19. Road Drainage and the Water Environment

Summary

This chapter assesses the impacts of the proposed scheme on the surface water environment, specifically considering the aspects of flood risk, hydromorphology, surface water quality and surface water supply.

The proposed scheme is located within the River Tay catchment. Within the 500m study area, 20 surface water features were identified which may be affected by the proposed scheme and 16 of these cross the proposed scheme. The majority of these are steep, cascading low stream order watercourses characterised by step/pool sequences with cobble, pebble and/or gravel substrates, or artificial drainage channels, and which currently feature culverted crossings associated with the existing A9.

The largest watercourse within the study area is the River Tay, which is a partially embanked mobile gravel-bed river. The River Braan within the study area forms part of the River Tay Special Area of Conservation (SAC). The proposed scheme is partially located within the functional floodplain of the River Tay, and in sections within close proximity to the River Tay. This has been a key constraining factor in the design of the proposed scheme.

The River Tay receives surface runoff from the existing A9 drainage system, which is predominantly un-attenuated and untreated. Land uses within the River Tay catchment are primarily sheep grazing and managed moorland in the upper reaches, forestry in the middle reaches, and arable farming and built development in the lower reaches therefore, potential pollution sources are generally limited to agricultural runoff, road runoff and forestry operations.

The impact assessment was informed by consultation, desk-based assessments, site walkovers and surveys. Hydraulic assessments were undertaken for the 16 watercourses that cross the scheme, including hydraulic modelling of the four principal watercourses and three minor watercourses (WF09, WF13 and WF16). Hydraulic calculations on the nine other minor watercourses were undertaken to assess 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 within receiving watercourses from construction and operational runoff.

Mitigation during construction would be delivered through a Construction Environmental Management Plan (CEMP), which would include measures for flood risk, hydromorphology, surface water quality and surface water supply.

With the implementation of mitigation measures during construction, residual effects on all receptors would be reduced to either Neutral or Slight adverse significance.

During the operational phase, mitigation measures include the use of Sustainable Drainage Systems (SuDS), compensatory flood storage, scour protection and erosion monitoring to protect affected watercourses.

With the implementation of proposed mitigation, residual effects during operation would be of Neutral or Slight significance. The exception to this relates to significant effects on hydromorphology on two watercourses. Compensation measures of de-culverting and offsite restoration are proposed to offset these impacts.

19.1 Introduction

19.1.1 This chapter presents the Design Manual for Roads and Bridges (DMRB) Stage 3 assessment of the proposed scheme (see Chapter 6: The Proposed Scheme) in terms of the following aspects of the surface water environment: flood risk, hydromorphology, surface water quality and surface water supply. The chapter is supported by the following appendices, which are cross-referenced where relevant:

- Appendix A19.1 (Baseline Conditions);
- Appendix A19.2 (Flood Risk Assessment);
- Appendix A19.3 (Watercourse Crossings Report);
- Appendix A19.4 (SuDS and Water Quality); and
- Appendix A19.5 (Impact Assessment).

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

- Figure 19.1(a-d): Surface Water Features; and
- Figure 19.2(a-d): Baseline Flood Risk.

Legislative and Policy Background

19.1.3 The following paragraphs report the key legislation and policies of relevance to this chapter.

<u>European Union (Withdrawal Agreement) Act 2020</u>

19.1.4 The UK government published the EU (Withdrawal) Bill on 13 July 2017, which transfers all existing EU law into domestic 'retained EU law' and gives powers to UK Ministers to change or remove this retained law. The Withdrawal Bill received Royal Assent on 26 June 2018 and was written into law as the Withdrawal Act.

19.1.5 In January 2020, the EU (Withdrawal Agreement) Act 2020 (UK Government, 2020) was also passed in parliament. This makes provisions for ratifying the Brexit Withdrawal Agreement which sets the terms of the UK's withdrawal from the EU. The UK left the EU on 31 January 2020 and was within a transition period until 31 December 2020. After this date the European Directives were superseded by domestic legislation which continues to place legal obligations on the protection of the natural environment, including the surface water environment, in the UK.

19.1.6 For the purposes of this assessment the domestic retained EU law is referred to in accordance with its original European Commission reference.

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

19.1.7 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) (Scottish Government, 2003). WEWS Act enables provisions to be made for protecting the water environment in connection with implementing the Directive. Under the WFD, new activities should not cause deterioration (of the ecological and chemical status of surface and groundwater bodies) or prevent the achievement of overall Good Ecological Status (GES) or Good Ecological Potential (GEP), for artificial or heavily modified water bodies.

19.1.8 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.

19.1.9 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 13 (Geology and Soils) and has been referred to where relevant.

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

19.1.10 The WEWS Act 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 more commonly known as the Controlled Activity Regulations (hereafter referred to as CAR) (Scottish Government, 2011) and their amendments. This legislation controls engineering works within inland surface waters, as well as point source discharges, abstractions and impoundments. There are four separate regulatory regimes, namely engineering, pollution control, abstractions and impoundments.

19.1.11 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, 2024a).

19.1.12 SEPA guidance for water run-off from construction sites (SEPA, 2024b) provides details of construction sites which require a CAR Licence. It is best practice for the operator of the construction site to have and implement site-specific plans for construction run-off management and pollution prevention to the water environment. However, these plans do not require approval from SEPA, but may be reviewed under investigation should a pollution incident occur.

Flood Risk Management (Scotland) Act 2009

19.1.13 The EU Floods Directive (2007/60/EC) is transposed into Scottish law through the Flood Risk Management (Scotland) Act 2009 (FRMA) (Scottish Government, 2009a). The FRMA 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.

19.1.14 The FRMA 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 FRMA, which are relevant to the planning system, are the assessment of flood risks and undertaking structural and non-structural flood management measures.

National Planning Framework 4 (NPF4)

19.1.15 NPF4 was approved by the Scottish Parliament and adopted and published by the Scottish Ministers in February 2023 (Scottish Government, 2023). NPF4 recognises and gives precedence to flood risk and water management as greater impacts are expected in future as a result of climate change. Local authorities are required to ensure they strengthen community resilience to the impacts of climate change, by avoiding development in areas at flood risk as a first principle and reducing the vulnerability of existing and future development to flooding.

