11 Road Drainage and the Water Environment

This chapter presents the DMRB Stage 3 assessment of the proposed scheme on the surface water environment, specifically considering the attributes of hydrology, flood risk, fluvial geomorphology and water quality.

The proposed scheme is located within the River Tay catchment. Within the 500m study area, 23 surface water features were identified which may be affected by the proposed scheme. The majority of these are upland, fast flowing and low stream order watercourses which are currently crossed by the existing A9. The largest watercourse within the study area is the River Tummel (catchment area: 1715km^2), which is a transitional river with a predominantly cobble and gravel substrate. Loch Faskally is also located within the study area, which is a reservoir formed from the impoundment of the River Tummel by the Pitlochry Dam.

Several water features within the study area form part of the River Tay Special Area of Conservation (SAC); these include the River Tummel, the River Garry (from downstream of Struan weir), and Loch Faskally. The drainage system associated with the existing A9 consists primarily of kerbs and gullies, which currently discharge untreated and un-attenuated road runoff directly to watercourses. Land uses within the River Tummel catchment are primarily low intensity agriculture, forestry and managed moorland; therefore, potential pollution sources are generally limited to agricultural runoff, road runoff and forestry operations.

The assessment was informed by consultation, desk-based assessments, site walkovers and topographic surveys. Hydraulic modelling of the River Tummel was undertaken to assess the potential impacts on flood risk.

Significant potential impacts from the proposed scheme, in the absence of mitigation, include increases in fluvial flood risk, alterations to flows and sediment processes within watercourses, and deterioration in water quality in receiving watercourses from construction and operational runoff.

Standard mitigation during construction would be provided within a Construction Environmental Management Plan (CEMP), which would include measures for flood risk, fluvial geomorphology and water quality. Mitigation measures proposed include: a sediment management plan; storage of machinery and material outside of the floodplain; adherence to guidance such as SEPA's Guidance for Pollution Prevention (GPPs); and specific management plans to manage drainage and minimise the generation of suspended sediment.

With the implementation of the proposed mitigation measures during construction, potential impacts would be avoided or reduced. Residual Impacts on the majority of water features would be of Slight or Negligible significance, and are not considered significant in the context of the EIA Regulations. A residual impact of Moderate significance on flood risk during construction would remain for the River Tummel, due to the requirement for works within the functional floodplain to construct the new Tummel Crossing.

During the operational phase, mitigation incorporated into the design would include the use of Sustainable Drainage Systems (SuDS), scour protection and plans to manage flood flows.

With the proposed mitigation, the majority of residual impacts during operation would be of Slight or Negligible significance. For flood risk, adverse residual impacts of Moderate significance and beneficial impacts of Large significance are reported. However, the net effect of the proposed scheme on flood risk is considered to be beneficial, due to a reduction in flood risk to residential properties as a result of the proposed mitigation. Adverse residual impacts from flood risk relate to localised increases in flood depths on agricultural land already subject to flooding.

11.1 Introduction

11.1.1 This chapter presents the DMRB Stage 3 assessment of the proposed scheme (refer to Chapter 5: The Proposed Scheme) in terms of the following aspects of the surface water environment: hydrology and flood risk, fluvial geomorphology and water quality.

11.1.2 The chapter is supported by the following appendices, which are cross-referenced where relevant:

- Appendix A11.1: Baseline Conditions;
- Appendix A11.2: Surface Water Hydrology;
- Appendix A11.3: Flood Risk Assessment;
- Appendix A11.4: Hydraulic Modelling Report;

- Appendix A11.5: Fluvial Geomorphology;
- Appendix A11.6: Water Quality;
- Appendix A11.7: Impact Assessment; and
- Appendix A11.8: Watercourse Crossing Report.

11.1.3 The chapter is further supported by the following figures, which are cross-referenced where relevant:

- Figure 11.1(a-c): Surface Water Features;
- Figure 11.2(a-c): Baseline Flood Risk;
- Figure 11.3(a-c): Residual Flood Risk (With Mitigation);
- Figure 11.4(a-c): Drainage Catchments;
- Appendix A11.3, Figures A11.3.1 – A11.3.6 (Flood Risk Figure); and
- Appendix A11.8, Figures A11.8.1 – A11.8.19 (Watercourse Crossing Drawings).

11.2 Approach and Methods

Structure of Assessment

11.2.1 The assessment of potential impacts on attributes of the surface water environment in this chapter includes:

- Hydrology and Flood Risk: potential impacts on the flow of water above ground and the risk of flooding from all sources;
- Fluvial Geomorphology: the sensitivity of, and potential impacts on, fluvial landforms associated with river systems and the flow and sediment transport processes which create and sustain them; and
- Water Quality: the quality of the water in terms of potential impacts on biodiversity, dilution and removal of waste products, and water supply.

11.2.2 The surface water environment is intrinsically linked to groundwater and ecological receptors, considered in Chapter 10 (Geology, Soils, Contaminated Land and Groundwater) and Chapter 12 (Ecology and Nature Conservation) respectively. Commercial and recreational use of the water environment is considered in Chapter 8 (People and Communities: Community and Private Assets). The specialist teams undertaking each of these assessments worked closely together to cover interactions between these topics, and cross-referencing is provided throughout this chapter where relevant.

11.2.3 The approach and methods were informed by the recommendations made in the A9 Dualling Programme Strategic Environmental Assessment (SEA) (Transport Scotland, 2013). More detailed information on the SEA recommendations is presented in Appendix A6.1 (SEA Monitoring Framework).

Legislative and Policy Context

11.2.4 The assessment has taken into account relevant guidance, legislation, policy and regulations, including those listed in Table 11.1 below.

Table 11.1: Legislation, policy, regulations and guidance

Topic	Name
Key Legislation	Water Environment Water Services (WEWS) Act 2003 (Scottish Government, 2003); Flood Risk Management (Scotland) Act 2009 (Scottish Government, 2009a); European Union (EU) Floods Directive (2007/60/EC); The Water Environment (Controlled activities) (Scotland) Regulations 2011 (as amended) (CAR) (Scottish Government, 2013);
Other Legislation	The Climate Change (Scotland) Act 2009 (Scottish Government, 2009b); EU Drinking Water Directive (98/83/EC);

Topic	Name
	The Environment Act 1995; Surface Waters (Fishlife) (Classification) (Scotland) (Amendment) Regulations, 2003; Control of Pollution Act 1974 (CoPA); Environmental Protection Act 1990; Environmental Liability (Scotland) Regulations 2009. The Water Supply (Water Quality) (Scotland) Regulations, 2001; The Public Water Supplies (Scotland) Regulations 2014; The Private Water Supplies (Scotland) Regulations 2006; The Water Environment (Oil Storage) (Scotland) Regulations 2006; and Pollution Prevention and Control (Scotland) Regulations 2012 (PPC 2012).
Policy	Water Framework Directive (WFD) policy guidance 'The Future for Scotland's Waters, Guiding Principles on the Technical Requirements of the Water Framework Directive' (SEPA, 2002); Scottish Planning Policy (SPP), (Flooding and Drainage Chapter) Scottish Government (2014)
General Guidance	British Standards BS 6031:2009 Code of Practice for Earthworks (British Standards, 2009); British Water (Undated). Code of Practice – Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff; DMRB Volume 11, Section 3, Part 10 (HD 45/09): Road Drainage and the Water Environment (Highways Agency et al., 2009a), hereby referred to as DMRB HD45/09; DMRB Volume 4, Section 2, Part 7 (HA 107/04): Design of Outfall and Culvert Details (Highways Agency et al., 2004), hereby referred to as DMRB HA107/04; Interim Advice Note (IAN) 125/09: Supplementary Guidance for Users of DMRB Volume 11 Environmental Assessment (Highways Agency et al., 2009b). CIRIA C689: Culvert Design and Operation Guide (CIRIA, 2010); WAT-SG-29: Good Practice Guide – Construction Methods (2009) CIRIA C741: Environmental Good Practice on Site (fourth edition) (CIRIA, 2015a) River Crossings and Migratory Fish: Design Guidance (Scottish Executive, 2001) SEPA (WAT-SG-23) Engineering in the Water Environment: Good Practice Guidance: Bank Protection Rivers and Lochs (SEPA, 2008a); SEPA (WAT-SG-28) Engineering in the Water Environment: Good Practice Guidance: Intakes and Outfalls (SEPA, 2008b); SEPA (WAT-SG-29) Engineering in the Water Environment: Good Practice Guidance: Temporary Construction Methods (SEPA, 2009); SEPA (WAT-SG-25) Engineering in the Water Environment: Good Practice Guidance: River crossings (SEPA, 2010); SEPA (WAT-PS-06). Position Statement to Support the Implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (SEPA, 2015a). SEPA The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) A Practical Guide (SEPA, 2017a); and SEPA Regulatory Method (WAT-RM-08), Sustainable Urban Drainage Systems (SEPA, 2017b)
Flood Risk Guidance	Technical Flood Risk Guidance for Stakeholders (SS-NFR-P-002) (SEPA, 2015b); and Scottish Government's Online Planning Advice on Flood Risk (22 June 2015).
Fluvial Geo-morphology Guidance	Waterway Bank Protection: a guide to erosion assessment and management (Environment Agency, 1999); The Fluvial Design Guide (Environment Agency, 2010); Guidebook of Applied Fluvial Geomorphology (Sear et al., 2010); SEPA (WAT-SG-21) Environmental Standards for River Morphology (SEPA, 2012a); and SEPA (WAT-PS-07-02) Engineering in the Water Environment Good Practice Guide: Bank Protection – Rivers and Lochs (SEPA, 2008a).
Water Quality Guidance	CIRIA C532: Control of water pollution from construction sites (CIRIA, 2001); CIRIA C609: Sustainable drainage systems: Hydraulic, structural and water quality advice (CIRIA, 2004); CIRIA C648: Control of water pollution from linear construction projects: Technical Guidance (CIRIA, 2006a); CIRIA C649: Control of water pollution from linear construction projects: Site Guide (CIRIA, 2006b); CIRIA C698: Site handbook for the construction of SUDS (CIRIA, 2007); CIRIA C753: The SuDS Manual (CIRIA, 2015b); CIRIA R142: Control of pollution from highway drainage discharge (CIRIA, 1994); SEPA Code of Practice for installers, owners and operators of underground storage tanks and pipelines (SEPA, 2006); and SEPA Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs) (SEPA, 2006-2017).

11.2.5 The following paragraphs discuss the key legislation of relevance to this chapter.

Water Environment and Water Services (Scotland) Act 2003 (WEWS Act)

11.2.6 The Water Framework Directive (WFD) (2000/60/EC) was transposed into Scottish law under the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act). Under the WFD, new activities should not cause deterioration (of the ecological and chemical status of surface and ground water bodies), or prevent the achievement of overall Good Ecological Status (GES) or Potential (GEP, for artificial or heavily modified water bodies). However, such activities may be permitted, where:

- the benefits to human health, human safety or sustainable development outweigh their costs to the environment and to society;
- there are no significantly better alternative means of providing the benefits; and
- all practicable mitigation measures are taken to minimise their adverse effects on the water environment.

11.2.7 The aims of the WEWS Act are to:

- provide a sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use;
- significantly reduce groundwater pollution;
- protect territorial and other marine waters; and
- achieve the objectives of international agreements.

11.2.8 This chapter is primarily concerned with surface water and has considered the requirements of the WEWS Act during the baseline characterisation of water features, the assessment of impacts and selection of mitigation measures. The assessment of groundwater is covered in Chapter 10 (Geology, Soils, Contaminated Land and Groundwater) and was referred to where relevant.

The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)

11.2.9 The WEWS Act (Scottish Government, 2003) gives Scottish Ministers power to regulate activities in the water environment (both surface waters and groundwater). This is achieved under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) (Scottish Government, 2013); herein referred to as 'CAR'. This legislation controls engineering works within inland surface waters, as well as point source discharges, abstractions and impoundments.

11.2.10 There are three different levels of authorisation under CAR: General Binding Rules (GBR), Registration, and Licence (either Simple or Complex). The level of authorisation required for an activity relates to the risk associated with the activity, and is determined from the criteria set out within the CAR: A Practical Guide (SEPA, 2017a). The level of authorisation under CAR for the proposed scheme is likely to range from GBRs covering discharges from short road drainage catchments, to Simple Licences for culvert replacements and Complex Licenses for channel realignments. Discharges during construction are also likely to require a Simple Licence as a result of proposed amendments to CAR (SEPA, 2016a).

11.2.11 The development of a specimen design, preparation of a CAR scoping report and drafting of CAR license applications will be undertaken in consultation with SEPA following the completion of the DMRB Stage 3 Assessment.

Flood Risk Management (Scotland) Act 2009

11.2.12 The EU Floods Directive (2007/60/EC) is transposed into Scottish law through the Flood Risk Management (Scotland) Act 2009 (FRM). The FRM Act sets in place a statutory framework for delivering a sustainable and risk-based approach to the management of flooding, including the preparation of assessments of the likelihood and impacts of flooding and associated catchment focussed plans.

11.2.13 The FRM Act places a duty on responsible authorities (Scottish Ministers, SEPA, Scottish Water and local authorities) to manage and reduce flood risk and promote sustainable flood risk management. The main elements of the FRM Act, which are relevant to the planning system, are the assessment of flood risks and undertaking structural and non-structural flood management measures.

Scottish Planning Policy (SPP)

11.2.14 Through the FRM Act, SPP (Scottish Government, 2014) requires planning authorities to consider all sources of flooding (coastal, fluvial, pluvial, groundwater, sewers and blocked culverts) and their associated risks when preparing development plans and reviewing planning applications.

11.2.15 The aims of SPP in relation to flooding are:

- to prevent developments which would be at significant risk of being affected by flooding;
- to prevent developments which would increase the probability of flooding elsewhere; and
- to provide a risk framework from which to identify a site's flood risk category and the related appropriate planning response.

11.2.16 This approach places planning in the wider context of Scottish Government aims and policies. SPP does not reinstate policy and guidance used elsewhere but should take into account the wider policy framework including the National Planning Framework in decision making.

Study Area

11.2.17 The baseline study area for this assessment extends up to 500m from the footprint of the proposed mainline as shown on Figure 11.1, and includes identified water features (WFs: including natural and artificial rivers, streams, drainage ditches, lochs and ponds), existing watercourse crossing points and flood inundation extents. Ecological designations are shown on Figure 5.2 and Figure 12.1.

11.2.18 As described in Chapter 1 (Introduction), the southern section of the A9 dualling programme comprises of five projects (from the Pass of Birnam to Glen Garry). The majority of the identified water features within this southern section were referenced sequentially from south to north (with occasional late additions appearing out of sequence). The proposed scheme is the second northernmost dualling project of the southern section and as such the assessed water feature referencing starts at WF57.

11.2.19 For fluvial geomorphology, the study area was extended to 1km upstream and downstream of proposed watercourse crossings to consider potential impacts on WFD status for designated water bodies, assess erosion risk, ascertain baseline sensitivity and inform the design of the proposed scheme and appropriate mitigation.

Baseline Conditions

11.2.20 Baseline conditions were identified through a combination of consultation with relevant stakeholders, desk-based assessment and site walkovers.

Desk-based Assessment

11.2.21 The desk-based assessment took into account relevant guidance (including DMRB HD45/09), legislation and regulations, as provided in Table 11.1. In addition, data sources detailed in Table 11.2 and the section 11.8 (References), have informed the assessments.

Table 11.2: Road Drainage and the Water Environment data sources

Topic	Sources of Information
Mapping and spatial data	• Aerial photography (BLOM, 2013); • Ordnance Survey (OS) 1: 25,000 mapping and 1:1,250 to 1:10,000 MasterMap data; • LiDAR topographical survey data; • Historical maps (National Library of Scotland, 2015); and • British Geological Survey (BGS) Digital Mapping (BGS, 2016).
Hydrological data	• Flood Estimation Handbook (FEH) CD-ROM v3, Centre for Ecology and Hydrology (CEH, 2009); • SEPA Flood Maps (2015c); • Low Flows Enterprise (LFE) flow duration curve percentiles supplied by Wallingford Hydro Solutions; • SEPA Flood Frequency Curves and Time Series Data (SEPA, 2016b) • National River Flow Archive (CIRIA);

Topic	Sources of Information
	• SEPA river gauging data records from 1952 to 2015 for station 15012 (River Tummel at Pitlochry) and associated hydrometric data (SEPA, 2016c); • SEPA RBMP data and classification results available on the SEPA Water Environment Hub (SEPA, 2016d); and • The River Basin Management Plan for the Scotland River Basin District: 2015 – 2027 (Scottish Government, 2015)
Previous assessments	• A9 Dualling Programme Strategic Environmental Assessment (SEA) – Environmental Report (Transport Scotland, 2013); • A9 Dualling Programme Strategic Environmental Assessment (SEA) – Environmental Report Addendum (Transport Scotland, 2014a); • A9 Dualling Programme Strategic Environmental Assessment (SEA) – Post Adoption SEA Statement (Transport Scotland, 2014b); • DMRB Stage 1 Assessment A9 Dualling: Preliminary Engineering Support (PES) Services (Jacobs, 2014); • A9 Dualling Pitlochry to Killiecrankie: DMRB Stage 2 Scheme Assessment Report, Volume 1: Main Report and Appendices, Part 3: Environmental Assessment (Jacobs, 2016).

