DMRB3, but may be applied at DMRB2 where determined necessary.

6.3.2 DMRB Stage 3

Detailed Assessment

Detailed assessments usually build on desk-based DMRB2 exercises, supplemented with information collected on site, to enable a more detailed, site-specific quantitative assessment; potentially including specialist surveys. The following elements are likely to be required:

- Detailed hydrological assessment;
    - Hydrological modelling to improve the design flow estimation;
- Hydraulic modelling of the watercourse/ floodplain;
    - To determine the existing flood extent/ levels;
    - To assess the potential impacts of the proposed works;
    - To design (re-design) flood mitigation measures for proposed works.

The level of detail in the applied methodology should be commensurate with the level of risk any proposed dualling works present.

6.4 SFRA Design Recommendations

The following are best practice recommendations for future design consideration of flood risk issues (adapted from DMRB Vol. 11 Sec. 3 Pt. 10 HD 45/09 and Scottish Planning Policy (SPP)):

Functional Floodplain

- Avoid new infrastructure in the functional floodplain (recognising that this may not be achievable in all locations).

Where unavoidable:

- New infrastructure should be restricted to the shortest practical crossing, avoiding extensive construction within the functional floodplain.

Road Alignment

- The road level should be above the level of the 0.5% annual flood event (also referred to as the design flood event), to comply with SPP.
- Sensitivity check against the 0.1% annual flood event should be undertaken at DMRB Stage 3.

Climate Change

- Potential for climate change impacts on the design flood event should be considered.

Water-Crossings

- All water-crossings should be screened to determine the level of DMRB assessment required (i.e. simple, detailed or exempt).
- A flood risk assessment may not be required when:
    - There is no modification to the existing water-crossing.
    - Water-crossing modifications are like-for-like in terms of dimensions and/ or conveyance.
- New bridge/ culvert designs should achieve a no net afflux target; i.e. no increase in peak design flood level.
- Water-crossing designs should include an appropriate freeboard at locations that are sensitive to flooding.

Flood Mitigation Measures

- Before considering flood mitigation measures, route alignment options which avoid the floodplain should be fully investigated at DMRB Stage 2.
- Where unavoidable, a suitable range of flood mitigation design options should be assessed at DMRB2, and cost-benefit analysis undertaken to justify individual flood mitigation measure options in terms of value for money.
- All design mitigation, such as flood relief culverts, should be investigated before considering provision of compensatory storage as flood mitigation.
- Compensatory storage may reduce the potential impact of loss of floodplain storage, and should be designed to deliver no net change to floodplain capacity and catchment hydrology.

- In the event that a road embankment is designed as a barrier to store flood water on the floodplain upstream of a settlement, as part of flood mitigation measures, compensatory storage for the upstream floodplain may not be required.
- In this event, the new road embankment could cause significant afflux but reduce flood risk downstream. Where this is a design option (though considered unlikely for the A96 Dualling) there are two major considerations:
    - Check if the retaining volume will be regulated under the Reservoirs Act 1975;
    - Consideration should include the failure scenario, if the embankment breaches or is overtopped.

Flood Protection Measures

- Where new road infrastructure/ crossings (following design mitigation measures) increase the risk of flooding to local communities, it will be necessary to include local flood protection measures as part of the road project to reduce risks to an acceptable level.
  These may include flood walls, flood protection embankments, flood storage areas and other measures.

6.5 March 2015 Addendum – SEPA Feedback

In their March 2015 response to this SFRA Report (see Appendix E), SEPA stated that:

"…we note the summary of the findings in Section 6 and note that the most problematic areas have been identified.
These accord with the areas in which we have the greatest degree of concern with the development.
We note and accept that all route options will have an impact on flood risk and it will not be entirely avoidable.
However, we feel particularly strongly that the options B North in both sections 3 and 4 (potential bypasses north of Forres and Elgin) should be avoided.
Both options involve crossing extensive areas of flood plain at such a scale that impacts would be extremely difficult to adequately mitigate the effects of.
Both areas contain existing properties which are extremely vulnerable to flooding and in the case of Forres have been severely flooded as recently as August 2014."

List of Appendices

A96 Dualling Programme Inverness to Aberdeen

Strategic Flood Risk Assessment (SFRA)

Main Report

March 2015

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A96 DUALLING INVERNESS TO ABERDEEN

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