19.1.16 The aims of NPF4 (Policy 22) in relation to flood risk and water management are to:

- improve resilience to current and future flood risk;
- make water resource use more efficient and sustainable; and
- increase the use of natural flood risk management.

Other Legislation and Policy

19.1.17 The additional legislation and policies set out in Table 19.1 relate to the water environment and have been considered in this chapter.

Table 19.1: Additional legislation and policy

Topic	Sources of Information
Parent EU Directive	Drinking Water Directive (2015/1787/EU) on the quality of water intended for human consumption;

Topic	Sources of Information
	EIA Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment; Floods Directive (2007/60/EC) on the assessment and management of flood risks; Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration; Environmental Liability Directive (2004/35/EC) on environmental liability with regard to the prevention and remedying of environmental damage; Water Framework Directive (2000/60/EC) establishing a framework for Community action in the field of water policy; Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora; Urban Wastewater Treatment Directive (91/271/EEC) to protect the water environment from the adverse effects of discharges of urban waste water and from certain industrial discharges; and Nitrates Directive (91/676/EEC) concerning the protection of waters against pollution caused by nitrates from agricultural sources.
Primary legislation – Acts of Parliament	Climate Change (Scotland) Act 2009 (Scottish Government, 2009b); European Union (Withdrawal Agreement) Act 2020 (UK Government, 2020) Environment Act 1995 (UK Government, 1995); Environmental Protection Act 1990 (UK Government, 1990); and Control of Pollution Act 1974 (CoPA) (UK Government, 1974).
Regulations	Water Environment (Miscellaneous) (Scotland) Regulations 2017 (Scottish Government, 2017a); Roads (Scotland) Act 1984 (Environmental Impact Assessment) Regulations 2017 (Scottish Government, 2017b); Public Water Supplies (Scotland) Regulations 2014 (Scottish Government, 2014); Pollution Prevention and Control (Scotland) Regulations 2012 (Scottish Government, 2012); Environmental Liability (Scotland) Regulations 2009 (Scottish Government, 2009c); The Water Environment (Oil Storage) (Scotland) Regulations 2006 (Scottish Government, 2006a); Private Water Supplies (Scotland) Regulations 2006 (Scottish Government, 2006b); and Water Supply (Water Quality) (Scotland) Regulations 2001 (Scottish Government, 2001).
Policy	National Planning Framework 4 (NPF4) (Scottish Government, 2023).

19.2 Approach and Methods

Structure of Assessment

19.2.1 The assessment of potential impacts of the proposed scheme on the attributes of the surface water environment in this chapter comprises the following:

- Flood Risk: potential risk of flooding from all sources to the proposed scheme or elsewhere as a result of the proposed scheme.
- Hydromorphology: the sensitivity of, and potential impacts upon, fluvial landforms associated with river systems, and the flow and sediment transport processes which create and sustain them.
- Surface Water Quality: potential impacts on the quality of the water from construction and operational runoff of pollutants, including both acute impacts from soluble pollutants and chronic impacts from sediment related pollutants and from spillage events.
- Surface Water Supply: potential impacts on the quality and quantity of surface water fed water supplies.

19.2.2 The surface water environment is also intrinsically linked to groundwater and ecological receptors, and associated impacts are considered in Chapter 13 (Geology and Soils) and Chapter 12 (Biodiversity) respectively. Groundwater fed water supplies are assessed in Chapter 13 (Geology and Soils), while commercial and recreational uses of the water environment are considered in Chapter 16 (Population – Land Use). The specialist teams undertaking each of these assessments worked collaboratively to consider interactions between the environmental discipline assessments and cross-referencing is provided throughout these chapters where relevant.

19.2.3 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 A3.2 (SEA Monitoring Framework).

Guidance and Standards

19.2.4 The assessment has considered relevant legislation, policy and regulations as outlined in Section 19.1 (Introduction), and the guidance documents as listed in Table 19.2 below.

Table 19.2: Guidance

Topic	Sources of Information
General Guidance	DMRB LA 104 'Environment assessment and monitoring', Revision 1 (Highways England et al., 2020a) (hereafter referred to as DMRB LA 104); DMRB LA 113 'Road Drainage and the Water Environment', Revision 1 (Highways England et al., 2020b) (hereafter referred to as DMRB LA 113);

Topic	Sources of Information
	DMRB LA 120 'Environmental management plans' Revision 1 (Highways England et al., 2020c); SEPA Guidance for Transport Infrastructure Projects (WAT-SG-93) (SEPA, 2018a); SEPA (WAT-SG-86) Registration Rules for Exposed Sediment Removal, Version 3 (SEPA, 2016b); SEPA Regulatory Method (WAT-RM-08), Sustainable Urban Drainage Systems (SEPA, 2019a); and SEPA Supporting Guidance (WAT-SG-75). Sector Specific Guidance: Water Run-Off from Construction Sites (SEPA, 2021).
Design and Best Practice Guidance	CIRIA C609: Sustainable drainage systems: Hydraulic, structural and water quality advice (CIRIA, 2004); CIRIA C741: Environmental Good Practice on Site (fourth edition) (CIRIA, 2015a); CIRIA C753: The SuDS Manual (CIRIA, 2015b); CIRIA C786: Culvert, screen and outfall manual (CIRIA, 2019); DMRB CD 529: Design of outfall and culvert details, Version 1.0.1 (Highways England et al., 2021) (hereafter referred to as DMRB CD 529); DMRB CG 501: Design of highway drainage systems, Version 2.1.0 (Highways England et al., 2022) (hereafter referred to as DMRB CG 501); River Crossings and Migratory Fish: Design Guidance (Scottish Executive, 2012); SEPA (WAT-PS-06-02) Culverting of Watercourses – Position Statement and Supporting Guidance (SEPA, 2015); SEPA (WAT-SG-23) Engineering in the Water Environment: Good Practice Guidance: Bank Protection Rivers and Lochs (SEPA, 2008); SEPA (WAT-SG-25) Engineering in the Water Environment: Good Practice Guidance: River crossings (SEPA, 2010b); SEPA (WAT-SG-26) Engineering in the Water Environment: Good Practice Guide: Sediment Management (SEPA, 2010c); SEPA (WAT-SG-28) Engineering in the Water Environment: Good Practice Guidance: Intakes and Outfalls (SEPA, 2019b); and SEPA (WAT-SG-29) Good Practice Guide: Temporary Construction Methods (SEPA, 2009).
Flood Risk Guidance	Climate change allowances for flood risk assessment in land use planning (LUPS-CC1), Version 5 (SEPA, 2024c). Flood Risk and Flood Risk Assessments (Perth & Kinross Council, 2021). Flood Risk and Land Use Vulnerability Guidance, July 2024 (SEPA, 2024g).