Site Walkover and Surveys

11.2.22 The site walkovers and surveys undertaken in support of the assessments are detailed in Table 11.3.

Table 11.3: Site walkover and surveys

Stage	Date	Discipline	Surveys
DMRB Stage 2	February, March, April and June (2015)	All	• Visual inspection of surface water features and the adjacent area to provide an understanding of the local topography, the hydrological regime and to enable catchment boundaries to be defined where they could not be identified with certainty from the desk-based assessment.
DMRB Stage 3	July, August, November and December (2016)	Flood Risk	• Surveys of water feature geometry e.g. channel cross-sections and hydraulic structures, using conventional topographical survey techniques. • Inspections of minor culvert crossings on the existing A9. • Strategic walkover surveys were at selected locations with a focus on developing Flood Risk Assessment (FRA) methodologies related to minor water features and how they should be analysed.
	May (2016)	Fluvial Geomorphology	• Geomorphological processes and features around several existing structures over a number of water features including: WF70 (River Tummel) and WF75 (Loch Faskally). • Areas of erosion along the River Tummel were visited in May 2016 to inform the baseline erosion risk assessment (see Appendix A11.6 Fluvial Geomorphology).
	September and October (2016)	Water Quality	• Visible inspection of proposed locations of SuDS outfalls, proposed locations of watercourse crossings associated with side roads and areas where additional specific mitigation may be required. • Properties with private water supplies (PWS) within the study area, where the location or source of the supply required confirmation.

Consultation

11.2.23 Details of the full consultation process for the proposed scheme are provided in Chapter 7 (Consultation and Scoping) and Appendix A7.2 (Summary of Consultation Responses). Consultation of particular relevance to this assessment was undertaken with regulatory bodies and key stakeholders, including SEPA, SNH, Perth & Kinross Council (PKC), Scottish Water and the Tay District Salmon Fisheries Board. Specific consultation undertaken during the DMRB Stage 3 assessment and of relevance to this chapter is summarised in Table 11.4.

Table 11.4: Consultation undertaken for DMRB Stage 3

Consultee	Date(s)	Aspect	Comments
Scottish Water	18 October 2016	Water supply abstractions	Details of abstraction points within watercourses in hydraulic connection with the proposed scheme.

Consultee	Date(s)	Aspect	Comments
SEPA	13 April 2015 and 21 May 2015	Hydrometric data	Historical flood flows and river flow data.
	26 April 2016	CAR licence locations	Provided GIS file of CAR licence locations.
	28 July 2016	Minor watercourses and flood risk	Meeting held on the 28 July 2016 to discuss the proposed approach to the assessment of minor watercourses and the completion of the associated Watercourse Crossing Report (Appendix 11.8: (Watercourse Crossings Report of the ES). SEPA had no issues on the proposed approach. The approach to Flood-Risk Assessment was discussed. SEPA indicated that where compensatory flood storage is to be provided, like-for-like compensatory storage locally would be preferred, particularly where there are sensitive receptors, however where this was not possible, a modelling approach to show effectiveness of remote compensatory storage would, if necessary, be acceptable (with consideration of potential receptors). To secure areas as floodplain SEPA's preference would be to include the land affected within the CPO boundary (as per A9 Dualling: Luncarty to Pass of Birnam). SEPA noted that culvert screens are not favourable because of the risk of blockage and clarified that blockage would need to be assessed as a residual risk. SEPA also noted that Network Rail had plans for culvert/structure improvements/changes and that these should be incorporated into the proposed scheme design.
	August 2016	Water quality chemistry data	Provided monthly water quality monitoring data for locations throughout Scotland.
	Meetings - 14 December 2015 and 28 September 2016	Drainage design	Sought feedback on drainage design throughout the design process. This included providing justification for scenarios where proprietary systems have been proposed as a second level of treatment.
	Meetings 28 July 2015 and November, 2016	FRA methodology and results	Ongoing dialogue was undertaken with SEPA which has included multiple telephone conversations and meetings to clarify specific issues related to SEPA's written responses and wider flood risk issues. Advice and guiding principles from SEPA were taken into consideration during the design and assessment stages.
	Meeting (WebEx) 27 April 2017	FRA findings and proposed mitigation	Presented results of hydraulic modelling and discussed proposed mitigation measures at the Tummel crossing.
	Technical Notes issued between February to July 2017	Technical Notes on Drainage Design	Following the meeting with SEPA on 28th September 2016, JUK provided technical notes for drainage design proposals for drainage catchments where variations on conventional SuDS were proposed. SEPA provided comments in response on water quality and further information was provided to SEPA. This information has been used in the design development of the proposed scheme and to inform the assessment reported in this ES.
	Meeting 19 October 2017	CAR	It was agreed that, across the A9 Dualling projects, CAR licence applications would be drafted up in conjunction with a specimen design after submission of the ES and draft Road Orders.
Spey Fishery Board (SFB)	Meeting 05 November 2014	Salt application on roads	SFB raised concerns over salt discharge into designated waters through SuDS and highlighted that existing drainage may 'percolate' through 'habitats'. See comment below and refer to Appendix A11.6 (Water Quality) for the approach undertaken in relation to salt.
SNH	Meeting – 07 July 2015	Salt application on roads	SNH highlighted the issue of salt and its importance in gaining an understanding of current discharge. SEPA does not hold any evidence to suggest that salt from the A9 is a current threat, but note that the existing A9 has few discharge points. Transport Scotland should consider the salt issue in relation to the A9 Dualling Programme. Refer to Appendix A11.6 (Water Quality) for the approach undertaken in relation to salt.

11.2.24 Flooding issues have been raised at local drop-in sessions and public exhibitions by landowners and members of the public, and these opportunities were used to capture local evidence and concerns. Discussions with attendees focussed on the nature of the observed flood extents, structure condition

and maintenance and potential cumulative effects of other development proposals in addition to the proposed scheme. Meetings have also been held with some individual landowners, particularly in the Dalshian area, and SEPA, where the flood history has suggested there may be local flooding issues to consider. Information obtained from this consultation was used to inform the baseline assessment and mitigation, where appropriate.

Impact Assessment Methodology

Introduction

11.2.25 The impact assessment reported in this chapter was undertaken in accordance with the guidance provided in DMRB HD45/09 (Highways Agency et al., 2009a), whereby the level of significance of a potential impact on the existing baseline condition of the surface water environment is determined by the sensitivity of the surface water feature, combined with the magnitude of impact. This assessment takes account of general and specific impacts from construction and/or operational activities, both before and after the application of mitigation measures i.e. potential and residual impacts respectively.

11.2.26 It should be noted that the sensitivity and magnitude criteria presented in Tables 11.5 and 11.6 represent a development of those provided within DMRB HD45/09 Annex IV to reflect local sensitivities and regulatory guidance.

Hydrology and Flood Risk

11.2.27 Assessment of potential impacts on hydrology and flood risk considered changes to the flow of water above the ground surface and within associated water features. In particular, the likelihood of flooding was assessed against the design 0.5% Annual Exceedance Probability (AEP) (1 in 200-year) plus a 20% allowance for climate change (cc) flood event in line with SEPA's Technical Flood Risk Guidance for Stakeholders (SEPA, 2015b); hereafter referred to as the 0.5% AEP (200-year) plus CC event.

11.2.28 AEP refers to the chance that a flood of a particular size is experienced or exceeded during any year. This chapter refers to a probability value expressed as a percentage to quantify this. For example, a 50% AEP equates to a 1 in 2 chance of the flood being experienced or exceeded in any given year, and a 0.5% AEP equates to a 1 in 200 probability of the flood being experienced or exceeded in any given year. The potential effects of climate change were allowed for in flood flow calculations by adding 20% to the 0.5% AEP (200-year) flood flows, in accordance with guidance (SEPA, 2015b). For simplicity, the terms 0.5% AEP (200-year) plus CC event *and* the 'design flood event' are used interchangeably to describe the flood event used in the assessment of flood risk.

Fluvial Geomorphology

11.2.29 Assessment of potential impacts on fluvial geomorphology considered both upstream and downstream changes in the bed substrate, and fluvial and geomorphological processes (including erosion, transport and deposition of sediment) both within the channel and adjacent floodplain habitats.

11.2.30 Assessment of fluvial geomorphology impacts was undertaken using standard good practice and guidance notes from SEPA, noted in Table 11.1, in the absence of specific methodologies for the assessment of fluvial geomorphology, with respect to road developments. The assessment was supported and further developed using professional judgement.

Water Quality

11.2.31 The assessment of potential impacts on water quality included the sub-attributes of water supply/quality, dilution and removal of waste products and biodiversity, as specified within DMRB HD45/09.

Sensitivity

11.2.32 The sensitivity of water features assigned within Appendix A11.1 (Baseline Conditions) was categorised on a scale of 'low' to 'very high' using various sources of information described below, as well as professional judgement, in accordance with the criteria provided in Table 11.5. In some cases, water

features were categorised with a higher or lower sensitivity if there is sufficient justification. Where applicable, supporting information is provided within the relevant technical appendix.

11.2.33 For hydrology and flood risk, the sensitivity was based on the number and type of potential flood receptors, including the existing A9 (assessed as critical social infrastructure in line with Scottish Government, 2014). Very high, high, medium and low sensitivities were assigned to watercourses taking into account the likelihood of flooding to the existing A9 during the 0.5% AEP (200-year) plus CC event (SEPA, 2015b).

11.2.34 The sensitivity assessment of water quality was informed by the WFD water body condition status published by SEPA (to meet WEWS Act requirements) on its Water Environment Hub website (SEPA, 2016d). Where no data exist for smaller/minor water features, assumptions were made based on the status of the nearest classified water feature of a similar character (Mustow et al., 2005). In addition, any field observations which would likely affect the status of the water feature, if it were to be classified, were also taken into consideration.

Table 11.5: Sensitivity criteria – water features

Sensitivity	Criteria
Very High	**Attribute has a high quality and/or rarity on international scale**
	Hydrology and Flood Risk
	Water feature with direct flood risk to the adjacent populated areas, with greater than 100 residential properties and/or critical social infrastructure units such as the existing A9, hospitals, schools, safe shelters or other land use of great value at risk during the design 0.5% AEP (200-year) plus CC event. Water feature with hydrological importance to: (i) sensitive and protected ecosystems of international status; and/or (ii) critical economic and social uses (e.g. water supply, navigation, recreation, and amenity).
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides a diverse mosaic of habitat types suitable for species sensitive to changes in sediment concentration and turbidity, such as migratory salmon and/or freshwater pearl mussel (FWPM). Water feature appears in complete equilibrium with natural erosion and deposition occurring. The water feature has sediment processes reflecting the nature of the catchment and fluvial system. **Channel Morphology** Water feature includes varied morphological features (e.g. pools, riffles, bars, natural bank profiles) with no sign of channel modification. **Natural Fluvial Processes** Water feature displays natural fluvial processes and natural flow regime, which would be highly vulnerable to change as a result of modification.
	Water Quality
	Water Supply/Quality '*High*' overall water quality status, and/or Water feature constitutes a valuable water supply resource due to extensive exploitation for public, private domestic and/or agricultural and/or industrial use, feeding ten or more properties; and/or Considered to exhibit 'High' water quality based on site observations and professional judgement, which may include no or very limited anthropogenic pressures on water quality from surrounding land-use with no impact on Environmental Quality Standards (EQS). **Dilution and Removal of Waste Products** A high number of licensed discharges/high daily volume of discharges to or within 50m of water feature (with potential hydraulic connectivity to the water feature) under CAR relative to flow. **Biodiversity** '*High*' overall ecology status or potential; or for non-classified water features, high ecosystem quality, based on site observations and professional judgement, and/or Protected/designated under EC legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site), and/or No existing pressures to biodiversity.
High	**Attribute has a high quality and/or rarity on national scale**
	Hydrology and Flood Risk
	Water feature with direct flood risk to adjacent populated areas, with between 1 and 100 residential properties and/or more than 10 industrial premises at risk from flooding during the 0.5% AEP (200-year) plus CC design flood event. Minor watercourses with an indirect and localised flood risk to critical infrastructure (including existing A9), during 0.5 % AEP plus CC event, due to undersized culverts.

Sensitivity	Criteria
	Water feature with hydrological importance to: (i) national designation sensitive and protected ecosystems; and/or (ii) locally important economic and social uses (e.g. water supply, navigation, recreation, and amenity).
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides habitats suitable for species sensitive to changes in sediment concentration and turbidity, such as migratory salmon and/or FWPM. Water feature appears largely in natural equilibrium with some localised accelerated erosion and/or deposition caused by land use and/or modifications. Primarily the sediment regime reflects the nature of the natural catchment and fluvial system. **Channel Morphology** Water feature exhibiting a natural range of morphological features (e.g. pools, riffles, bars, varied natural river bank profiles), with limited signs of artificial modifications or morphological pressures. **Natural Fluvial Processes** Predominantly natural water feature with a diverse range of fluvial processes that is highly vulnerable to change as a result of modification.
	Water Quality
	Water Supply/Quality '*Good'* overall water quality status and/or Water feature constitutes a valuable water supply resource due to exploitation for public, private domestic and/or agricultural and/or industrial use, feeding fewer than 10 properties and/or Considered to exhibit 'Good' water quality based on site observations and professional judgement. May have a small number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are not considered likely to affect compliance with EQS. This includes potentially contaminated land sites (as identified in Chapter 10: Geology, Soils and Groundwater) present 25-50m from water feature with potential hydraulic connection to the water feature and/or pollutant inputs that do not significantly affect WFD aims. **Dilution and Removal of Waste Products** Some existing licensed discharges/moderate daily volume of discharges to or within 50m of water feature under CAR relative to flow. **Biodiversity** '*Good*' overall ecology status or potential; or for non-classified water features, good ecosystem quality, based on site observations and professional judgement and/or Few existing pressures to biodiversity.
Medium	**Attribute has a medium quality and/or rarity on regional/local scale**
	Hydrology and Flood Risk
	A water feature with a possibility of direct flood risk to less populated areas (no residential properties or critical infrastructure units at risk) with <10 industrial premises and/or utilisable agricultural fields. A water feature with some but limited hydrological importance to: sensitive or protected ecosystems; and/or economic and social uses.
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime provides some habitat suitable for species sensitive to change in suspended sediment concentrations or turbidity. A water feature with natural processes occurring but modified, which causes notable alteration to the natural sediment transport pathways, sediment sources and areas of deposition. **Channel Morphology** Water feature exhibiting some morphological features (e.g. pools, riffles and depositional bars). The channel cross-section is partially modified in places, with obvious signs of modification to the channel morphology. Natural recovery of channel form may be present (e.g. eroding cliffs, depositional bars). **Natural Fluvial Processes** Water feature with some natural fluvial processes, including varied flow types. Modifications and anthropogenic influences having an obvious impact on natural flow regime, flow pathways and fluvial processes.
	Water Quality
	Water Supply/Quality '*Moderate*' overall water quality status, and/or Considered to exhibit 'Moderate' water quality based on site observations and professional judgement. May have a number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are considered likely to be affecting compliance with EQS for one or more parameters. This includes potentially contaminated land sites (as identified in Chapter 10: Geology, Soils and Groundwater) present 10-25m from water feature with potential hydraulic connection to the water feature. **Dilution and removal of waste products** Few existing licensed discharges/low daily volume of discharges to or within 50m of water feature under CAR relative to flow.