Topic	Sources of Information
	Scottish Government's Flood risk: planning advice (22 June 2015) (Scottish Government, 2015a); Technical Flood Risk Guidance for Stakeholders (SS-NFR-P-002), SEPA requirements for undertaking a Flood Risk Assessment, Version 13 (SEPA, 2022a).
Hydromorphology Guidance	Guidebook of Applied Fluvial Geomorphology (Sear et al., 2010); Manual of River Restoration Techniques (RRC, 2013); SEPA (WAT-PS-07-02) Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011: Bank Protection (SEPA, 2012a); SEPA (WAT-SG-21) Environmental Standards for River Morphology (SEPA, 2012b); SEPA (WAT-SG-30) Review of Impact Assessment Tools and Post Project Monitoring Guidance, Haycock Associates (Skinner, K & Thorne, C, 2005); The Fluvial Design Guide (Flood and Coastal Erosion Risk Management Research and Development Programme & Environment Agency, 2021); Applied Fluvial Geomorphology for River Engineering and Management (Thorne et al. 1997); The Scottish Rivers Handbook (CREW 2013); and Waterway Bank Protection: a guide to erosion assessment and management (Environment Agency, 1999).
Surface Water Quality Guidance	Code of Practice – Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff British Water (Undated); CIRIA C532: Control of water pollution from construction sites (CIRIA, 2001); 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 C768: Guidance on the construction of SuDS (CIRIA, 2017) CIRIA R142: Control of pollution from highway drainage discharge (CIRIA, 1994); Code of Practice for installers, owners and operators of underground storage tanks and pipelines (SEPA, 2006); and Guidance for Pollution Prevention (GPPs) (NRW, NIEA and SEPA, 2024).

Study Area

19.2.5 The baseline study area for this assessment extends 500m from the footprint of the proposed scheme (Figure 19.1) and includes each identified water feature (WF) including major to minor watercourses, drainage ditches and palaeochannels, existing watercourse crossings and flood inundation extents.

19.2.6 Where appropriate, the potential for flood risk impacts associated with the proposed scheme beyond the 500m study area are considered within the assessment.

19.2.7 For hydromorphology, if the total length of the watercourse was less than 500m, then the full watercourse was surveyed. For more sensitive watercourses, the study area was extended to 1km to allow for a more detailed assessment of the baseline characteristics and processes.

19.2.8 As described in Chapter 1 (Introduction), the southern section of the A9 Dualling Programme comprises five projects (from the Pass of Birnam to Glen Garry). The proposed scheme is within the lower part of the southern section and, for the purposes of this EIA, each assessed WF is referenced sequentially, e.g. Birnam Burn is WF01, Birnam Burn secondary channel is WF02 and so on.

Baseline Conditions

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

Desk-based Assessment

19.2.10 The desk-based assessment considered relevant guidance, legislation and regulations, as provided in Table 19.1 and Table 19.2. In addition, the data sources detailed in Table 19.3 have informed the assessments.

Table 19.3: Data sources

Topic	Sources of Information
Mapping and spatial data	Aerial photography (BLOM, 2013); British Geological Survey (BGS) Digital Mapping (BGS, 2024); Historical maps (National Library of Scotland, 2024); LiDAR topographical survey data (Scottish Government, 2020); and Ordnance Survey (OS) 1: 25,000 mapping and 1: 1,250 to 1: 10,000 MasterMap data.
Hydrological & WFD data	Flood Estimation Handbook (FEH) Centre for Ecology and Hydrology (CEH, 2024a); SEPA Flood Maps (SEPA, 2024d); Low Flows Enterprise (LFE) flow duration curve percentiles supplied by Wallingford Hydro Solutions; SEPA flow estimates (SEPA, 2016c) at four gauging stations on the Rivers Tay, Tummel and Garry;

Topic	Sources of Information
	National River Flow Archive (CEH, 2024b); SEPA river gauging data records for six gauging stations on the Rivers Tay, Braan, Tummel, Garry and Tilt (SEPA, 2016d); SEPA RBMP data and classification results available on the SEPA Water Environment Hub (SEPA, 2024e) and the SEPA Water Classification Hub (SEPA, 2024f); The River Basin Management Plan for Scotland 2021 – 2027 (Scottish Government and SEPA, 2021)
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); and A9 Dualling Pass of Birnam to Tay Crossing: DMRB Stage 2 Scheme Assessment Report, Volume 1: Main Report and Appendices, Part 3: Environmental Assessment (Transport Scotland, 2024).

Site Walkover and Surveys

19.2.11 The site walkovers and surveys undertaken to support the assessments are detailed in Table 19.4.

Table 19.4: Site walkover and surveys

Stage	Date	Surveys
DMRB Stage 2	April 2015, October 2016, February 2017	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.
	May 2016, March 2017	Areas of potential erosion along the River Tay were visited in May 2016 and March 2017 to inform the baseline erosion risk assessment.
	August 2018, February 2019	Geomorphological surveys, including on-site sample analysis and recording of current geomorphological processes to inform subsequent design stages (DMRB Stage 3, Specimen Design etc.)
DMRB Stage 3	August 2020	Surveys of existing minor culvert crossings and water feature geometry e.g. channel cross-sections and hydraulic structures, using conventional topographical survey techniques.