Sensitivity	Criteria
	Biodiversity '*Moderate*' overall ecology status or potential; or for non-classified water features, moderate ecosystem quality, based on site observations and professional judgement, and/or Existing pressures which are likely to be adversely affecting biodiversity.
Low	**Attribute has a low quality and/or rarity on local scale**
	Hydrology and Flood Risk
	A water feature passing through uncultivated agricultural land. A water feature which is assessed as not being a flood risk to the existing A9 for the 0.5% AEP (200-year) plus CC design flood event. A water feature with minimal hydrological importance to: (i) sensitive or protected ecosystems; and/or (ii) economic and social uses.
	Fluvial Geomorphology
	Sediment Regime Water feature sediment regime which provides very limited physical habitat for species sensitive to changes in suspended solids concentration or turbidity. Highly modified sediment regime with limited/no capacity for natural recovery. **Channel Morphology** Water feature that has been extensively modified (e.g. by culverting, addition of bank protection or impoundments) and exhibits limited-to-no morphological diversity. The water feature is likely to have uniform flow, uniform banks and absence of bars. Insufficient energy for morphological change. **Natural Fluvial Processes** Water feature which shows no or limited evidence of active fluvial processes with unnatural flow regime or/and uniform flow types and minimal secondary currents.
	Water Quality
	Water Supply/Quality '*Poor*' or 'Bad' overall water quality status or potential, and/or Considered to exhibit 'Poor' or 'Bad' water quality based on site observations and professional judgement. May have a large number of anthropogenic pressures and/or pollutant inputs from surrounding land-use that are considered likely to be affecting the compliance of EQS for the majority of parameters. This includes potentially contaminated land sites (as identified in Chapter 10: Geology, Soils and Groundwater) present within 10m of water feature with potential hydraulic connection to the water feature. **Dilution and removal of waste products** No existing licensed discharges to or within 50m of the water feature under CAR. **Biodiversity** '*Poor*' or '*Bad*' overall ecology status or for non-classified water features, poor or bad ecosystem quality, based on site observations and professional judgement, and/or Many existing pressures which are considered to be adversely affecting biodiversity.

Impact Magnitude

11.2.35 The magnitude of potential impacts was assessed on a scale of 'major' to 'negligible' for both adverse and beneficial impacts based on the likely effect of proposed activities, guided by the criteria and examples provided in Table 11.6 and using professional judgement where necessary. The assessment of magnitude was influenced by the timing, scale, size and duration of changes to the baseline conditions, as well as the likelihood or probability of occurrence.

11.2.36 The highest magnitude of impact is applied when any one of the criteria are met from the adverse categories presented in Table 11.6.

11.2.37 The classification of magnitude of impact on hydrology and flood risk in Table 11.6 below follows the guidance set out in DMRB HD45/09. However, it should be noted that DMRB HD45/09 classifies the magnitude of potential impacts on flood level using the 1% AEP (100-year) design flood event. In Scotland, the design standard (from Scottish Government, 2014 and SEPA, 2015b) is the 0.5% AEP (200-year) plus CC event, therefore the magnitude of impacts has been assessed using this design flood event.

11.2.38 To meet the requirements of the WEWS Act, the magnitude of impact assessment on fluvial geomorphology takes into account the potential impacts on the condition status of the WFD waterbodies and/ the supporting hydromorphological quality elements, as published on the SEPA Water Environment Hub website (SEPA, 2016d).

Table 11.6: Magnitude criteria – water features

Magnitude	Criteria
Major adverse	**Results in loss of water feature and/or quality and integrity of the water feature**
	Hydrology and Flood Risk
	Increase in peak flood level for the 0.5% AEP (200-year) plus CC event > 100mm.
	Fluvial Geomorphology
	Sediment Regime Extensive impacts on the water feature bed, banks and vegetated riparian corridor resulting in changes to sediment characteristics, transport processes, sediment load and turbidity. This includes extensive input of sediment from the wider catchment due to modifications. Impacts would be at the water body scale. **Channel Morphology** Extensive alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. This could include: significant channel realignment (negative); extensive loss of lateral connectivity due to new/extended embankments; and/or, significant modifications to channel morphology due to installation of culverts or outfalls. Impacts would be at the water body scale. **Natural Fluvial Processes** Major shift away from baseline conditions with potential to alter processes at the catchment scale. **Condition Status** Adverse impacts causing loss or damage to habitats. Impacts have the potential to cause deterioration in hydromorphology quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone) preventing the achievement of water body objectives for Good Ecological Status (GES) or Good Ecological Potential (GEP).
	Water Quality
	Major shift away from baseline conditions. Likely to result in a downgrade in overall water quality status for all attributes (water supply/quality; dilution and removal of waste products; biodiversity) from either: • a measureable deterioration in EQS for greater than one month (construction); and/or • failure of both soluble and sediment-bound pollutants in the Highways Agency Water Risk Assessment Tool (HAWRAT) assessment, and compliance failure against EQS values (operation). Total removal of the water feature's capacity to dilute existing licenced discharges under CAR. Long term loss or change to designated site or water supply. Calculated risk of pollution from a spillage >2% annually during operation.
Moderate adverse	**Results in effect on integrity of attribute, or loss of part of the water feature**
	Hydrology and Flood Risk
	Increase in peak flood level for the 0.5% AEP (200-year) plus CC design flood event > 50mm.
	Fluvial Geomorphology
	Sediment Regime Some changes and impacts on the water feature bed, banks and vegetated riparian corridor resulting in some changes to sediment characteristics, transport processes, sediment load and turbidity. Impacts would be at the multiple reach scale. **Channel Morphology** Some alteration to channel planform and/or cross section, including modification to bank profiles or the replacement of a natural bed. Activities could include: channel realignment, new/extended embankments, modified bed and/bank profiles, replacement of bed and/or banks with artificial material and/or installation of culverts. Impacts would be at the multiple reach scale. **Natural Fluvial Processes** A shift away from baseline conditions with potential to alter processes at the reach or multiple reach scale. **Condition Status** Moderate adverse impacts at the reach or multiple reach scale, which causes some loss or damage to habitats. Impacts have the potential to cause failure or deterioration in one or more of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone). May prevent the achievement of water body objectives for GES or GEP.
	Water Quality
	A moderate shift away from baseline conditions that may be long-term or temporary. Likely to result in a decline in water quality but not a downgrade in overall water quality status from either: • a measureable deterioration in EQS for less than one month (construction); and/or • failure of both soluble and sediment-bound pollutants in HAWRAT but compliance with EQS values (operation) Reduction in the water feature's capacity to dilute existing discharges under CAR. May result in temporary impacts on designated species/habitats or water supply.

Magnitude	Criteria
	Calculated risk of pollution from a spillage >1% and <2% annually during operation.
Minor adverse	**Results in some measurable change in quality or vulnerability of attribute of the water feature**
	Hydrology and Flood Risk
	Increase in peak flood level for the 0.5% AEP (200-year) plus CC design flood event of > 10mm.
	Fluvial Geomorphology
	Sediment Regime Limited impacts on the water feature bed, banks and vegetated riparian corridor resulting in limited (but notable) changes to sediment characteristics, transport processes, sediment load and turbidity at the reach scale. **Channel Morphology** A small change or modification in the channel planform and/or cross section. Includes upgrade to and/or extension of existing water feature crossing and/or structure with associated minor channel realignment with localised impacts. **Natural Fluvial Processes** Minimal shift away from baseline conditions with typically localised impacts up to the reach scale. **Condition Status** Minor adverse impacts at the reach scale, which may cause partial loss or damage to habitats. Impacts have the potential to cause failure or deterioration in one of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone).
	Water Quality
	Minor shift away from baseline conditions. Likely to result in a slight decline in water quality with no associated impacts on designated species/habitats or water supply, which is characterised by: • a temporary decline in water quality during construction; and/or • failure of either soluble or sediment-bound pollutants in HAWRAT during operation. Slight reduction in the water feature's capacity to dilute existing discharges under CAR. Calculated risk of pollution from a spillage >0.5% and <1% annually during operation.
Negligible	**Results in effect on attribute of the water feature, but of insufficient magnitude to affect the use or integrity**
	Hydrology and Flood Risk
	Negligible change in peak flood level for the 0.5% AEP (200-year) plus CC design flood event of up to <+/-10mm.
	Fluvial Geomorphology
	Minimal or no measurable change from baseline conditions in terms of sediment transport, channel morphology and natural fluvial processes. Any impacts are likely to be highly localised and not have an effect at the reach scale.
	Water Quality
	No perceptible changes to baseline conditions. No measureable change in water quality at any time during construction. No change in the water feature's capacity to dilute existing discharges under CAR. No risk identified by HAWRAT (Pass for both soluble and sediment-bound pollutants) during operation. Risk of pollution from a spillage <0.5% during operation.
Minor beneficial	**Results in some beneficial effect on attribute of the water feature or a reduced risk of negative effect occurring to the water feature**
	Hydrology and Flood Risk
	Reduction in peak flood level for the 0.5% AEP (200-year) plus CC design flood event > 10mm
	Fluvial Geomorphology
	Sediment Regime Partial improvement to sediment processes at the reach scale, including reduction in siltation and localised recovery of sediment transport processes. **Channel Morphology** Partial improvements include enhancements to in-channel habitat, riparian zone and morphological diversity of the bed and/or banks. **Natural Fluvial Processes** Slight improvement on baseline conditions with potential to improve flow processes at the reach scale. **Condition Status** Slight beneficial impacts at the reach scale, which may cause partial habitat enhancement. Impacts have the potential to improve one of the hydromorphological quality elements (quality and quantity of flow; river depth

Magnitude	Criteria
	and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone).
	Water Quality
	Minor improvement over baseline conditions. HAWRAT assessment of either soluble or sediment-bound pollutants becomes 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
Moderate beneficial	**Results in moderate improvement of the quality of the attribute of the water feature**
	Hydrology and Flood Risk
	Reduction in peak flood level for the 0.5% AEP (200-year) plus CC design flood event > 50mm
	Fluvial Geomorphology
	Sediment Regime Reduction in siltation and recovery of sediment transport processes at the reach or multiple reach scale. **Channel Morphology** Partial creation of both in-channel and vegetated riparian habitat. Improvement in morphological diversity of the bed and/or banks at the reach or multiple reach scale. Includes partial or complete removal of structures and/or artificial materials. **Natural Fluvial Processes** Notable improvements on baseline conditions and recovery of fluvial processes at the reach or multiple reach scale. **Condition Status** Notable beneficial impacts at the reach to multiple reach scale. Impacts have the potential to improve one or more of the hydromorphological quality elements (quality and quantity of flow; river depth and width variation; structure and substrate of the bed dynamics; river continuity; structure of the riparian zone) and/or assist in achieving the water body objectives for GES or GEP.
	Water Quality
	A moderate improvement over baseline conditions. HAWRAT assessment of both soluble and sediment-bound pollutants becomes 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).
Major beneficial	**Results in major improvement of attribute quality**
	Hydrology and Flood Risk
	Reduction in peak flood level for the 0.5% AEP (200-year) plus CC design flood event > 100mm
	Fluvial Geomorphology
	Sediment Regime Improvement to sediment processes at the catchment scale, including recovery of sediment supply and transport processes. **Channel Morphology** Extensive creation of both in-channel habitat and riparian zone. Morphological diversity of the bed and/or banks is restored, such as natural planform, varied natural cross-sectional profiles, recovery of fluvial features (e.g. cascades, pools, riffles, and bars) expected for river type. Removal of modifications, structures, and artificial materials. **Natural Fluvial Processes** Substantial improvement on baseline conditions at catchment scale. Recovery of flow and sediment regime. **Condition Status** Substantial beneficial impacts at the catchment scale, which result in recovery/restoration of natural habitats suitable for supporting sensitive species. Potential improvement of overall status condition, which could lead to achievement of water body objectives for GES or GEP.
	Water Quality
	Major improvement over baseline conditions. The removal or likelihood of removal of existing pressures, resulting in a water body achieving its objectives for GES or GEP.

Impact Significance

11.2.39 The significance of impacts (either with or without mitigation measures) was determined as a function of the sensitivity of the water feature and the magnitude of a predicted impact. The matrix for the determination of significance, provided in the DMRB HD 45/09 guidance, is shown in Table 11.7.

11.2.40 Where the matrix indicates two alternative options (e.g. Slight/Moderate), the significance rating was selected using professional judgement, in accordance with the DMRB HD45/09 guidance. The selection of a higher significance is chosen where a greater number of high risk activities are proposed, or where the impact on one attribute is intrinsically linked to another attribute (e.g. water quality and biodiversity) that has a higher sensitivity.

Table 11.7: Matrix for determination of significance

Magnitude / Sensitivity	Negligible	Minor	Moderate	Major
Very High	Neutral	**Moderate/Large**	**Large/Very Large**	**Very Large**
High	Neutral	Slight/**Moderate**	**Moderate/Large**	**Large/Very Large**
Medium	Neutral	Slight	**Moderate**	**Large**
Low	Neutral	Neutral	Slight	Slight/**Moderate**

11.2.41 For the purposes of this assessment, impact significance of 'Moderate' or higher is considered significant in the context of the EIA Regulations and, therefore, is the focus for mitigation where practicable. However, it should be noted that for flood risk in particular (guided by discussions with SEPA and to ensure consistency with SPP (Scottish Government, 2014) on flood risk), the aim has been to avoid any increased flood risk where feasible as part of DMRB Stage 3 design development. This avoidance of any increased flood risk is therefore considered irrespective of the significance classification as set out in this chapter.

11.2.42 Only those water features considered to potentially be significantly impacted (i.e. impacts of Moderate or greater significance) are presented within Section 11.4 (Potential Impacts). Appendix A11.7 (Impact Significance) provides the full assessment of water features within the study area (excluding those which are scoped out of the impact assessment, see Table 11.11).

Specific Methodologies

11.2.43 Throughout the DMRB Stage 3 assessments, there was regular discussion with members of the Environmental Steering Group (ESG) regarding the development of the proposed scheme design as well as the environmental assessment methods, with reference to the SEA (Transport Scotland, 2013) for the wider A9 dualling programme.

Hydrology and Flood Risk

11.2.44 A flood risk assessment was undertaken following SEPA's Technical Flood Risk Guidance for Stakeholders (SEPA, 2015b), and giving consideration to the guidance within DMRB HD45/09. Numerical hydraulic modelling was undertaken of the existing flood risk from the River Tummel, where the risk of flooding has the potential to be medium/high, and hydraulic spreadsheet calculations undertaken of the existing flood risk from smaller watercourses.

11.2.45 Full detailed methodologies are provided in Appendix A11.2 (Surface Water Hydrology), Appendix A11.3 (Flood Risk Assessment) and Appendix A11.4 (Hydraulic Modelling Report).

Fluvial Geomorphology

11.2.46 As part of the assessment for the proposed scheme, an assessment of potential impacts on the fluvial geomorphology of the water features affected by the proposed scheme was carried out in line with the Supporting Guidance (WAT-SG-21): Environmental Standards for River Morphology (SEPA, 2012a).

11.2.47 A baseline assessment of existing areas at risk of erosion along the River Tummel was also undertaken to inform the sensitivity ratings. These included locations where the existing A9 infrastructure is currently at risk or the proposed scheme could be at risk from fluvial erosion in the future. Results of the erosion risk assessment are included in Appendix A11.1 (Baseline Conditions) with further details provided in Appendix A11.5 (Fluvial Geomorphology).

11.2.48 An additional geomorphological assessment was undertaken for the Habitat Regulations Appraisal (HRA), focussing on potential impacts on the existing condition of SAC habitats and species. Further details on the methodology and results of the assessment are provided in Appendix A11.5 (Fluvial Geomorphology).

Water Quality

11.2.49 Specific water quality assessments were carried out to assess the impacts on the water environment from the operation of the proposed scheme.

Highways Agency Water Risk Assessment Tool (HAWRAT)

11.2.50 The assessment of operational impacts relating to routine runoff and spillage risk was carried out in line with the methods contained in DMRB HD45/09 (Method A and Method D, respectively). The assessment of the magnitude and significance of operational impacts has taken into account the nature of the water features proposed to receive road drainage and the dilution or dispersal potential of the water features.

11.2.51 A summary of Methods A and D of DMRB HD45/09 is provided in Appendix A11.6 (Water Quality).

Salt

11.2.52 The DMRB does not provide a method for assessing the potential impacts of salt on the surface water environment. However, SNH and the Spey Fisheries Board (refer to Table 11.3) recommended consideration as part of this assessment.

11.2.53 In the absence of an existing method for assessing salt concentrations in runoff and at the point of dilution, a simple and conservative risk-based model was developed that generally follows the approach taken by the HAWRAT method.

11.2.54 Full details of the salt assessment methodology, results and limitations are provided in Appendix A11.6 (Water Quality). As this approach is not a standardised assessment method, it is not considered appropriate to incorporate the salt assessment into the assessment of impact magnitude and significance, therefore it is not discussed further within this chapter.

Access Tracks (Tier 3 Accesses)

11.2.55 Tier 3 accesses are private and/or agricultural accesses which are included as part of the proposed scheme. These access tracks would experience low traffic volumes with an annual average daily traffic (AADT) of <100 vehicles per day (vpd) and in some instances <10vpd.

11.2.56 The 'Simple Index Approach' (SIA) presented in 'The SuDS Manual' (Construction Industry Research and Information Association (CIRIA), 2015b) was used to assess the impacts of runoff from these access tracks. Full details of these assessments are provided in Appendix A11.6 (Water Quality). The SIA assessments do not form part of the DMRB methodology and therefore are not discussed further within this chapter.

Limitations to Stage 3 Assessment

11.2.57 Baseline conditions described in Appendix A11.1 (Baseline Conditions) were informed by site walkover observations with surveys of water features made at specific times and water levels. However, it is recognised that seasonal variables (such as flow levels, vegetation growth and land use) can affect the visibility of in-channel features; as well as the overall morphology and fluvial processes observed at the time of survey, representing a limitation in recorded data sets, common to all aquatic field studies. In addition, some of the data received during consultation may have been updated since the time of writing of this chapter.

Hydrology and Flood Risk

11.2.58 Flood risk related to groundwater sources has not been specifically addressed within this chapter; it is considered in Appendix A11.3 (Flood Risk Assessment), and consideration of potential impacts on flood

risk in relation to artesian conditions is reported in Chapter 10 (Geology, Soils, Contaminated Land and Groundwater). In addition, flood risk related to the failure of water-retaining infrastructure is reported in Appendix A11.3 (Flood Risk Assessment).

11.2.59 Limitations relating to the flow estimation methods, flood risk assessment and hydraulic modelling are also provided in Appendix A11.2 (Surface Water Hydrology), Appendix A11.3 (Flood Risk Assessment) and Appendix A11.4 (Hydraulic Modelling Report) respectively.

Fluvial Geomorphology

11.2.60 Many watercourses were observed in the field at one point in time, therefore the predominant sediment regime and processes operating within the channel were inferred using best available site data and desk-based information. Measurements taken during initial geomorphological surveys were visual estimates only. Where geomorphological issues were identified, further investigations to inform the design process made use of detailed topographic survey data.

11.2.61 Further limitations relating to the surveys and assessments undertaken for fluvial geomorphology are provided in Appendix A11.5 (Fluvial Geomorphology).

Water Quality

11.2.62 The identification of private water supplies (PWS) was based on the information obtained through desk studies, consultation with local authorities and SEPA as well as site visits (refer to Chapter 10: Geology, Soils, Contaminated Land and Groundwater). Reasonable skill, care and diligence were exercised in identifying PWS; however, notwithstanding this, there may remain PWS which have not been identified, or PWS which may not be correctly characterised, due to erroneous or out of date information provided during consultation.

11.2.63 Limitations relating to the water quality assessments undertaken are provided in Appendix A11.6 (Water Quality).

11.3 Baseline Conditions

Water Features

11.3.1 A detailed description of all water features potentially affected by the proposed scheme is provided within Appendix A11.1 (Baseline Conditions). This includes the baseline conditions for all water environment attributes covered within this chapter, namely: Hydrology and Flood Risk, Fluvial Geomorphology and Water Quality (Water Supply, Dilution and Biodiversity). As part of the baseline assessment for all water features, a sensitivity rating was determined for each water environment attribute, and this is included within the appendix. Where more information is required, for example in relation to increased sensitivity levels, this is located within the relevant technical appendix and a cross-reference provided.

11.3.2 Within the 500m study area, 28 water features were initially identified, including artificial drainage channels, lochs, minor watercourses and larger river systems. As explained in paragraph 11.2.18 the water features within the Pitlochry to Killiecrankie (Project 04) section are numbered from WF57 (Altrory Burn) to WF100. The locations of the water features, with corresponding identification references, proposed scheme crossing locations and flood inundation extents are shown on Figures 11.1 and 11.2.

11.3.3 During the assessment process, a number of the 28 initially identified water features within the 500m study area were screened out of assessment for some or all attributes, as they were assessed as being unlikely to be affected by the construction or operation of the proposed scheme due to factors such as feature location, routing or type of feature. The baseline conditions of all water features are summarised in the following paragraphs, and those screened out of the impact assessment are confirmed at the end of this section (refer to Table 11.12).

11.3.4 The baseline assessment includes consideration of river typology as defined within the Environmental Standards for River Morphology (SEPA, 2012a). The different types and definitions of water features identified within the study area are described below in Table 11.8 and an example photograph of each

has also been included. Details of the baseline conditions for all water features are provided in Appendix A11.1 (Baseline Conditions).

Table 11.8: Types and definitions of water features within the study area

Water Feature Type	Definition	Example within the Study Area	
Major watercourse	Natural river channel Width typically >10m	**Photograph 11.1** River Tummel (WF70) – view upstream at the Tummel crossing.	
Medium watercourse	Natural river Width typically 2-10m	**Photograph 11.2** Allt Bhaic (WF115) - View downstream towards existing A9 bridge crossing (note example from A9 Dualling: Killiecrankie to Glen Garry scheme).	
Minor watercourse	Natural or modified watercourse Width typically 1-2m	**Photograph 11.3** WF64 – view upstream from A9 culvert.	

Water Feature Type	Definition	Example within the Study Area	
Drainage channel	Artificial field, forest or road drainage channel Width <2m	**Photograph 11.4** WF58 – view downstream of A9 carriageway and Highland Mainline railway.	
Loch	Natural body of inland surface water	**Photograph 11.5** Loch Faskally (WF75) – view from bridge crossing.	
Artificial pond	Man-made body of inland surface water	**Photograph 11.6** WF72 - view across pond towards B8019.	

SEPA Flow Monitored Surface Water Features

11.3.5 The majority of water features within the study area are not monitored by SEPA. Only three of the larger water features are currently monitored, comprising:

- River Tummel (Loch Faskally to River Tay) (WF70);
- Loch Faskally (WF75); and
- River Garry (Errochty Water Confluence to Loch Faskally) (WF100).

Licenced Abstractions and Discharges

11.3.6 As advised by SEPA (consultation response received 26 April 2016), there are discharges, abstractions and impoundments licenced under CAR within the study area. Licenced discharges are detailed in Table 11.9. The locations of the licensed activities are further detailed in Appendix A11.1 (Baseline Conditions).

Table 11.9: Licenced activities (abstractions, discharges and impoundments)

Water Feature	Total Number Licenced Activities	Licenced Activity (No.)
WF57 (Altrory Burn)	5	Private septic tank effluent (5)
WF59	3	Private septic tank effluent (2)
		Sewage treatment final effluent (1)
WF60	2	Private septic tank effluent (1)
		Sewage treatment final effluent (1)
WF61	4	Septic tank effluent (2)
		Sewage treatment final effluent (2)
WF66	1	Sewage treatment final effluent (1)
WF70 (River Tummel)	15	Sewage discharge overflows (8)
		Sewage treatment final effluent (2)
		Private septic tank effluent (1)
		Impoundment (1)
		Recharge (1)
		Privately owned abstraction for Blair Athol Distillery (1)
		Trade effluent discharge for Blair Athol Distillery (1)
WF73	3	Private septic tank effluent (2)
		Impoundment (1)
WF75 (Loch Faskally)	10	Private septic tank effluent (4)
		Sewage discharge overflow (4)
		Sewage treatment final effluent (2)
WF77	2	Sewage tank effluent discharge (2)
WF184 (Moulin Burn)	2	Sewage discharge overflows (2)

Water Supply

11.3.7 A number of private water supply (PWS) abstractions from surface waters were identified within the 500m study area, as detailed in Table 11.10 and shown on Figure 11.1. Chapter 10 (Geology, Soils, Contaminated Land and Groundwater) provides a full list of PWS, including those from springs and groundwater sources, within 850m of the proposed scheme.

Table 11.10: PWS abstractions from surface water features within the study area

Water Feature	PWS Reference	Source of Information	Property	Status	Comments
WF64	PK-PWS04	Landowner consultation questionnaire & Local Authority	Littleton of Fonab Easter Ballinluig Wester Ballinluig Milton of Fonab	Active	Landowner consultation suggests a domestic supply that serves four properties and an agricultural use. Sourced from WF64 via gravity fed underground pipes.
	PK-PWS10	Tenant consultation questionnaire	Ballintuim Farm	Active	Landowner consultation suggests a domestic supply that serves one property via gravity fed underground pipes from a surface water spring.

Water Feature	PWS Reference	Source of Information	Property	Status	Comments
					Water level fluctuates and water quality shows high levels of lead.
WF66	PK-PWS12	Local Authority, Landowner	Overton of Fonab	Active	The water supply for Overton of Fonab is supplied watercourse WF66. It only supplies this property.
WF76 (Allt an Aghastair)	PK-PWS06	Landowner consultation	Tigh-na-Beithe	Abandoned/ Not active	Landowner consultation suggests a domestic supply that serves one property. Property is to be demolished prior to construction therefore considered as an abandoned supply.

11.3.8 The River Tay is a designated Drinking Water Protected Area (DWPA) under The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2007 (Scottish Government, 2007). There is a Scottish Water abstraction from the River Tay at Perth; however, this is at a considerable distance downstream of the proposed scheme (~50km) and is therefore not considered further in this assessment.

Existing Road Drainage Network

11.3.9 Road drainage treatment on the existing A9 between Pitlochry and Killiecrankie is generally limited, consisting predominantly of kerbs and gullies which discharge untreated road runoff to the nearest watercourse. There are some limited sections of filter drains within the roadside verges, which will provide an initial level of treatment for road runoff.

Existing Flood Risk

11.3.10 The characterisation of baseline flood risk is described in detail in Appendix A11.3 (Flood Risk Assessment). This includes an assessment of existing flood risk from fluvial sources, surface water (pluvial) sources, groundwater, sewers and failure of water-retaining infrastructure. Fluvial and surface water flood risk is of particular relevance for this flood risk assessment.

11.3.11 A summary of existing fluvial and surface water (pluvial) flood risk from Appendix A11.3 (Flood Risk Assessment) is provided below.

Fluvial Flood Risk

11.3.12 Existing fluvial flood risk was separated into flood risk from principal watercourses (medium/major watercourses) and flood risk from minor watercourses (including drainage channels).

Principal Watercourses

11.3.13 The SEPA Flood Maps indicate the majority of the study area between Pitlochry and Killiecrankie is currently located outside the SEPA Flood Map 0.5% AEP (200-year) flood extent. The exceptions to this occur where sections of the existing A9 transverse the floodplain of the River Tummel at the Tummel Crossing and where the existing A9 crosses Loch Faskally at the Clunie Underbridge, as shown in Figure 11.2.

11.3.14 There are no records of historical flooding impacting the existing A9 between Pitlochry and Killiecrankie. During 1993, flooding from the River Tummel affected Bridge Road, Duke of Edinburgh Drive and Fonab Crescent, which are located within Pitlochry.

11.3.15 Within the study area there are two principal watercourses; the River Tummel and the River Garry. The River Garry and associated floodplain does not impact on the existing A9. The River Tummel was identified as having the greatest potential to cause flooding to the existing A9, principally at the location of the Tummel Crossing, and consequently was subject to numerical hydraulic modelling to determine flood mechanisms.

11.3.16 The numerical hydraulic model for the River Tummel extends from 450m downstream of Pitlochry Dam, to Tomdachoille, comprising a 3.5km long reach of the River Tummel. The baseline flood extent, from the 0.5% AEP (200-year) plus CC flood event on the River Tummel, is presented in Figure 11.2, and is summarised below.

11.3.17 During the 0.5% AEP (200-year) plus CC event the River Tummel is predicted to overtop both the left and right banks upstream and downstream of the Aldour Bridge, flooding residential properties on Fonab Crescent and Aldour Gardens, a waste water treatment works, the A924 and a caravan park.

11.3.18 The River Tummel is also predicted to overtop on the left bank upstream of Tummel Crossing, across the A924 and the junction with General Wade's Military Road, with depths of up to 2.8m during the design event. A railway underpass near Donavourd Lodge conveys the design flood event flows under the Highland Mainline railway, which would subsequently impact properties and access roads at Dalshian. The potential flooding at this location is further compounded by backflow and surcharging from the undersized culverts on WF59, WF60 and WF61.

11.3.19 On the right bank, upstream of the Tummel Crossing, during the 0.5% AEP (200-year) plus CC event, floodwaters would also extend across the rural area between the River Tummel and Foss Road, reaching depths in excess of 2.5m.

Lochs

11.3.20 Loch Faskally is located upstream of the River Tummel and downstream of the River Garry and crosses the existing A9 at the Clunie Bridge. Loch Faskally is considered to pose a low flood risk as it is maintained under the Reservoirs (Scotland) Act 2011 and has therefore not been subject to numerical hydraulic modelling. The drainage channel WF73 discharges into Loch Dunmore (situated between the proposed scheme and Loch Faskally), and due to the scale of both water features, these were assessed together as a minor watercourse.

Minor Watercourses

11.3.21 Between Pitlochry and Killiecrankie, there are 19 minor watercourses within the study area, which drain the adjacent hillside towards the River Tummel, Loch Faskally and the River Garry. These are typically unnamed watercourses, confined to narrow, often deep channels with relatively small catchment areas (typically < 1km^2) and steep gradients.

11.3.22 There are 15 minor watercourses out of the 19 identified which flow underneath the existing A9, through circular culverts ranging in diameter from 0.3m to 1.8m. Six existing watercourse crossings (40%) are shown to have adequate capacity to pass the peak 0.5% AEP (200-year) plus CC event including a 600mm culvert freeboard. Freeboard is an additional allowance in flood design to account for uncertainties in the methods and physical imponderables such as wave action. Nine watercourse crossings (60%) have been identified to be under capacity; these include WF71, WF74, WF76, WF59, WF60, WF61, WF63, WF64 and WF65.

11.3.23 The remaining four minor watercourses within the study area were not subject to a culvert capacity assessment either because the watercourse is already within a dualled section of the existing A9 or because the proposed scheme will not cross the minor watercourse.

Surface Water (Pluvial) Flood Risk

11.3.24 The existing A9 follows the steep sided valley of the River Tummel, Loch Faskally and the River Garry. The underlying low permeability geology and steep hillsides are likely to generate significant volumes of runoff during a high intensity rainfall event that would flow towards the existing A9. Surface water runoff combined with localised depressions in the topography may result in the 'ponding' of surface water.

11.3.25 The majority of the existing A9 sits on a raised embankment, which reduces the risk of the road becoming flooded by surface water. The SEPA Flood Map (SEPA, 2014) indicates that for the 10% AEP (10-year) event there is a risk of surface water flooding at five isolated locations between ch0-ch350, ch4800-ch4900, ch5000-ch5100, ch6100-ch6200 and ch6300-ch6400. However, the modelling on

which the SEPA surface water flood mapping is based upon does not take into account the road drainage system installed to intercept runoff upslope of the existing A9.

Erosion Risk

11.3.26 As part of the geomorphological baseline investigations, an initial assessment of erosion risk along the River Tummel (WF70) identified two sites where either the existing A9 or the proposed scheme may be at risk from fluvial erosion. Both sites were located at ch900-1000 within the vicinity of the existing bridge over the River Tummel (Figure 11.1). Further investigation, coupled with design development, resulted in the erosion risk sites being scoped out of further assessment. Further information is provided in Appendix A11.5 (Fluvial Geomorphology).

Baseline Sensitivity Summary

11.3.27 Table 11.11 provides a summary of the baseline classification for hydrology and flood risk, fluvial geomorphology and water quality attributes for all water features within the study area, in addition to surface water features that were scoped out of the impact assessment. Water features are generally scoped out on the basis that no pathway was identified by which the proposed scheme could impact them.

11.3.28 A full description of the baseline conditions for all water features is provided in Appendix A11.1 (Baseline Conditions).

11.3.29 Water Quality is considered in terms of four sub-attributes: ‘Quality’, ‘Water Supply’, ‘Dilution and Removal of Waste Products’, and ‘Biodiversity’. Water supply is only relevant for where a PWS or public water supply abstraction is identified.