Stage	Date	Surveys
	September 2020	Flood risk site walkover, focussing on WF01 which was added to the scope since the last visit.
	February 2021	Flood risk site walkover.

Consultation

19.2.12 Details of the full consultation process for the proposed scheme are provided in Chapter 7 (Consultation and Scoping). Consultation relating to this assessment was undertaken with regulatory bodies and key stakeholders including SEPA, NatureScot, Perth & Kinross Council, Scottish Water, the Tay District Salmon Fisheries Board (TDSFB) and the Spey Fishery Board (SFB). Specific consultation undertaken during the DMRB Stage 2 and Stage 3 assessments is summarised in Table 19.5.

Table 19.5: Consultation undertaken for DMRB Stage 2 and DMRB Stage 3

Consultee	Date(s)	Aspect	Comments
Environmental Steering Group (ESG)	Various/ TBC	DMRB Stage 3 Assessment	The proposed scheme design and environmental assessment methods have been development with regular discussion with members of the Environmental Steering Group.
Scottish Water	October 2016	Water supply abstractions	Details of abstraction points within watercourses in hydraulic connection with the proposed scheme.
SEPA	April 2016	CAR licence locations	Provided GIS file of CAR licence locations.
	August 2016	Water quality chemistry data	Monthly water quality monitoring data for locations throughout Scotland.
	October 2019	DMRB Stage 2 Assessment	SEPA provided review of the draft DMRB Stage 2 Assessment and provided comment on the assessment of the proposed route options. Commentary focussed primarily on impacts and potential issues associated with Options ST2A and ST2B.
	April 2021		SEPA were consulted on the updates made to the DMRB Stage 2 Assessment undertaken to align the assessment with DMRB LA 113.

Consultee	Date(s)	Aspect	Comments
	June 2024	DMRB Stage 3 EIA Scoping Report	SEPA are generally satisfied with the proposed scope of the assessment. SEPA provided commentary on Flood Risk, Hydromorphology, SUDS and Construction environmental management.
	July 2024	CAR licence locations, Private Water Supply locations and MoRPH classifications	Provided updated dataset of CAR licence locations, PWS locations and MoRPH classifications for WFD water bodies.
	July 2024	Watercourse characteristics	SEPA were provided a list of watercourses present within the study area. These were categorised according to baseline characteristics. SEPA carried out inspections of these watercourses (Autumn 2024) to confirm these characteristics and provided feedback on features such as sediment availability erosion risk.
	December 2024	CAR licence and CAR registration information	Provided updated copies of the licences for the surface water / groundwater abstractions and discharges within a 2km study area. Provided locations of receiving water bodies from licensed discharges and source water bodies for licensed abstractions. Provided details of activities under the CAR Registrations.
Spey Fishery Board (SFB)	November 2014	Salt application on roads	SFB raised concerns for the wider A9 Dualling Programme over salt discharge into designated waters through SuDS and highlighted that existing drainage may 'percolate' through 'habitats'. See comment below and refer to Appendix A19.4 (SuDS and Water Quality) for the approach undertaken in relation to salt.

Consultee	Date(s)	Aspect	Comments
NatureScot	July 2015	Salt application on roads	NatureScot highlighted the issue of salt and importance in gaining an understanding of current discharge. SEPA does not hold any evidence to suggest salt from the A9 is a current threat; only concern that the A9 has few discharge points. Transport Scotland should consider salt issues in relation to the A9 Dualling Programme. Refer to Appendix A19.4 (SuDS and Water Quality) for the approach undertaken in relation to salt.

19.2.13 Flooding issues were raised at public exhibitions, correspondence and consultation meetings with landowners and members of the public, which provided opportunities to capture local evidence and concerns. Information obtained from this consultation was used to inform the baseline assessment and to help calibrate model findings and mitigation, where appropriate.

Impact Assessment

Introduction

19.2.14 The impact assessment reported in this chapter was undertaken in accordance with the guidance provided in DMRB LA 113 (Highways England et al., 2020b), whereby the level of significance of a potential impact, on the existing baseline condition of the surface water environment, is determined by factoring the importance 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. In accordance with DMRB LA 104 and DMRB LA 113, embedded mitigation measures are to be integrated into design proposals and as a result any applicable environmental effects inclusive of them are outlined within Section 19.4 (Potential Impacts and Effects).

19.2.15 The importance and magnitude criteria and applicable scheme examples presented in Table 19.6 and Table 19.7 represent a development of those provided within DMRB LA 113, as well as professional judgement, to reflect the local sensitivities and other regulatory guidance. This follows DMRB LA 113, which states that the typical examples should be used as a gauge.

Flood Risk

19.2.16 The assessment of potential impacts on 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 53% allowance for climate change (CC) flood event, for main watercourses, and 39% for minor watercourses in line with current SEPA guidance (SEPA, 2024c); hereafter referred to as the 0.5% AEP (200-year) plus CC event.

19.2.17 AEP refers to the chance that a flood of a particular size is experienced or exceeded during any year. To quantify this, a probability value is expressed as a percentage. 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. For the Tay River basin 53% was added to the 0.5% AEP (200-year) flood flow estimations, to allow for the potential effects of CC, in accordance with current guidance (SEPA, 2024c). 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.

Hydromorphology

19.2.18 The Scotland National Application Annex to DMRB LA 113 (S/1.13 to S/1.16), herein referred to as the 'National Annex to LA 113', requires a hydromorphological assessment of affected water bodies to ensure the requirements of CAR are embedded during the EIA process. The significant effects on hydromorphology have been documented, with an assessment made on the acceptability of any potential changes as well as commenting on whether the changes are compliant with the requirements of WFD.