Table 11.11: Summary of water feature sensitivity

Water Feature ID	Water Feature Type	Sensitivity						Initial Screening
		Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality				
				Quality	Water Supply	Dilution and Removal of Waste Products	Biodiversity	
WF57 (Altrory Burn)	Minor watercourse	high	low	low	N/A	low	low	Scoped out for hydrology and flood risk
WF58	Drainage channel	medium	low	low	N/A	low	low	Scoped out for hydrology and flood risk
WF59	Minor watercourse	very high	low	medium	N/A	low	medium	
WF60	Minor watercourse	very high	medium	medium	N/A	low	medium	
WF61	Drainage channel	very high	low	low	N/A	low	low	
WF63	Drainage channel	medium	low	low	N/A	low	low	
WF191	Drainage channel	low	low	low	N/A	low	low	
WF180 (Edradour Burn)	Medium watercourse	low	high	very high	N/A	high	very high	Scoped out for all attributes as does not cross A9
WF64	Minor watercourse	high	medium	medium	high	low	medium	
WF181 (Kinnaird Burn)	Medium watercourse	low	medium	medium	medium	high	medium	Scoped out for all attributes as does not cross A9
WF182	Minor watercourse	low	low	medium	N/A	high	medium	Scoped out for all attributes as does not cross A9
WF183	Minor watercourse	low	low	medium	N/A	low	low	Scoped out for all attributes as does not cross A9
WF65	Minor watercourse	high	medium	medium	N/A	low	low	
WF184 (Moulin Burn)	Medium watercourse	high	medium	medium	N/A	medium	low	Scoped out for all attributes
WF66	Minor watercourse	low	medium	medium	N/A	low	medium	
WF67	Drainage channel	low	low	low	N/A	low	low	
WF68	Minor watercourse	low	high	medium	N/A	low	medium	
WF69	Minor watercourse	low	medium	medium	N/A	low	medium	
WF71	Drainage channel	low	low	low	N/A	low	low	
WF72	Pond and feeder channel	low	low	low	N/A	low	low	Scoped out for fluvial geomorphology

Water Feature ID	Water Feature Type	Sensitivity						Initial Screening
		Hydrology and Flood Risk	Fluvial Geomorphology	Water Quality				
				Quality	Water Supply	Dilution and Removal of Waste Products	Biodiversity	
WF73 (including Loch Dunmore)	Drainage channels and loch	low	low	medium	N/A	low	medium	Scoped out for fluvial geomorphology
WF74	Minor watercourse	low	medium	medium	N/A	low	medium	
WF76 (Allt an Aghastair)	Minor watercourse	very high	medium	medium	low	low	medium	
WF77	Minor watercourse	low	low	medium	N/A	low	low	
WF78	Minor watercourse	low	low	medium	N/A	low	medium	
WF70 River Tummel: Loch Faskally to River Tay	Major watercourse	very high	high	high	high	medium	very high	
WF75 Loch Faskally	Loch	very high	medium	very high	N/A	medium	very high	
WF100 River Garry: Errochty Water Confluence to Loch Faskally	Major watercourse	very high	high	very high	N/A	low	very high	

11.4 Potential Impacts

Introduction

11.4.1 This section describes the assessment of potential impacts, on the surface water environment, of the proposed scheme (as described in Chapter 5: The Proposed Scheme), in the absence of mitigation measures (i.e. those not already embedded within the proposed scheme designs).

11.4.2 Associated potential impacts affecting groundwater and ecological receptors are addressed in Chapter 10 (Geology, Soils, Contaminated Land and Groundwater) and Chapter 12 (Ecology and Nature Conservation) respectively.

11.4.3 Potential impacts on the surface water environment arising from the construction and operational phases of the proposed scheme are assessed separately for each of the hydrology and flood risk, fluvial geomorphology and water quality attributes.

11.4.4 For all surface water environment attributes, a set of potential general and specific potential impacts associated with each of the construction and operational phases of activity is identified. All potential impacts reported are adverse, unless otherwise stated.

Construction

11.4.5 A summary of typical construction activities associated with the proposed scheme that are likely to occur in close proximity, over or within surface water features, is provided in Table 11.12. Further detail on proposed construction activities is provided in Appendix 11.8 (Watercourse Crossings Report) and Appendix 11.7 (Impact Assessment).

Table 11.12: Summary of construction activities within, near or close to water features

Location of Activity	Infrastructure to be Constructed	No. of Water Features Potentially Impacted
Within 50m of water feature	Mainline widening	17
	Proposed SuDS basins	5
	New side road/tier 3 access	15
	Other infrastructure (including retaining wall)	11
Over water feature	New bridge	3
Within water feature	New culverts	6
	Culvert extensions	8
	Channel realignments	3
	New outfalls	7
	Temporary support system for bridge construction	1

Construction – General Impacts

11.4.6 This section presents an overview of the potential general impacts that could occur during construction in the absence of mitigation.

11.4.7 Potential impacts arising from construction activities are typically considered to be short term, although in some cases they can have longer term effects. For instance, short term, acute impacts on water quality could have longer term chronic effects on aquatic ecology.

11.4.8 Table 11.13 outlines potential general impacts on the surface water environment during the construction of the proposed scheme.

Table 11.13: Potential general construction impacts

Type of Impact	Potential General Impacts from Construction Activities
Hydrology and Flood Risk	
Changes to runoff rates and flow characteristics	• Increased runoff and/or reduced infiltration rates from soil compaction due to construction traffic and the presence of temporary haul routes in the area of the proposed scheme. • Changes to flow characteristics due to disturbance or unintentional changes to channel dimensions and/or sedimentation etc. associated with works which may impact on the hydraulic flow characteristics of a water feature. • Disruption or blockage of existing natural flow paths due to temporary channel diversions and other associated temporary works, coffer dams etc. to facilitate culvert or bridge construction. • Increases peak flow rates going into water feature(s) due to temporary construction works for SuDS within catchments. • Local lowering of groundwater and/or barriers to groundwater flow due to dewatering of excavations or temporary works for excavations requiring groundwater cut-offs. • Flash flooding of works during rapid runoff (pluvial) events potentially leading to major hazards, in particular if there are haul routes upstream of steep slopes where the proposed scheme is in cutting.
Increase in flood risk	• Increased flood risk due to temporary channel diversions to facilitate culvert or bridge construction; any associated temporary works and/or re-direction of flow through constructed realignments or into pre-earthwork ditches with a lower conveyance. • Reduced flood storage capacity due to temporary loss of floodplain area or compartmentalisation of the floodplain. • Reduced natural floodplain conveyance due to construction materials and plant within the floodplain; haul route construction or other temporary works related to carriageway widening and other activities in the floodplain. • Reduced watercourse conveyance capacity due to under-sized culverts or sediment/blockage e.g.at temporary haul route crossings and under the existing A9. • Increased risk of flooding from exposed sewers and water mains that may also result in a pollution incident due to the increased potential for service strikes. • Increased risk of flooding of working areas, potentially damaging plant and materials and/or leading to pollution incidents.
Fluvial Geomorphology	
Changes to sediment regime	• Release of suspended solids from: exposed bare earth surfaces; due to in-channel working for culvert and outfall installation and channel realignment construction; construction of clear-span bridges; vegetation clearance (likely to be greater in winter months). • Increased sediment supply from accidental damage to river banks or bed resulting from vegetation clearance, plant movement or other construction activities. • Increased sediment delivery and transport due to temporary earthworks being washed away.
Changes in channel morphology	• A reduction in diversity of the channel bed due to increased fine sediment supply from bare earth surfaces, in-channel construction of structures and vegetation clearance. • Loss of active features such as exposed gravel deposits due to smothering by fine sediment. • Loss or disturbance of channel bed in the vicinity of culvert installation and outfall construction or where channels are realigned. • Reduced morphological diversity due to vegetation clearance, loss of tree roots and/or woody material. (Woody material within the channel may encourage the formation of different geomorphological features such as riffles, deposits and pools.) • In-channel adjustments, through erosion and deposition, due to alterations to cross-section and planform. • Increase in channel erosion as water is released down realigned channels, particularly if the channel is straightened and gradient increased. • Reduced bank stability during the construction of crossings, channel diversions/realignments or other works requiring vegetation clearance of the banks of the water features. This could result in increased bank erosion and associated sediment release.
Changes to natural fluvial processes	• Increased bare earth surfaces and changes to flow pathways could result in alterations to the quantity of flow entering the channel with potential to locally alter flow processes. This could lead to changes in erosion and deposition and sediment processes. • Alteration to fluvial processes and associated erosion and deposition regimes within a channel due to changes to the quantity of flow. • Channel instability may be triggered by straightening, particularly during high flows. • Changes in lateral (floodplain) connectivity as a result of works within the channel and the surrounding floodplain.
Water Quality	
Decline in water quality or supply	• An increase in suspended sediment concentrations in downstream water features from construction of crossing structures in-channel or on watercourse banks, soil stripping and

Type of Impact	Potential General Impacts from Construction Activities
	vegetation removal, soil storage, erosion of drainage ditches and all other earthworks which could result in the mobilisation of sediment. This would form silt-laden runoff which could migrate to downstream water features if insufficient treatment is provided. • Accidental release of oils, fuels and chemicals to the water environment from mobile or stationary plant in or near to water features, and from inappropriate refuelling and fuel storage practices. This could include an increase in alkalinity from poor management and spillages of concrete or cement. • Inputs of contaminants to the water environment could occur from disturbance of potentially contaminated land with potential drainage pathways to surface water features. Contaminated particles within suspended sediment may increase the bio-toxicity of in-channel sediment deposits. • Sewage inputs to the water environment from accidental/uncontrolled release from sewers through damage to pipelines during service diversion or unsatisfactory disposal of sewage from site staff facilities. • Pollution of a viable water resource through construction activities taking place upstream of a public or private water supply surface water abstraction. • Severance of a public or private water supply due to disruption of pipelines and other buried assets present along the existing A9 corridor.
Reduction in dilution capacity	• A reduction in the dilution capacity of a watercourse due to the decline in water quality (as described above) or diversion of sub-catchment flows.
Adverse impacts on biodiversity	• A decline in river ecosystem health and loss of protected aquatic species due to the decline in water quality (as described above). • Excess sediment settling out in sensitive stretches of a watercourse with the potential to smother gravels used for salmonid spawning and hatching. • Excess sediment affecting the health of aquatic fauna by interfering with respiration and increasing stress levels. • Releases of chemicals and concrete which can have severe or fatal consequences on freshwater ecology.

Construction – Specific Impacts

11.4.9 This section provides the results of an assessment of the significance of potential impacts likely to occur during construction, that are specific to individual water features within the study area and in the absence of mitigation measures. The assessment is based on key construction works proposed either within or near to each water feature.

11.4.10 Table 11.14 below summarises the potential impacts of Moderate significance or above for hydrology and flood risk, fluvial geomorphology and water quality (all attributes). Full details are provided within Appendix A11.7 (Impact Assessment).

Table 11.14: Potential specific impacts water features – construction

Water Feature	Attribute	Description of Specific Construction Impacts on Water Feature	Sensitivity	Magnitude	Significance
WF59	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates. Construction of replacement culvert/channel realignment may cause restriction of flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage.	very high	moderate	**Large**
WF60	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of replacement culvert/channel realignment may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage.	very high	moderate	**Large**
WF61	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of replacement culvert/channel realignment may cause restriction in flood flows, temporarily	very high	moderate	**Large**

Water Feature	Attribute	Description of Specific Construction Impacts on Water Feature	Sensitivity	Magnitude	Significance
		increasing flood risk locally, and construction works may be at risk from flood damage.			
WF63	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of replacement culvert/channel realignment may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage.	medium	moderate	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	low	major	**Moderate**
	Biodiversity		low	major	**Moderate**
WF64	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of culvert extension/channel realignment may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage.	high	moderate	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	moderate	**Moderate**
	Biodiversity		medium	moderate	**Moderate**
	Water Supply	Disruption, pollution or severance of PK-PWS04 serving Littleton of Fonab, Easter Ballinluig, Wester Ballinluig and Milton of Fonab through disruption to PWS pipework underlying the existing A9.	high	major	**Very Large**
WF65	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of replacement culvert may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage. Excavation for the Rob Roy Way Underpass may be subject to pluvial (surface water) flooding and fluvial flooding (from existing culvert surcharging).	high	moderate	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	major	**Large**
	Biodiversity		low	major	**Moderate**
WF66	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	major	**Large**
	Biodiversity		medium	major	**Large**
WF68	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	moderate	**Moderate**
	Biodiversity		medium	moderate	**Moderate**
WF69	Fluvial Geo-morphology	Increase in fine sediment delivery due to runoff from bare earth surfaces, in-channel works and extensive earthworks to fill in water feature gorge. Potential for sediment to be transferred to Loch Faskally.	medium	moderate	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	major	**Large**
	Biodiversity		medium	major	**Large**
WF71	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	low	major	**Moderate**
	Biodiversity		low	major	**Moderate**
WF74	Fluvial Geo-morphology	Temporary increase in fine sediment delivery due to runoff from bare earth surfaces and extensive in-channel works disturbing channel	medium	moderate	**Moderate**

Water Feature	Attribute	Description of Specific Construction Impacts on Water Feature	Sensitivity	Magnitude	Significance
		bed and banks. Diversion/damming of flow during in-channel works to enable construction of culvert.			
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	major	**Large**
	Biodiversity		medium	major	**Large**
WF76 Allt an Aghastair	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of culvert/channel realignment may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage.	very high	moderate	**Large**
	Fluvial Geo-morphology	Temporary increase in fine sediment delivery due to runoff from bare earth surfaces and extensive in-channel works disturbing channel bed and banks. Diversion/damming of flow during in-channel works to enable construction of culvert.	medium	moderate	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	medium	major	**Large**
	Biodiversity		medium	major	**Large**
WF77	Water Quality	Decline in water quality from the generation of fine sediment-laden runoff and chemical pollution.	medium	moderate	**Moderate**
WF70 River Tummel	Hydrology and Flood Risk	The proposed construction method for the Tummel Crossing would require support systems which would be located within the main channel of the River Tummel, but would be positioned within the terrestrial (high-flow) area of the River Tummel. Construction of the Tummel Crossing (including temporary support systems in-channel) may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage. There is a potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse.	very high	moderate	**Large**
	Fluvial Geo-morphology	The construction methods for the Tummel Crossing would likely require support systems which would be located within the terrestrial (high-flow) area of the River Tummel. This activity would lead to the removal of natural bed and banks to accommodate the temporary structure, as well as a depositional feature on the right bank. There is the potential for scour around the temporary structure during high flow or flood events leading to loss of natural bed, fine sediment delivery and smothering of downstream bed substrate. Due to removal of natural features, there is potential for the movement of coarse material downstream. Works in the terrestrial channel may require a dry working area during higher flows leading to some form of dam being put in place within the channel, further disturbing the channel bed. A loss of riparian vegetation could also occur for access to the channel, further destabilising the channel bed. Due to the temporary supports potentially being in place for an extended period of time (i.e. over a year), there could also be potential	high	moderate	**Moderate**

Water Feature	Attribute	Description of Specific Construction Impacts on Water Feature	Sensitivity	Magnitude	Significance
		impacts arising from removal of the structures, with destabilisation of any channel adjustment or features that develop.			
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	high	major	**Very Large**
	Biodiversity		very high	major	**Very Large**
WF75 Loch Faskally	Hydrology and Flood Risk	Potential for increase in hardstanding area and/or soil compaction during construction resulting in temporary increases in runoff rates into the watercourse. Construction of bridge may cause restriction in flood flows, temporarily increasing flood risk locally, and construction works may be at risk from flood damage. Temporary loss of floodplain area.	very high	minor	**Moderate**
	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	very high	major	**Very Large**
	Biodiversity		very high	major	**Very Large**
WF100 River Garry	Water Quality	Decline in water quality and adverse impacts on biodiversity from the generation of fine sediment-laden runoff and chemical pollution.	very high	moderate	**Large**
	Biodiversity		very high	moderate	**Large**

Operation

Operation – General Impacts

11.4.11 This section describes the general potential impacts on the surface water environment likely to occur during operation, in the absence of mitigation measures. Operational impacts are generally longer-term or permanent effects that would influence the water environment after the proposed scheme is constructed.

11.4.12 These potential impacts are described in Table 11.15 in terms of hydrology and flood risk, fluvial geomorphology and water quality.