19.2.19 Assessment of potential impacts on hydromorphology considered both upstream and downstream changes which have the potential to cause a deterioration in WFD morphological status or prevent the watercourse from achieving 'Good' status. For non-WFD classified watercourses, impacts are assessed on the potential disturbance to the existing watercourses bed, banks, riparian corridor, channel planform, cross section, morphological features and sediment transport capabilities.

19.2.20 The assessment of hydromorphology impacts was undertaken using standard good practice and guidance notes from SEPA noted in Table 19.2, in the absence of specific methodologies for the assessment of hydromorphology with respect to road developments.

Surface Water Quality

19.2.21 The assessment of potential impacts on water quality includes any potential deterioration from construction and operational runoff and changes to WFD classification as specified within DMRB LA 113.

Surface Water Supply

19.2.22 The assessment of potential impacts on water supply considered any disruption, pollution or severance of any surface water public or private water supplies or water supply infrastructure.

<u>Importance</u>

19.2.23 The importance of surface water features was categorised on a scale of 'low' to 'very high' using various sources of information described below, as well as professional judgement, with reference to the criteria and applicable scheme examples provided in Table 19.6.

19.2.24 Supporting information is provided within the relevant technical appendices for flood risk, hydromorphology, surface water quality and Appendix A19.1 (Baseline Conditions).

19.2.25 For flood risk, the importance was based on SEPA Flood Risk and Land Use Vulnerability Guidance, hereafter referred to as SEPA LUPS-GU24 (SEPA, 2024g). The level of importance (very high, high, medium and low) was assigned to watercourses taking into account the likelihood of flooding to identified receptors during the 0.5% AEP (200-year) plus CC event (SEPA, 2022a) and translates directly to the Land Use Vulnerability Classification contained within SEPA Land use vulnerability guidance (SEPA, 2024g). Most Vulnerable Uses in a flooding context include vulnerable land uses and development, essential infrastructure and water compatible uses defined in line with Policy 22 of NPF4.

19.2.26 The importance assessment of surface water quality was informed by the WFD water body overall status and relevant parameters on its Water Environment Hub and Water Classification Hub websites (SEPA, 2024e; SEPA, 2024f). Where no WFD data exists for smaller/minor water features, potential deterioration of water quality from anthropogenic pressures, discharges and surrounding land use relative to flow volume is assessed. In addition, Q_{95} flows and the presence of any protected/designated sites are used in the assessment.

19.2.27 Surface Water Supply is assessed ‘very high’ or ‘high’ importance only in relation to the number of properties/receptors a water resource is supplying.

Table 19.6: Importance criteria and examples

Importance	DMRB LA 113 Typical Examples	Applicable Scheme Examples
Very High	**Nationally significant attribute of high importance**	
	Surface water: Watercourse having a WFD classification shown in a RBMP and $Q_{95} \geq 1.0m^3/s$. **Site**: protected/designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water)/species protected by EC legislation. **Flood Risk:** Essential infrastructure or highly vulnerable development.	**Flood Risk**
		Most Vulnerable Land Uses, including essential infrastructure as defined in SEPA LUPS-GU24 (SEPA, 2024g) at risk from flooding during the 0.5% AEP (200-year) plus CC event.
		Hydromorphology
		WFD classified water body achieving 'High' Morphology status. WFD classified water body considered to be sensitive to additional morphological pressures as it is within 2.5% of a morphological condition limit boundary (e.g. High/Good, Good/Moderate, Moderate/Poor). Non WFD classified watercourses may be applicable if they demonstrate qualities such as: a channel in stable equilibrium and exhibiting a range of natural morphological features (such as pools, riffles and bars); diversity in morphological processes reflects unconstrained natural function; free from artificial modification or anthropogenic influence.
		Surface Water Quality
		WFD classified water body achieving 'High' Physico-chemical and Biological elements status, 'Pass' for Specific pollutants and /or Priority substances. Q_{95} likely to be $\geq 1.0m^3/s$. Watercourse part of a site protected/designated under International/EC/EU or UK legislation (SAC, SPA, SSSI, Ramsar site). Non WFD classified watercourses may be applicable if part of a protected site.
		Surface Water Supply
		Water resource extensively exploited for public, private domestic and/or agricultural and/or industrial use, feeding ten or more properties.
High	**Locally significant attribute of high importance**	

Importance	DMRB LA 113 Typical Examples	Applicable Scheme Examples
	Surface water: Watercourse having a WFD classification shown in an RBMP and Q_{95} <1.0m³/s. **Flood risk:** More vulnerable development.	**Flood Risk**
		Highly Vulnerable Land Uses as defined in SEPA LUPS-GU24 (SEPA, 2024g) at risk from flooding during the 0.5% AEP (200-year) plus CC event.
		Hydromorphology
		WFD classified water body achieving or having established RBMP objectives (for a later RBMP cycle) to achieve 'Good' Morphology status. Non WFD classified watercourses may be applicable if they demonstrate qualities such as: a channel achieving near-stable equilibrium and exhibiting a range of natural morphological features (such as pools, riffles and bars); diversity in morphological processes reflects relatively unconstrained natural function, with minor artificial modification or anthropogenic influence.
		Surface Water Quality
		WFD classified water body achieving or having established RBMP objectives (for a later RBMP cycle) to achieve 'Good' Physico-chemical and Biological elements status ('Good potential' for HMWBs), 'Pass' for Specific pollutants and /or Priority substances. Q_{95} likely to be <1.0m³/s. Contains species protected under EC or UK legislation Ecology and Nature Conservation but is not part of a protected site. Non WFD classified water bodies may be applicable if protected species are present, indicating good water quality and supporting habitat.
		Surface Water Supply
		Valuable water supply resource due to exploitation for public, private domestic and/or agricultural and/or industrial use, feeding fewer than 10 properties.
Medium	**Of moderate quality and rarity.**	
		Flood Risk

Importance	DMRB LA 113 Typical Examples	Applicable Scheme Examples
	Surface water: Watercourses not having a WFD classification shown in an RBMP and Q_{95} >0.001m³/s. **Flood risk:** Less vulnerable development.	Least Vulnerable Land Uses as defined in SEPA LUPS-GU24 (SEPA, 2024g) at risk from flooding during the 0.5% AEP (200-year) plus CC event.
		Hydromorphology
		Water body not classified under WFD. A channel currently showing signs of historical or existing modification and artificial constraints. Attempting to recover to a natural equilibrium and exhibiting a limited range of natural morphological features (such as pools, riffles and bars).
		Surface Water Quality
		Water body not classified under WFD. May have a number of anthropogenic pressures and/or pollutant inputs from discharges (licenced under CAR) and/or surrounding land-use relative to flow volume. Q_{95} likely to be >0.001m³/s.
Low	**Lower quality**	
	Surface water: Water body not having a WFD classification shown in a RBMP and Q_{95} ≤0.001m³/s **Flood risk:** Water compatible development.	**Flood Risk**
		Water Compatible Land Uses as defined in SEPA LUPS-GU24 (SEPA, 2024g) at risk from flooding during the 0.5% AEP (200-year) plus CC event.
		Hydromorphology
		Water body not classified under WFD. A channel currently showing signs of extensive historical or existing modification and artificial constraints. There is no evidence of diverse fluvial processes and morphology and active recovery to a natural equilibrium.
		Surface Water Quality
		Water body not having a WFD classification shown in a RBMP. May have a large number of anthropogenic pressures and/or pollutant inputs from discharges (licenced under CAR) and/or surrounding land-use relative to flow volume. Q_{95} likely to be ≤0.001m³/s.

Impact Magnitude

19.2.28 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 applicable scheme examples provided in Table 19.7 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, in addition to the likelihood or probability of occurrence.

19.2.29 The highest magnitude of impact is applied when any one of the criteria are met from the adverse categories presented in Table 19.7.

19.2.30 The classification of magnitude of impact on flood risk in Table 19.7 below follows the guidance in DMRB LA 113. In Scotland, the design standard (from Scottish Government, 2023 and SEPA, 2022a) is the 0.5% AEP (200-year) event; the assessment uses this design flood event and also includes an allowance for climate change impacts to align with best practice principles of long-term sustainability as detailed in NPF4.

19.2.31 To meet the requirements of the WEWS Act, the assessment of the magnitude of impact on hydromorphology takes into account the potential impacts on the morphological status of the WFD water bodies, as published on the SEPA Water Environment Hub website (SEPA, 2024e) and is covered in Appendix A19.3 (Watercourse Crossings Report).

Table 19.7: Magnitude criteria and examples

Magnitude	DMRB LA 113 Criteria	Applicable Scheme Examples
Major adverse	Results in loss of attribute and/or quality and integrity of the attribute.	**Flood Risk**
		Increase in peak flood water level for the 0.5% AEP (200-year) plus CC event of ≥ 100mm.
		Hydromorphology
		Loss of, or extensive adverse changes to the watercourse bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes. Impacts would be at the water body scale. For WFD classified water bodies, impacts have the potential to cause deterioration on morphology status or prevent the achievement of 'Good' Morphology status due to an increase in the extent of morphological pressures on the water body.
		Surface Water Quality
		Construction works in-channel and/or extensive construction works adjacent to a watercourse which are therefore likely to risk a major, measurable shift from baseline water quality. Risk of adverse impacts on protected aquatic species. Construction works on multiple tributaries of a watercourse resulting in the risk of a significant cumulative impacts on water quality. Loss or extensive change to a designated nature conservation site. Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT and compliance failure with EQS values. Calculated risk of pollution from a spillage ≥2% annually (spillage assessment). For WFD classified water bodies, water quality impacts have the potential to cause deterioration in WFD status.
		Surface Water Supply
		Long term loss or change to water supply.
Moderate adverse	Results in effect on integrity of	**Flood Risk**
		Increase in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of ≥ 50mm and < 100mm.
		Hydromorphology

Magnitude	DMRB LA 113 Criteria	Applicable Scheme Examples
	attribute, or loss of part of attribute.	Adverse changes to on the water feature bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes. Impacts would be at the reach scale. For WFD classified water bodies, impacts may increase the extent of morphological pressures. May contribute to, but not cause a deterioration of Morphology status.
		Surface Water Quality
		Construction works adjacent to a watercourse which are therefore likely to risk a moderate, measurable shift away from baseline water quality. Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values. Calculated risk of pollution from spillages ≥1% annually and <2% annually. Partial loss in productivity of a fishery. For WFD classified water bodies, water quality impacts may contribute to, but not cause a reduction in water body WFD classification.
		Surface Water Supply
		Temporary disruption or deterioration in a water supply.
Minor adverse	Results in some measurable change in attributes, quality or vulnerability.	**Flood Risk**
		Increase in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of ≥10mm and < 50mm.
		Hydromorphology
		Slight adverse changes to/impacts on the water feature bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes. Impacts would be at the local scale. For WFD classified water bodies, impacts may result in a slight increase the extent of morphological pressures or occur where there are existing morphological pressures. Morphology status unaffected.
		Surface Water Quality

Magnitude	DMRB LA 113 Criteria	Applicable Scheme Examples
		Construction works within the watercourse catchment that may result in a risk of a minor, measurable shift from baseline water quality. Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. Calculated risk of pollution from spillages ≥0.5% annually and <1% annually.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	**Flood Risk**
		Negligible change in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event of up to <+/- 10mm.
		Hydromorphology
		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.
		Surface Water Quality
		Construction works within the watercourse catchment that are not anticipated to result in a risk of a change in water quality. No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). Risk of pollution from spillages <0.5%.
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	**Flood Risk**
		Creation of additional flood storage and decrease in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event ≥ 10mm and < 50mm.
		Hydromorphology
		Potential for slight improvements to channel morphology. For WFD classified water bodies, impacts may result in a slight decrease in the extent of morphological pressures but insufficient in extent to improve water body WFD morphology classification.
		Surface Water Quality