Table 11.15: Potential general operational impacts

Type of Impact	Potential General Operational Impacts
Hydrology and Flood risk	
Changes to runoff rates and flow characteristics	• Introduction of new impermeable areas (e.g. due to widening of the carriageway) within surface water catchments could potentially increase the volume and peak flow of surface runoff reaching water features and could therefore contribute to an increased flood risk. The proposed scheme may also act as a barrier to water movement within existing catchments, increasing flooding upstream. • Alteration of the physical flow and water level regimes from crossings including new culverts/bridges or the modifications to existing culverts/bridges. • Channel realignments could potentially change the discharge regime of water features. • Operation of integrated SuDS features could slow the movement of water and increase infiltration locally. • Potential changes to flow regimes as a result of flows from one catchment being discharged to another via the proposed scheme's drainage system, could potentially increase or decrease flood risk depending on the specific location.
Changes in flood risk	• Changes in flow regimes could potentially increase or decrease flood risk depending on the specific location. • Operation of, culverts (or bridges) can affect flow carrying capacity of a water feature/channel. Imposing a constriction would potentially result in higher flood levels upstream. Conversely, increasing the size of a culvert could increase the flood risk downstream if, previously, the culvert restricted flow, effectively making it a flood retention structure. Earthworks partially spanning a floodplain can cause a constraint in the movement of flood waters along the floodplain and result in an increased flood risk either upstream or downstream.
Fluvial Geomorphology	
Changes to sediment regime	• Potential for changed sediment processes due to increased runoff from impervious surfaces, areas of erosion, new structures (such as culverts, outfalls) and channel realignments. Increased flow velocities and decreased roughness from culverts would further alter the sediment processes.

Type of Impact	Potential General Operational Impacts
	• Additional sediment supply from potentially eroding banks and bed, e.g. scour at culvert outlets caused by new structures (including culverts and outfalls). • Deposition within culverts during low flows. • Increased discharge into the channel has the potential to locally alter sediment regime (e.g. increased flow velocity could remove a layer of fine sediment from the channel substrate). • Realignment of a water feature would have potential to either reduce or increase the length of a channel, directly altering the gradient and changing sediment processes. Realignment could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes.
Changes in channel morphology	• Increased runoff from drainage could potentially cause increase in erosion downstream on water features. • A permanent crossing in the form of a culvert or an outfall structure would remove the natural channel bed and banks within the particular location, creating a uniform artificial channel. Locally altered flow patterns have the potential to create areas of erosion and/or deposition upstream and/or downstream of the structure. • Changes in flow regime and sediment processes caused by channel realignment could alter the morphology of the channel. In some cases, disruption to the channel morphology would be short-term and realignment may actually improve the channel morphology. Along historically modified (engineered) channels, realignment may offer an opportunity to restore/rehabilitate the water feature. • Bank protection requirements could result in the transfer of the site of erosion downstream resulting in bank retreat and/or channel incision. Hard or raised reinforcement could also impact on lateral connectivity and marginal habitat. • Alteration to channel morphology, flow and/or sediment processes could cause changes to the current channel characteristics and in-channel physical habitat features which provide ecological resilience for water-dependent flora and fauna. These changes may also impact on the function and habitat value of designated sites, including SSSIs and SACs.
Changes to natural fluvial processes	• Potential for increase in runoff which could locally alter flow regime within the channel. • Lateral and longitudinal connectivity would be impacted within the immediate location of culverts. Alteration of flow patterns due to the uniform, artificial channel. • Realignment of a water feature would have potential to either reduce or increase the length of a channel, directly altering the gradient and changing flow processes. • Outfall structures and the associated discharge to the channel would have the potential to locally alter flow patterns. • Potential impact on riparian woodland which could inhibit lateral connectivity with the floodplain.
Water Quality	
Decline in water quality or supply	• Increased pollutant loading from the operation of the proposed scheme, comparative to the pollutant loading from the existing A9, could reach surface water features from accidental spillages via outfalls or other surface water pathways. This could include: suspended solids and contaminants bound to them (such as metals and phosphorus); biodegradable organic materials (such as debris and grass cuttings); diffuse sources with high levels of nutrients (nitrogen and phosphorus); de-icing salt (chloride); and oil and related compounds. • Changes to channel morphology (detailed above) could have an associated effect on water quality by mobilising suspended solids and releasing previously 'locked' contaminants into the water column. • New or extended culverts could cause oxygen sags due to the lack of light, restricting aquatic plant photosynthesis and rapid microbiological degradation of biodegradable matter. Typically, longer structures would have greater impacts on water quality. Any reduction in surface area through culverts would also likely reduce atmospheric oxygenation of the water. • Changes in turbulence could also affect atmospheric oxygenation of the water.
Reduction in dilution capacity	• A reduction in dilution capacity due to the decline in water quality
Adverse impacts on biodiversity	• A decline in ecosystem health due to the decline in water quality.

Operation – Specific Impacts

11.4.13 This section describes the specific potential impacts on the surface water environment that could occur during operation in the absence of mitigation, which are specific to individual surface water features within the study area. The assessment is based on operational structures that would be permanent during operation, such as drainage outfalls, culverts and bridges and other elements of the proposed scheme, such as new or widened mainline, side roads and access tracks. Further information on water features crossings is provided in Appendix A11.8 (Watercourse Crossings Report) and the location of all crossings is shown on Figure 11.1.

11.4.14 The specific operational impacts for hydrology and flood risk, fluvial geomorphology and water quality with potential significance of Moderate or above are presented in Table 11.16. A more detailed overview of the impact assessment process and results for each of the water features (including those not considered to have a significant impact) is provided in Appendix A11.7 (Residual Impacts).

Table 11.16: Potential impacts on specific water features – operation

Water Feature	Attribute	Description of Specific Operational Impacts	Sensitivity	Magnitude	Significance
	Adverse Impacts				
WF59	Hydrology and Flood Risk	The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tummel floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). This causes an increase in fluvial flood depth from the River Tummel (WF70). During the design flood event, the modelled flows from WF59 coincide with flows from the River Tummel which overtop on the left bank upstream of the Tummel Crossing and pass under the railway underpass towards Dalshian. The River Tummel also overtops on the left bank downstream of the Tummel Crossing to restrict the outflows from WF59, thereby causing backflow through the extended culvert and exacerbating the flood risk in the Dalshian area. The proposed scheme results in an increase in fluvial flood depth from WF59 by >10mm and <50mm during the 0.5% AEP (200-year) plus CC event when considered in conjunction with increased flooding from the River Tummel (WF70). This includes a <10mm increase in peak flood levels to the Dalshian Chalets and East Haugh Hotel. The areas of increased flood depth >10mm are on agricultural land not considered to be sensitive to minor changes in flood levels.	very high	minor	**Large**
WF60	Hydrology and Flood Risk	The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tummel floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). This causes an increase in fluvial flood depth from the River Tummel (WF70). During the design flood event, the modelled flows from WF60 coincide with flows from the River Tummel which overtop on the left bank upstream of the Tummel Crossing and pass under the railway underpass towards Dalshian. The River Tummel also overtops on the left bank downstream of the Tummel Crossing to restrict the outflows from WF60, thereby causing backflow through the extended culvert and exacerbating the flood risk in the Dalshian area. The proposed scheme results in an increase in fluvial flood depth from WF60 by >10mm and <50mm during the 0.5% AEP (200-year) plus CC event when considered in conjunction with increased flooding from the River Tummel (WF70). This includes a <10mm increase in peak flood levels to the Dalshian Chalets and East Haugh Hotel. The areas of increased flood depth >10mm are on agricultural land not considered to be sensitive to minor changes in flood levels.	very high	minor	**Large**

Water Feature	Attribute	Description of Specific Operational Impacts	Sensitivity	Magnitude	Significance
WF61	Hydrology and Flood Risk	The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tummel floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). This causes an increase in fluvial flood depth from the River Tummel (WF70). During the design flood event, the modelled flows from WF61 coincide with flows from the River Tummel which overtop on the left bank upstream of the Tummel Crossing and pass under the railway underpass towards Dalshian. The River Tummel also overtops on the left bank downstream of the Tummel Crossing to restrict the outflows from WF59, thereby causing backflow through the extended culvert and exacerbating the flood risk in the Dalshian area. The proposed scheme results in an increase in fluvial flood depth from WF61 by >10mm and <50mm during the 0.5% AEP (200-year) plus CC event when considered in conjunction with increased flooding from the River Tummel (WF70). This includes a <10mm increase in peak flood levels to the Dalshian Chalets and East Haugh Hotel. The areas of increased flood depth >10mm are on agricultural land not considered to be sensitive to minor changes in flood levels.	very high	minor	**Large**
WF64	Fluvial Geo-morphology	The culvert extension requires realignment of the main channel upstream and downstream of the carriageway. This would have a particular impact upstream where a natural boulder cascade would be removed. Realignment would remove existing dense riparian vegetation, including continuous lining of trees. Potential for natural channel adjustment post construction both upstream and downstream as the watercourse establishes a new equilibrium.	medium	moderate	**Moderate**
WF66	Fluvial Geo-morphology	Channel is modified and man-made where the culvert inlet would be lowered; therefore, works are likely to have an insignificant impact. However, regrading upstream would remove a length of natural step-pool sequence and natural riparian vegetation. Potential for channel adjustment upstream and downstream as a direct consequence of the new structures within the water feature, particularly due to the step-pool nature of the water feature.	medium	moderate	**Moderate**
WF68	Fluvial Geo-morphology	The extended culvert would be close to an existing knickpoint (area of instability) located downstream where the man-made reinforcement stops. Potential for natural channel adjustment post construction as the watercourse established a new equilibrium.	high	minor	**Moderate**
WF69	Fluvial Geo-morphology	The culvert extension would remove a length of steeper channel with a step-pool sequence, natural bed and banks and vegetated riparian corridor. The extension would also reduce the existing channel gradient and lead to potential natural channel adjustment post construction downstream as the watercourse establishes a new equilibrium.	medium	moderate	**Moderate**
WF74	Fluvial Geo-morphology	Complete removal of the majority of the artificial channel and small natural upstream section upstream of the existing A9. The new culvert would also lead to removal of an	medium	major	**Large**

Water Feature	Attribute	Description of Specific Operational Impacts	Sensitivity	Magnitude	Significance
		extensive area of riparian vegetation including trees.			
WF76 Allt an Aghastair	Fluvial Geo-morphology	Extensive removal of natural channel under the mainline widening and the new side road. Permanent removal of natural bed and banks and natural step-pool sequence. Lateral connectivity removed as a result of the new culvert; although the natural valley is steep. Extensive removal of riparian vegetation. Change in the gradient of the water feature by straightening through a culvert, potentially altering flow processes downstream of the existing A9. Change to channel morphology and the sediment and flow processes due to channel realignment in a small tributary of main channel.	medium	major	**Large**
WF77	Water Quality	Discharge of routine road runoff (from proposed drainage outfall I) resulting in a HAWRAT 'Fail' for soluble pollutants and an exceedance of the Annual Average Environmental Quality Standard (AA-EQS) for dissolved copper.	medium	major	**Large**
	Biodiversity		low	major	**Moderate**
WF70 River Tummel	Hydrology and Flood Risk	The proposed scheme results in a loss of floodplain storage of approximately 18,199m^3 due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tummel floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). The proposed scheme results in increased fluvial flood depths ranging from <10mm to >50mm from the River Tummel (WF70) during the 0.5% AEP (200-year) plus CC event. This includes a <10mm increase in peak flood levels to the Dalshian Chalets and East Haugh Hotel when considered in conjunction with flooding from WF59/WF60/WF61. The areas of increased flood depth >10mm are on agricultural land not considered to be sensitive to minor changes in flood levels. Permanent changes to site runoff rates would also arise from the increase in impermeable area within the catchment.	very high	moderate	**Very Large**
	Fluvial Geo-morphology	The Tummel Bridge abutments are set back in the floodplain, with some potential very minor alterations to lateral connectivity. The outfalls from SuDS pond C would require permanent removal of a length of natural bank and bed, localised changes to flow dynamics with potential for alterations in sediment processes. This length of the River Tummel has large bars that have adjusted over time. This could potentially mean that the outfall discharge is not always directly connected to the Tummel, but instead flows over a depositional feature. The diversion of three water features into an open channel to the Tummel will increase flow into the river at this location	high	moderate	**Moderate**
WF75 Loch Faskally	Hydrology and Flood Risk	Permanent changes to site runoff rates from the increase in impermeable area and discharge from new SuDS outfalls.	very high	minor	**Moderate**

11.5 Mitigation

Introduction

11.5.1 This chapter makes reference to overarching standard measures applicable across A9 dualling projects ('SMC' mitigation item references), and also to project-specific measures ('P04' mitigation item references). Those that specifically relate to Road Drainage and the Water Environment are assigned a 'W' reference.

11.5.2 The objective of this section is the identification of mitigation measures to avoid/prevent, reduce or offset potential significant impacts, described in Section 11.4 (Potential Impacts), taking into account best practice, legislation and guidance, during both construction and operation.

11.5.3 As stated in Section 11.12 (Approach and Methods), consultation with SEPA and SNH was undertaken throughout the DMRB Stage 3 process to seek guidance on surface water drainage, pollution prevention measures and engineering activities on waterbodies. Further information on the consultation process is provided in Chapter 7 (Consultation and Scoping).

Embedded Mitigation

11.5.4 Substantial environmental input has contributed to the design process to help inform the most sustainable alignment options, watercourse crossing design and drainage solutions (referred to as primary or embedded mitigation). This iterative approach has included discussion of proposed engineering options and their associated potential environmental impacts, as well as the recommendation of measures that limit the impacts on the water environment. For further details, refer to Chapter 4 (Iterative Design Development).

11.5.5 An engineering solution has been developed at each watercourse crossing, which is considered to be consentable under CAR based on the DMRB Stage 3 design; refer to Appendix A11.8 (Watercourse Crossing Report). A Specimen Design will be developed, in consultation with SEPA, to support the CAR authorisation process following the completion of the DMRB Stage 3 assessment. This will allow for the development of the design to include provision of fish passage and scour protection as required.

Land Made Available for Construction

11.5.6 A preliminary review of construction drainage requirements was undertaken in order to inform the land required to provide adequate surface water management during construction.

11.5.7 This review has assessed the land required to accommodate the 10% AEP (10-year) return period rainfall event, as would reasonably be expected to occur during the period of construction, for each construction drainage catchment and within each construction phase. An additional volume to account for the estimated soil loss from each corresponding construction drainage catchment has also been considered in the assessment, using methods as detailed in CIRIA (2006a). The inclusion of the soil loss volume provides an increased treatment volume on catchments that will likely be more susceptible to soil erosion.

11.5.8 The results of the review were used in the planning of the Compulsory Purchase Orders (CPO) and will form a baseline for the Contractor to develop a construction drainage strategy.

Mainline, Junctions, Side Roads and Access Tracks

11.5.9 The proposed scheme was designed to be above the 0.5% AEP (200-year) plus CC flood level with an additional 600mm of freeboard where reasonably practicable. Unsurfaced access tracks would remain unchanged from existing ground elevations and as a result may have lower flood design standards.

SuDS

11.5.10 SuDS are a legal requirement in Scotland under WEWS and CAR and have been included within the DMRB Stage 3 design. The proposed scheme includes nine SuDS outfalls discharging to five water

features. SuDS are designed to treat pollutants and attenuate runoff to acceptable levels before discharging to watercourses. SuDS have been located where practical outside the 0.5% AEP (200-year) functional floodplain; where this is not possible, they have been designed to ensure that they are not inundated by the 3.33% AEP (30-year) flood event. They have been designed to attenuate the 0.5% AEP (200-year) rainfall event plus CC with appropriate freeboard and discharge at the 50% AEP (2-year) 'greenfield' runoff rate.

11.5.11 Engineering and environmental factors were considered to confirm the drainage design and the types and locations of SuDS components. The results from the HAWRAT assessment also contributed to this process and the outcomes are reported in Table 11.19. For the purposes of the water quality assessments, discharges are reported in the absence of treatment by SuDS in Section 11.4 (Potential Impacts) above, and with treatment by SuDS in Section 11.6 (Residual Impacts) below.

11.5.12 Two levels of SuDS treatment have been identified as a minimum requirement for the proposed scheme. On several drainage catchments (A, D1, E and F; refer to Table 11.19), a second level of treatment has been achieved through the adoption of a proprietary system (hydrodynamic vortex separator or HVS) as opposed to conventional SuDS (e.g. a pond or basin). This is due to these drainage runs being considered 'constrained sites' where the adoption of a second level of conventional SuDS would have resulted in the loss of ancient woodland, significant landscape impacts or increased flood risk. In addition, proprietary SuDS are being retrofitted into an existing dualled carriageway section in the south of the proposed scheme.

Culverts

11.5.13 The culvert design for the watercourse crossings of the A9 mainline takes account of three different design conditions in the hydraulic analysis as follows:

- All new replacement watercourse crossings (i.e. where it is proposed that an existing culvert is fully removed and replaced with a new culvert) have been sized in accordance with the Design Manual for Roads and Bridges (DMRB) HA107/04. This includes the minimum requirement to freely pass the 1% AEP (100-year) design fluvial event with appropriate freeboard within the culvert barrel.
- The culverts for the replacement crossings, as well as those that are extended based on their existing geometry, have also been tested in the 0.5% AEP (200-year) event to confirm that they remain free flowing (i.e. they are not surcharged) in this event, and that there is appropriate culvert freeboard, taking account of other factors influencing culvert design.
- All culverts have also been assessed against the design flood event i.e. 0.5% AEP (200-year) plus an allowance for climate change to confirm that there is a minimum 600mm freeboard to road level as reported in Appendix A11.3 (Flood Risk Assessment).

11.5.14 All new (or replaced) side road (unsurfaced tracks) culverts are designed to freely pass the 2% AEP (50-year) design event (with appropriate freeboard within the culvert barrel). The flood design standard for unsurfaced access track (Tier 3) culverts is lower than for mainline culverts as these tracks are mainly unsurfaced, with a low traffic volume, which only serve as access to a few agricultural properties. Unsurfaced access tracks are also to be set at existing ground level (which may or may not already be elevated above existing flood levels), to avoid impacts on flood risk.

Pre-earthworks Drainage

11.5.15 Pre-earthworks drainage will take the form of open ditches and will be constructed at the top of all cuttings and the base of all embankments where the natural catchment falls towards the earthworks, thus allowing the overland flow to be intercepted. The purpose of the pre-earthworks drainage is to collect runoff from the natural catchments surrounding the proposed scheme and convey overland flow to the nearest watercourse, maintaining the existing hydrological regime of the natural catchment where possible. Pre-earthworks drainage has been designed to convey the 1.3% AEP (75-year) rainfall runoff event. Once operational, this system does not require any formal treatment or attenuation prior to discharge, beyond the treatment and attenuation that is provided by the drain itself, as it is draining the natural catchment and kept separate from any polluted carriageway runoff. However, mitigation during construction is required, which is detailed in Table 11.18.

Standard Mitigation

11.5.16 Standard mitigation commitments during construction (SMC-S1 to SMC-S4) are set out in Chapter 21 (Schedule of Environmental Commitments) and consist predominantly of best practice measures. The standard construction and operational mitigation commitments for Road Drainage and Water Environment are detailed in Table 11.17 and Chapter 21 (Schedule of Environmental Commitments).

Table 11.17: Standard mitigation for Road Drainage and Water Environment

Mitigation Item	Description
Standard Construction Mitigation	
SMC-W1	In relation to authorisations under CAR, the Contractor will be required to provide a detailed Construction Method Statement which will include proposed mitigation measures for specific activities including any requirements identified through the pre-CAR application consultation process.
SMC-W2	In relation to flood risk the Contractor will implement the following mitigation measures during construction: • The Flood Response Plan (as part of the CEMP, refer to **Mitigation Item SMC-S1** in Table 21.1 of Chapter 21 (Schedule of Environmental Commitments)) will set out the following mitigation measures to be implemented when working within the functional floodplain (defined here as the 0.5% AEP (200-year) flood extent): ➢ Routinely check the MET office Weather Warnings and the SEPA Floodline alert service for potential storm events (or snow melt), flood alerts and warnings relevant to the area of the construction works. ➢ During periods of heavy rainfall or extended periods of wet weather (in the immediate locality or wider river catchment) river levels will be monitored using, for example, SEPA Water Level Data when available/visual inspection of water features. The Contractor will assess any change from base flow condition and be familiar with the normal dry weather flow conditions for the water feature, and be familiar with the likely hydrological response of the water feature to heavy rainfall (in terms of time to peak, likely flood extents) and windows of opportunity to respond should river levels rise. ➢ Should flooding be predicted, works close or within the water features will be immediately withdrawn (if practicable) from high risk areas (defined as: within the channel or within the bankfull channel zone - usually the 50% (2-year) AEP flood extent). Works will retreat to above the 10% AEP (10-year) flood extent) with monitoring and alerts for further mobilisation outside the functional floodplain should river levels continue to rise. • Plant and materials will be stored in areas outside the functional floodplain where practicable, with the aim for temporary construction works to be resistant or resilient to flooding impacts, to minimise/prevent movement or damage during potential flooding events. Where this is not possible, agreement will be required from the Environmental Clerk of Works (EnvCoW). • Stockpiling of material within the functional floodplain, if unavoidable, will be carefully controlled with limits to the extent of stockpiling within an area, to prevent compartmentalisation of the floodplain, and stockpiles will be located >10m from watercourse banks. • Temporary drainage systems will be implemented to alleviate localised surface water flood risk and prevent obstruction of existing surface runoff pathways. Where practicable, temporary haul routes will be located outside of the functional floodplain.
SMC-W3	The Contractor will implement appropriate controls for construction site runoff and sedimentation including: • avoiding unnecessary stockpiling of materials and exposure of bare surfaces, limiting topsoil stripping and phasing stripping to areas where bulk earthworks are immediately programmed; • installation of temporary drainage systems/SuDS (or equivalent) including pre-earthworks drainage; • pre-earthworks drainage/SuDS with appropriate outfalls to be in place prior to any earthworks activities; • treatment facilities to be scheduled prior to any works which may generate site run-off and sedimentation, to allow settlement and treatment of any pollutants contained in site runoff and to control the rate of flow before water is discharged into a receiving watercourse; • the adoption of silt fences, check dams, settlement lagoons, soakaways and other sediment trap structures as appropriate; • the maintenance and regrading of haulage route surfaces where issues are encountered with the breakdown of the existing surface and generation of fine sediment; • provision of wheel washes at appropriate locations (in terms of proposed construction activities) and >10m from water features; • protecting soil stockpiles using bunds, silt fencing and peripheral cut-off ditches, and location of stockpiles at distances of >10m; and • restoration of bare surfaces (seeding and planting) throughout the construction period as soon as possible after the work has been completed.
SMC-W4	In relation to in-channel working, the Contractor will adhere to GPP/PPGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1), and implement appropriate measures which will include, but may not be limited to: • undertaking in-channel works during low flow periods (i.e. when flows are at or below the mean average) as far as reasonably practicable to reduce the potential for sediment release and scour;

Mitigation Item	Description
	• no in-channel working during the salmonid spawning seasons unless permitted within any CAR license; • minimise the length of channel disturbed and size of working corridor, with the use of silt fences or bunds where appropriate to prevent sediment being washed into the water feature; • limit the removal of vegetation from the riparian corridor, and retaining vegetated buffer zone wherever reasonably practicable; and • limit the amount of tracking adjacent to watercourses and avoid creation of new flow paths between exposed areas and new or existing channels.
SMC-W5	Where channel realignment is necessary the Contractor will adhere to good practice guidance (Table 11.1) and implement appropriate measures which will include, but may not be limited to: • once a new channel is constructed, the flow should, where practicable, be diverted from the existing channel to the new course under normal/low flow conditions; • diverting flow to a new channel should be timed to avoid forecast heavy rainfall events at the location and higher up in the catchment (the optimum time will be the spring and early summer months to allow vegetation establishment to help stabilise the new channel banks); • with offline realignments, the flow will be diverted with a steady release of water into the newly constructed realignment to avoid entrainment of fine sediment or erosion of the new channel; and • any proposed channel realignment works will be supervised by a suitably qualified geomorphologist.
SMC-W6	In relation to refuelling and storage of fuels the Contractor will adhere to GPP/PPGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1), and implement appropriate measures which will include, but may not be limited to: • only designated trained and competent operatives will be authorised to refuel plant; • refuelling will be undertaken at designated refuelling areas (e.g. on hardstanding, with spill kits available, and >10m from water features) where practicable; • appropriate measures will be adopted to avoid spillages (refer to Mitigation Item W7); and • compliance with the Pollution Incident Control Plan (refer to Mitigation Item S1).
SMC-W7	In relation to oil/fuel leaks and spillages the Contractor will adhere to GPP/PPGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1), and implement appropriate measures which will include, but may not be limited to: • stationary plant will be fitted with drip trays and emptied regularly; • plant machinery will be regularly inspected for leaks with maintenance as required; • spillage kits will be stored at key locations on-site and detailed within the Construction Environmental Management Plan (CEMP) (refer to Mitigation Item S1); and • construction activities will comply with the Pollution Incident Control Plan (refer to Mitigation Item S1).
SMC-W8	In relation to chemical storage, handling and reuse the Contractor will adhere to GPP/PPGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1), and implement appropriate measures which will include, but may not be limited to: • chemical, fuel and oil storage will be undertaken within a site compound, which will be located on stable ground at a low risk of flooding and >10m from any watercourse; • chemical, fuel and oil stores will be locked and sited on an impervious base within a secured bund with 110% of the storage capacity; and • pesticides, including herbicides, will only be used if there are no alternative practicable measures, and will be used in accordance with CAR requirements, the manufacturer's instructions and application rates.
SMC-W9	In relation to concrete, cement and grout the Contractor will adhere to GPP/PPGs (SEPA, 2006-2017) and other good practice guidance (Table 11.1), and implement appropriate measures which will include, but may not be limited to: • concrete mixing and washing areas will be: ➢ be located more than 10m from any water bodies; ➢ have settlement and re-circulation systems for water reuse; and ➢ have a contained area for washing out and cleaning of concrete batching plant or ready-mix lorries. • wash-water will not be discharged to the water environment and will be disposed of appropriately either to the foul sewer (with permission from Scottish Water), or through containment and disposal to an authorised site; • where concrete pouring is required within a channel, a dry working area will be created; • where concrete pouring is required within 10m of a water feature or over a water feature, appropriate protection will be put in place to prevent spills entering the channel (e.g. isolation of working area, protective sheeting); and • quick settling products (cement, concrete and grout) will be used for structures that are in or near to watercourses.
SMC-W10	Sewage from site facilities will be disposed of appropriately either to foul sewer (with the permission of Scottish Water) or appropriate treatment and discharge agreed with SEPA in advance of construction in accordance with 'PPG04 Treatment and Disposal of Sewage' (SEPA, 2006 – 2017).

Mitigation Item	Description
SMC-W11	In relation to service diversions and to avoid damage to existing services from excavations and ground penetration, including temporary severance of public and private water supplies through damage to infrastructure, the Contractor will: • locate and map all private or public water supply assets and other service infrastructure prior to construction; • take measures to prevent damage to services and to avoid pollution during service diversions, excavations and ground works; and • provide a temporary alternative water supply (e.g. bottled or tankered) if services are to be disrupted or diverted by the works.
SMC-W12	For works within areas identified as potentially containing contaminated land and sediment the Contractor will reduce the risk of surface water pollution to an acceptably low level through: • further site investigation to determine the level of contamination prior to construction beginning; • the installation of temporary treatment facilities to enable removal of pollutants from surface waters; and • adoption of mitigation measures relating to contaminated land as outlined in Chapter 10 (Geology, Soils, Contaminated Land and Groundwater).
Standard Operation Mitigation	
SMC-W13	In relation to bank reinforcement, design principles and mitigation measures will adhere to good practice (SEPA, 2008a), which will include, but may not be limited to: • non-engineering solutions and green engineering (e.g. vegetation, geotextile matting) to be the preference during options appraisal; • requirements for grey engineering to control/prevent scour (e.g. rock armour, rip-rap, gabion baskets) to be minimised; and • post project appraisal to identify if there are issues that can be investigated and addressed at an early stage.
SMC-W14	In relation to outfalls, specimen and detailed design will ensure compliance to good practice (e.g. CIRIA, 2015b; Highways Agency et al., 2004; SEPA, 2008b), which will include, but may not be limited to: • directing each outfall downstream to minimise impacts to flow patterns; • avoiding projecting the outfall into the watercourse channel; • avoid installation of outfalls at locations of known historical channel migration; • avoid positioning in flow convergence zones or where there is evidence of active bank erosion/instability; • directing an outfall away from the banks of a river to minimise any potential risk of erosion (particularly on the opposite bank); • minimising the size/extent of the outfall headwall where possible to reduce the potential impact on the banks; and • post project appraisal to identify if there are issues that can be investigated and addressed at an early stage.
SMC-W15	In relation to watercourse crossings, specimen and detailed design will ensure compliance with good practice (SEPA, 2010), which will include, but may not be limited to: • Detailed design will mitigate flood risk impacts through appropriate hydraulic design of culvert structures. Flood risk will be assessed against the 0.5%AEP (200-year) plus an allowance for climate change design flood event. Detailed design will mitigate any loss of flood plain storage volume, where required, by appropriate provision of compensatory storage. Where culvert extension is not practicable or presents adverse impact on the water environment, appropriately designed replacement culverts may be installed. • Detailed design will mitigate impacts on the water environment through appropriate design of culvert structures and watercourse modifications (e.g. realignments) with respect to fluvial geomorphology, and both riparian and aquatic ecology. • Detailed design of culverts and associated watercourse modifications shall incorporate wherever practical: ➢ adherence to design standards and good practice guidance (Table 11.1); ➢ allowance for the appropriate conveyance of water and sediment for a range of flows (including at low flow conditions); ➢ maintenance of the existing channel gradient to avoid erosion at the head (upstream) or tail (downstream) end of a culvert; ➢ avoidance of reduction of watercourse length through shortening of watercourse planform; ➢ minimisation of culvert length; ➢ close alignment of the culvert with the existing water feature; ➢ depressing the invert of culverts to allow for formation of a more natural bed (embedment of the culvert invert to a depth of at least 0.15m to 0.3m); and ➢ roughening of culvert inverts to help reduce water velocities. • post project appraisal to identify if there are issues that can be investigated and addressed at an early stage.
SMC-W16	In relation to channel realignments, specimen and detailed design will ensure compliance with good practice (Table 11.1), which will include, but may not be limited to: • minimising the length of the realignment, with the existing gradient maintained where possible; • design of the realignment in accordance with channel type and gradient;

Mitigation Item	Description
	• if required, low flow channels or other design features to reduce the potential for siltation and provide an opportunity to improve the geomorphology of the water feature; • realignments designs will be led by a suitably qualified geomorphologist; • where realignments result in an increase or decrease of channel gradient, the following principles will be applied: ➢ an increased gradient within the channel (resulting in higher stream energies) will require mitigation in the form of energy dissipation, which could include the creation of a step-pool sequence; boulder bed-checks; plunge pools at culvert outlets; and/or; increased sinuosity; and ➢ a decrease in gradient within the channel will require mitigation in the form of the construction of a low flow channel to minimise the impacts on locally varying low flow conditions and reduce the risk of siltation of the channel. • post project appraisal to identify if there are issues that can be investigated and addressed at an early stage.
SMC-W17	In relation to SuDS, the following mitigation measures will be implemented: • where required, authorisations for the road drainage discharge under CAR would be obtained from SEPA; • detailed design to adhere to design standards and good practice guidance (Table 11.1), including The SuDS Manual (CIRIA, 2015b) and SuDS for Roads (SCOTS, 2010); • for each drainage run, a minimum of two levels of SuDS treatment within a 'treatment train' (see Table 11.18 for further details) to limit the volume of discharge and risk to water quality; • management of vegetation within ponds and drains through grass cutting, pruning of any marginal or aquatic vegetation (as appropriate to the SuDS component) and removal of any nuisance plants, especially trees; • SuDS retention ponds will be designed with an impermeable liner to maintain a body of standing water and provide treatment volume; • inspect inlets, outlets, banksides, structures and pipework for any blockage and/or structural damage and remediate where appropriate; and • regular inspection and removal of accumulated sediment, litter and debris from inlets, outlets, drains and ponds to avoid sub-optimal operation of SuDS; and • adherence to the maintenance plans specific to each SuDS component type as detailed within The SuDS Manual (CIRIA, 2015b).

Specific Mitigation

11.5.17 Construction and operation mitigation measures, which go beyond standard industry best practice, are required to reduce impacts to non-significant and are detailed in Table 11.18 for road drainage and water environment and in Chapter 21 (Schedule of Environmental Commitments). Each recommended mitigation measure was assigned a reference and a detailed description is provided.