Magnitude	DMRB LA 113 Criteria	Applicable Scheme Examples
		HEWRAT assessment of either acute soluble or chronic-sediment related 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 attribute quality	**Flood Risk**
		Creation of flood storage and decrease in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event > 50mm and ≤ 100mm.
		Hydromorphology
		Potential for modest improvements to channel morphology. For WFD classified water bodies, impacts may decrease the extent of morphological pressures and contributes to (but does not cause) an improvement in WFD Morphology classification.
		Surface Water Quality
		HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition. Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually). Contribution to improvement in water body WFD classification.
Major beneficial	Results in major improvement of attribute quality	**Flood Risk**
		Creation of flood storage and decrease in peak flood water level for the 0.5% AEP (200-year) plus CC design flood event ≥100mm.
		Hydromorphology
		Potential for major improvements to channel morphology. For WFD classified water bodies, impacts would decrease the extent of morphological pressures sufficiently to result in an improvement in water body WFD Morphology classification.
		Surface Water Quality
		Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse.

Magnitude	DMRB LA 113 Criteria	Applicable Scheme Examples
		Improvement in water body WFD classification.

Significance

19.2.32 The significance of effect is determined as a function of the importance of the surface water feature and the magnitude of a predicted impact. According to the environmental assessment methodology within DMRB LA 104 Scotland National Application Annex, specifically for projects in Scotland, the significance of any effect shall be reported including embedded mitigation measures. Any residual effects shall be reported after assessment of the effectiveness of essential mitigation measures required to reduce and, if possible, offset likely significant adverse environmental effects.

19.2.33 For the purposes of this assessment, '**Moderate'** or higher significant effects are considered significant in the context of The Roads (Scotland) Act 1984 (Environmental Impact Assessment) (Scotland) Regulations 2017 (hereafter referred to as the EIA Regulations). The matrix for the determination of significance, provided in the DMRB LA 104 guidance is shown in Table 19.8, and significant effects of Moderate or above are highlighted in bold.

Table 19.8: Matrix for determination of significance*

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

*Note the above matrix has been adapted from Table 3.8.1 of DMRB LA 104 and does not include a magnitude of 'No Change' or an importance of 'Negligible' as these categories are not included in DMRB LA 113.

19.2.34 Where the matrix indicates two alternative options (e.g. Slight or Moderate), evidence would be provided which supports the reporting of a single significance category. This would be based on professional judgement, considering the importance of receptor and duration or extent of works, in accordance with the DMRB LA 104 guidance.

19.2.35 The selection of a higher significance may be chosen where a greater number of high-risk activities are proposed. Examples where a lower significance may be selected include where no in-channel works are proposed, and where flood risk impacts occur on agricultural land or woodland as opposed to critical infrastructure or residential properties.

19.2.36 It should be noted that for flood risk there is the legal requirement to avoid any increase flood risk where feasible as part of DMRB Stage 3 design development in line with NPF4 and FRMA. This mitigation or avoidance of any increased flood risk is therefore considered irrespective of the significance classification as set out in this chapter and Section 19.5 (Mitigation) includes mitigation measures for any increase in flood risk.

Specific Methodologies

19.2.37 The specific methodologies developed for this assessment are described below.

Flood Risk

19.2.38 A flood risk assessment has been undertaken (Appendix A19.2 (Flood Risk Assessment)) following SEPA's 'Technical Flood Risk Guidance for Stakeholders' (SEPA, 2022a), 'Climate Change Allowances for Flood Risk Assessment in Land Use Planning' (LUPS-CC1) (SEPA, 2024c), and giving consideration to the guidance within DMRB LA 113.

19.2.39 For WF06 (River Tay) and its larger tributaries within the study area, a linked one-dimensional (1D)/two-dimensional (2D) hydraulic model was developed. The river channel is represented as a 1D component using Flood Modeller software, linked dynamically to the floodplain, which is represented in 2D, using TUFLOW software. Tributaries modelled include WF08 (Inchewan Burn), WF11 (River Braan) and WF12 (Mill Stream), all of which are referred to in Appendix A19.2 (Flood Risk Assessment) as 'principal watercourses'. Hydraulic modelling was also undertaken for minor watercourses WF09, WF13 and WF16, also covered in Appendix A19.2 (Flood Risk Assessment) as 'minor watercourses'. Hydraulic spreadsheet-based calculations were undertaken to assess flood risk from the remaining minor watercourses.

19.2.40 The differing methodologies employed to assess pluvial flood risk, groundwater flooding and flood risk associated with the proposed road drainage system are set out in Appendix A19.2 (Flood Risk Assessment).

19.2.41 The impacts of flood risk on human health are assessed in Chapter 18 (Human Health).

Hydromorphology

19.2.42 The assessment of potential impacts on the hydromorphology of the surface water features affected by the proposed scheme was carried out following SEPA guidance 'Environmental Standards for River Morphology' (WAT-SG-21; SEPA 2012b).

19.2.43 Full details of the hydromorphological baseline surveys and methodology of assessments are provided in Appendix A19.3 (Watercourse Crossings Report).

Surface Water Quality

19.2.44 Assessment of the construction impacts on surface water quality were undertaken in accordance with the magnitude criteria and examples detailed in Table 19.7.

19.2.45 Specific water quality assessments were carried out to assess the impacts on the water environment from the operation of the proposed scheme. The assessment of operational impacts relating to routine runoff and spillage risk was undertaken in line with the methods contained in DMRB LA 113 using the Highways England Water Risk Assessment Tool (HEWRAT), and a summary of the methodologies adopted for the assessment is provided in Appendix A19.4 (SuDS and Water Quality).

19.2.46 An additional assessment of the impacts from de-icing activities (specifically from chloride) and associated SuDS requirements for side road drainage was undertaken using the Simple Index Approach (CIRIA, 2015b). These assessments do not inform the impact assessment presented within this chapter due to the limitations associated with the methods, however, the conclusions are discussed qualitatively within Appendix A19.4 (SuDS and Water Quality) and the SuDS requirements for side roads are incorporated in essential mitigation items in Section 19.5 (Mitigation).