Table 11.18: Project specific mitigation for Road Drainage and Water Environment

Mitigation Item	Description	Water Features
Specific Construction Mitigation		
P04-W18	Measures to control sources of suspected sediment and other contaminants will be set out within a site specific Sediment Management and Pollution Prevention Plan (or similar such document), that will be submitted to SEPA for approval prior to construction. Specific measures would include, but would not be limited to: • Soil stripping schedule and plans which show how the works will be phased to avoid unnecessary stockpiling of materials and exposure of bare surfaces. • Minimisation of soil stripping and bank disturbance activities. Frequent use of weather forecasts should be made to inform the timing of specific activities. • Rapid restoration of areas of exposed ground, including implementing reseeding plans during the growing season (spring to autumn). Geotextiles, mulch and the roughening of exposed ground would be adopted where reseeding cannot be rapidly undertaken. • Plans showing the location and proposed protection (bunds or silt fencing) for stockpiles, which on this project would be located out with the 0.5% AEP (200 year) functional floodplain at a distance of >50m from any water features and over stable and flat ground (as far as reasonably practicable). • Minimisation in the extent, length and gradient of drainage ditches, and erosion control measures within the ditches to include lining and check dams. • Use of an appropriate grade of material on temporary haul routes that would be clean, washed, have a limited fines content and would be durable under heavy trafficking; this may require the importing of appropriate material if the on-site sources are assessed as being inadequate.	ALL

Mitigation Item	Description	Water Features
	• Frequent monitoring of the performance of haul routes, and maintenance and regrading where issues are identified. • Use of biodegradable fuels, oils and chemicals on site, as far as reasonably practicable. If flocculants are considered necessary to aid settlement of fine suspended solids, such as clay particles, only natural organic flocculants would be used for surface water treatment, if a requirement is identified, and permission from SEPA for the use of such chemicals would be sought at an early stage prior to construction. • An increased protection buffer distance of 50m from any surface water feature would be applied to all handling, storage and use of oils, fuels and chemicals (including concrete batching), as far as reasonably practicable. • Protocols would be developed for ceasing or reducing construction activities during periods of high rainfall to reduce the risks of erosion, sedimentation and pollution.	
P04-W19	Specific measures to remove suspended sediment and other contaminants from construction runoff will be included within a site specific Surface Water Management Plan (or similar such document) that would be approved by SEPA prior to construction. Specific measures would include, but would not be limited to: • Provision of temporary drainage measures during construction which would take consideration of the phasing of works, topography, land available for treatment of surface water and the location of surface water features. • Construction runoff would be discharged to land via temporary treatment measures (e.g. settlement ponds and/or soakaways) at frequent intervals along the working corridor to prevent unmanageable volumes of untreated runoff collecting at a single location. • Prior to the completion of operational SuDS, drainage will not directly enter water bodies but be directed over vegetation or vegetated channels to attenuate flow and treat sediment loads and pollutants, and a filter strip (10m minimum where practicable) will be provided between any drainage discharges and watercourses. Daily inspections of buffer strips will be undertaken during periods of high rainfall to ensure surface flow pathways do not develop. • For instances where the levels of fine sediment and volume of surface water cannot be treated using conventional methods, including where topography or land available is a constraint, an alternative treatment procedure may be used which would include: the use of portable settlement tanks, flocculants and dynamic separators. This 'emergency' treatment procedure would be put in place and agreed with SEPA prior to construction, so it can be enacted rapidly when issues are identified. • Settlement features would be sized appropriately to accommodate the maximum volume of run-off that would be reasonably expected to occur on any occasion during the period of construction (as to be agreed with SEPA). • All features associated with the temporary drainage system, including settlement ponds, settlement tanks, ditches and silt traps, will be maintained in a good state of repair by the Contractor.	ALL
P04-W20	To measure the effectiveness of implemented mitigation measures in protecting downstream water quality and aquatic ecological interests, monitoring protocols during the construction phase will be developed within a site specific Water Quality Monitoring Plan, which will be submitted to SEPA for approval prior to construction. This would include, but would not be limited to: • Appointment of a suitably qualified (minimum of 3 years' experience supervising construction sites, monitoring water quality and drainage design) Hydrological Clerk of Works (HCoW), who will review the scheduling of earthworks, storage of materials, implementation of drainage and surface water treatment measures, and undertake monitoring of water quality. The HCoW will be provided with the authority to stop works and implement remedial action with immediate effect. • Water quality monitoring one year prior to construction, during construction and one year's post construction. The monitoring regime to include monthly laboratory analysis, visual inspections and real time monitoring. • Water quality criteria and standards to be achieved for all site discharges during construction, and sampling locations, to be agreed in consultation with SEPA and SNH. The contractor will ensure compliance with these standards through the adoption of standard mitigation (Table 11.18) and **Mitigation Items P04-W18 and P04-W19.** • Real-time monitoring of electrical conductivity and turbidity to detect suspended solid concentrations in exceedance of baseline levels. An automated alert system would alert the HCoW and site staff of any pollution incidents, informing where further sampling is required to confirm compliance with the limits agreed with SEPA, and allow remedial actions to be implemented at specific locations.	ALL
P04-W21	Construction drainage systems/SuDS will be implemented prior to any significant earthworks to control/attenuate runoff during construction. Regular maintenance of construction SuDS and associated outfalls will be undertaken to ensure the basins are not susceptible to flood damage, and that flood risk is not increased locally during construction.	ALL

Mitigation Item	Description	Water Features
	In advance of flood events (identified from MET Office and SEPA Flood Warnings; refer to mitigation SMC-W2), in stream working areas would be evacuated and allowed to flood to prevent any increases in flood levels from constriction of flows.	
P04-W22	The new culverts/artificial channels associated with the flood mitigation proposals (P04-W24) will be constructed prior to the decommissioning of the existing culvert. Flows will be steadily released into the newly constructed realignment, and erosion protection measures will be put in place, to avoid sedimentation and erosion of the new channel.	WF59 WF60 WF61 WF63
P04-W23	During periods of higher flows, the establishment of a dry working area may be necessary for the construction of the Tummel Crossing for temporary support systems that would be located within the main channel but outwith the wetted perimeter of the River Tummel (WF70). Any pumping or abstraction from the dry working area would require adequate treatment as per the standards detailed under mitigation item **P04-W19**. The temporary support system for the Tummel Crossing will include for scour protection to prevent localised morphological adjustment. The extent of scour protection will be minimised where possible and soft-engineering techniques employed to avoid the additional need for bed and bank removal/disturbance. Following completion of the works, the natural morphology will be reinstated to its existing baseline state under the supervision of a geomorphologist. The tracking of machinery along the banks will be avoided to reduce the potential for erosion. Appropriate sediment management measures will be implemented throughout construction. A rapid evacuation plan would be required including daily weather updates and a response plan to ensure that in the event of rising water levels, plant and personnel can rapidly vacate in-channel working areas.	WF70
Specific Operation Mitigation		
P04-W24	To reduce the impact on flood risk from the proposed scheme to properties in Dalshian, the following measures will be adopted within a flood alleviation strategy: • Extension of existing culverts for WF59/WF60/WF61; • New 1.2m diameter flood relief culvert adjacent to WF61; • Abandonment of existing culvert through field downstream of A9 near WF61; • Interceptor pipe to divert flows from WF59 and WF60 into WF61; • Construction of a new artificial channel to connect WF61 to the River Tummel (WF70); and • 1.2m diameter culvert with flap valve to be located at the confluence of WF61 and River Tummel (WF70). Refer to Appendix 11.3 (Flood Risk Assessment) for further detail.	WF59 WF60 WF61 WF70
P04-W25	WF63, which is currently culverted under the proposed location of SuDS pond D2, is to be realigned into a new culvert/artificial channel to accommodate the proposed scheme. The existing culvert will be decommissioned. Refer to Appendix 11.3 (Flood Risk Assessment) for further detail.	WF63
P04-W26	Cascade design to be formed of natural boulder step-pools with the extent of reinforcement minimised as far as practicable, as well as re-using existing channel substrate.	WF64
P04-W27	Natural design of channel, with re-grading and replanting to mimic existing riparian vegetation.	WF66
P04-W28	Re-grade channel downstream to tie in with the culvert outlet and remove existing knickpoint. A scour pool or naturalised step-pool design should be adopted.	WF68
P04-W29	Grade culvert under the mainline to remove drop at the outlet; this may require a step-pool sequence within the culvert or re-grading downstream to tie in with the existing channel.	WF69
P04-W30	Additional planting along retained water feature channel (west of mainline widening) to mitigate for loss of vegetated riparian corridor.	WF71
P04-W31	Management of surface water through collection of water runoff and channelling the flow into the culvert to ensure the downstream channel is not deprived of flow.	WF74
P04-W32	Incorporate a stepped sequence into the culvert or a low flow channel to mimic the existing gradient change and cross-section. Appropriate re-grading of the upstream and downstream channel at the inlet and outlet to protect against scour and change in gradients (natural cascade design).	WF76
P04-W33	Detailed design of outfall from SuDS pond C to the River Tummel to include re-instatement/repair of existing failing bank reinforcement (gabion baskets) and appropriate tie in with the outfall wing-walls.	WF70
P04-W34	Operational SuDS: Treatment Train 1 comprising filter drains and a retention pond (wet). The calculated treatment efficiencies are provided in Appendix A11.6 (Water Quality). These calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage runs C, D2, G, H and I.	WF70 WF75 WF76 WF77

Mitigation Item	Description	Water Features
P04-W35	Operational SuDS: Treatment Train 2 comprising filter drains and a hydrodynamic vortex separator (HVS). The calculated treatment efficiencies are provided in Appendix A11.6 (Water Quality). These calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage runs A, D1, E and F. To fulfil regulatory requirements, the HVS systems will be designed to allow effective maintenance and removal of accumulated pollutants. The design of the HVS will allow removal of accumulated pollutants by using a standard vactor truck, with no requirement to enter the space. The maintenance regime will consist of removal of accumulated sediment and floatable oils, grease, trash and other debris. In line with The SuDS Manual (CIRIA, 2015), maintenance will be undertaken approximately every six months. Any HVS system will have undergone testing in line with British Water's "Code of Practice – Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff" (British Water, undated).	WF57 WF70 WF75
P04-W36	Operational SuDS: Treatment Train 3 comprising filter strip and filter drains. The calculated treatment efficiencies are provided in Appendix A11.6 (Water Quality). These calculations were used in the Step 3 routine run-off calculations. The Treatment Train will be adopted for drainage run B.	WF70
P04-W37	For tier 3 accesses (unpaved access tracks), an operational SuDS arrangement will consist of open drains or infiltration trenches (where they can be accommodated adjacent to the access track), followed by dispersal of collected runoff over dense vegetation, to allow for natural infiltration into groundwater.	WF64 WF74 WF77 WF78 WF65

11.5.18 In relation to mitigation items P04-W33 and P04-W35 described in Table 11.18, further detail on the proposed SuDS features and discharge locations are detailed in Table 11.19 below. The proposed SuDS, outfall locations and associated drainage catchments are shown on Figure 11.4.

11.5.19 As discussed in paragraph 11.5.12, the adoption of conventional SuDS as a second level of treatment has not been achieved on all catchments due to site constraints and the retrofitting of SuDS on existing dualled carriageway sections. However, 68% of the impermeable area associated with the proposed scheme will be treated by two levels of conventional SuDS, and any HVS system will be appropriately designed to meet regulatory requirements as part of mitigation item P04-W35. The principles behind the departures from two levels of conventional SuDS have been discussed with SEPA through the submission of drainage technical notes.

Table 11.19: Proposed SuDS and levels of treatment

Drainage Catchment	Impermeable Area (ha)	Receiving Water Feature	SuDS Treatment Level 1	SuDS Treatment Level 2
A	1.25	Altrory Burn (WF57)	Filter Drains	HVS
B	0.316	River Tummel (WF70)	Filter Strip	Filter Drain
C	0.633	River Tummel (WF70)	Filter Drains	Retention Pond
D1	1.81	River Tummel (WF70)	Filter Drains	HVS
D2	4.89	River Tummel (WF70)	Filter Drains	Retention Pond
E	2.69	Loch Faskally (WF75)	Filter Drains	HVS
F	0.731	Loch Faskally (WF75)	Filter Drains	HVS
G	3.54	Loch Faskally (WF75)	Filter Drains	Retention Pond
H	1.14	Un-named burn (WF74)	Filter Drains	Retention Pond
I	3.45	Un-named burn (WF77)	Filter Drains	Retention Pond

11.6 Residual Impacts

11.6.1 Following implementation of the mitigation measures outlined in Section 11.5 (Mitigation), potentially significant impacts on the water environment would be avoided/prevented, reduced or offset. The significant residual impacts likely to occur during either the construction and/or operational phases following the application of mitigation measures are set out in the following paragraphs and are adverse unless otherwise stated. Non-significant residual impacts identified for each surface water feature in terms of hydrology and flood risk, fluvial geomorphology and water quality are set out in Appendix A11.7 (Impact Assessment).

Construction

Hydrology and Flood Risk

11.6.2 The majority of hydrology and flood risk impacts arising from the construction of the proposed scheme would be 'Neutral' provided all mitigation recommendations are adhered to. However, a residual impact of **Moderate** significance would remain for the River Tummel (WF70), due to the inherent risks associated with the requirement to locate temporary structures within the functional floodplain during the construction of the new Tummel Crossing.

Fluvial Geomorphology

11.6.3 No residual impacts of Moderate significance or above are expected from the construction phase provided all proposed mitigation measures are adhered to.

Water Quality

11.6.4 No residual impacts of Moderate significance or above are expected during the construction phase provided all proposed mitigation measures are adhered to.

Operation

Hydrology and Flood Risk

11.6.5 The majority of impacts arising from the operation of the proposed scheme would be 'Neutral'. However, residual impacts with **Moderate** and **Large** significance for flood risk were identified for the operational phase of the proposed scheme as follows:

- Residual adverse impacts of **Moderate** significance were assessed for the River Tummel (WF70), WF59, WF60 and WF61 due to localised increases in the fluvial flood depth from the 0.5% AEP (200-year) plus CC event on agricultural land that is not deemed sensitive to increased flood depths; and
- Residual beneficial impacts of **Large** significance were noted for the River Tummel (WF70), WF59, WF60, WF61 due to decreases in the fluvial flood depth to residential properties from the 0.5% AEP (200-year) plus CC event.

11.6.6 It is emphasised that through the adoption of mitigation to reduce the potential impact at the location of these watercourses, flood risk to residential properties was reduced at the expense of localised increases in flood depths on agricultural land. The localised areas of agricultural land are not considered to be sensitive to these minor increases (<50mm) in flood levels as the land is already at risk of flooding. Therefore, a net beneficial effect on flood risk is reported from the proposed scheme.

11.6.7 The residual flood risk resulting from the proposed scheme is shown in Figure 11.3. Further detail is contained within Appendix A11.3 (Flood Risk Assessment).

Fluvial Geomorphology

11.6.8 No residual impacts of Moderate significance or above are expected during the operation phase. All potential significant impacts identified are considered to be mitigated by both the standard and specific mitigation measures outlined in Section 11.5 (Mitigation).

Water Quality

11.6.9 The HAWRAT Step 3 assessments have concluded that at all of the proposed drainage outfalls, no residual impacts of Moderate significance or above are expected during the operational phase. Detailed post-mitigation results from the HAWRAT water quality assessments are provided in Appendix A11.4 (Water Quality).

11.6.10 For water features currently receiving routine runoff from the existing A9, but not included within the drainage design for the proposed scheme, beneficial impacts are anticipated. However, the degree of

improvement cannot be quantified due to the lack of detailed information available on the existing A9 drainage system.

11.7 Statement of Significance

11.7.1 An assessment of potential impacts on the surface water environment, considering the attributes of hydrology and flood risk, fluvial geomorphology and water quality was undertaken for the proposed scheme at both construction and operational phases.

Hydrology and Flood Risk

11.7.2 During the construction of the proposed scheme adverse impacts of **Moderate** significance on the River Tummel (WF70) have been identified due to the requirement for activities within the functional floodplain during the construction of the Tummel Crossing.

11.7.3 During the operation of the proposed scheme adverse impacts of **Moderate** significance on the River Tummel (WF70), WF59, WF60 and WF61 have been identified due to localised increases in fluvial flood depth from the loss of floodplain storage.

11.7.4 Beneficial impacts of **Large** significance are reported for the River Tummel (WF70), WF59, WF60 and WF61 due to the reduction in flood depth to residential properties at Dalshian. The net effect of the proposed scheme on flood risk is considered to be beneficial, following successful implementation of all proposed mitigation measures.

Fluvial Geomorphology

11.7.5 For all water features the overall significance for fluvial geomorphology was assessed for both construction and operation as Neutral or Slight significance. Therefore, the proposed scheme will not have a significant impact on fluvial geomorphology, in the context of the EIA Regulations, following successful implementation of all proposed mitigation measures during the construction and operation of the proposed scheme.

Water Quality

11.7.6 For all water features, the overall significance for Water Quality (including 'Water Quality', 'Water Supply', 'Dilution and Removal of Waste Products' and 'Biodiversity') has been identified for both construction and operation as Neutral or Slight significance, following successful implementation of all proposed mitigation measures. The proposed scheme is therefore not predicted to have a significant impact on water quality, in the context of the EIA Regulations.

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