Surface Water Supply

19.2.47 Surface water supply assessments were carried out to identify abstractions within watercourses hydraulically connected to the proposed scheme. The identification was based on the information obtained through desk studies, consultation with local authorities and SEPA, as well as site visits (refer to Chapter 13: Geology and Soils).

Cumulative Effects

19.2.48 Potentially significant cumulative effects of the proposed scheme, and those of the proposed scheme in combination with other reasonably foreseeable developments, are assessed in Chapter 21 (Assessment of Cumulative Effects).

Limitations to DMRB Stage 3 Assessment

19.2.49 Baseline conditions described in Appendix A19.1 (Baseline Conditions) were informed by site walkover observations with surveys of water features made at specific times and water levels. It is acknowledged that seasonal variables (such as water 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; however, such limitations are common to all aquatic field studies.

Flood Risk

19.2.50 Although there are no flow gauging stations located within the 500m study area on WF06 (River Tay), gauging stations at Caputh on the River Tay (Station ID:15003, 2.4km downstream of the study area) and Hermitage on the River Braan (Station ID:15023, 1.4km upstream of the confluence with the River Tay, within the study area) were used to estimate the design inflows in the principal watercourses model, as they are close to the principal watercourse model extent. As insufficient gauge data was available to calibrate the hydraulic models, a high-level verification was carried out based on collected wrack mark levels and historical records for three past flood events (30 December 2015, 26 January 2008, 14 December 2006). Inflow time series for these events were obtained from the two aforementioned gauging stations.

19.2.51 The minor watercourses within the study area have small ungauged catchments. Design flows for these watercourses were estimated using FEH rainfall-runoff models and the FEH statistical method with default parameters based on catchment descriptors. No calibration or verification could be undertaken for these watercourses.

19.2.52 The hydraulic modelling software has a numerical convergence tolerance of +/- 10mm on water levels and there are further uncertainties within the survey data and hydrological and hydraulic parameters used to construct the model. Further details are available within Appendix A19.2 (Flood Risk Assessment). These uncertainties are applicable to both the baseline and proposed scheme modelling and are therefore not considered to impact the assessment of flood risk to the scheme unduly. The inherent uncertainties are addressed via the incorporation of freeboard within the proposed scheme design. Modelling results are reported to the nearest mm to allow for the comparison of baseline and proposed water levels, but it is emphasised that they are subject to these uncertainties.

19.2.53 Flood risk related to groundwater sources is not specifically addressed within this chapter; however, consideration of potential impacts on flood risk in relation to artesian conditions is reported in Chapter 13 (Geology and Soils) and Appendix A19.2 (Flood Risk Assessment). In addition, flood risk related to the failure of water-retaining infrastructure is reported in Appendix A19.2 (Flood Risk Assessment).

Hydromorphology

19.2.54 Many watercourses were observed between February and March 2019, therefore, the predominant sediment regime and processes operating within the channel were inferred using best available site data and desk-based information. Measurements obtained during geomorphological surveys were taken with respect to 'normal' flow conditions (e.g. bankfull) as observed at the time of survey. Where geomorphological issues were identified, further investigations to inform the design process made use of detailed topographic survey data.

19.2.55 Data required for numerical modelling of sediment input, transfer or deposition during road operation or construction was not collected as it is beyond the scope of this assessment, and due to the small size of most watercourses preventing accurate sediment sampling. The assessment of the potential impacts of the construction and operation of the proposed scheme upon the sediment regime for each watercourse is based on the existing baseline conditions. Sufficient information related to bed sediment has been recorded for the purposes of this stage of assessment through on-site survey observations.

19.2.56 All watercourses potentially impacted by the proposed scheme were surveyed over a minimum 500m reach length (or over the full reach if the watercourse was shorter than 500m), extending 250m upstream and 250m downstream, where accessible from proposed crossing point. Survey extents depended on the availability of land access, but where permissible. For more sensitive watercourses, the study area was extended to 1km to allow for a more detailed assessment of the baseline characteristics and processes.

19.2.57 It is not possible to fully assess the potential impacts of construction before the construction programme of works is developed, including the location of temporary access roads and timing of construction. However, an assessment was made of the likely potential impacts during construction upon each watercourse affected, based upon best available data at the time of writing. Assumptions include requirements for in-channel and bankside working, as well as the construction and use of access tracks, compounds and storage facilities.

Surface Water Quality

19.2.58 The basic data that has informed the HEWRAT tool is derived from several English motorways, which is noted as causing some notable differences when applied to the proposed scheme due to comparatively lower traffic volumes. The rainfall data used within the tool is taken from the nearest rainfall station (Ardtalnaig), which lies approximately 30km west of the proposed scheme.

19.2.59 The quoted SuDS treatment efficiencies taken from DMRB CG 501 (Highways England et al., 2022) are derived from limited studies and do not account for the length or size of certain SuDS components.

19.2.60 Further limitations relating to the water quality assessments undertaken are also provided in Appendix A19.4 (SuDS and Water Quality).

Surface Water Supply

19.2.61 The identification of private water supplies (PWS) was based on the information obtained through desk studies, consultation with land owners, local authorities and SEPA, as well as site visits (refer to Chapter 13: Geology and Soils). Reasonable skill, care and diligence were exercised in identifying PWS; however, there may be 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.

19.3 Baseline Conditions

Water Features

19.3.1 A detailed description of all water features affected by the proposed scheme is provided within Appendix A19.1 (Baseline Conditions). This includes the baseline conditions for all water environment attributes covered within this chapter, namely: Flood Risk, Hydromorphology, Surface Water Quality and Surface Water Supply. As part of the baseline assessment for all water features, an importance rating has been determined for each water environment attribute based on the criteria described in Table 19.6.

19.3.2 Within the 500m study area, 20 water features were initially identified, which range from large water bodies with European-level designations to minor straightened road and field drains, which provide only a functional land drainage benefit.

19.3.3 As described in Chapter 1 (Introduction), the southern section of the A9 Dualling Programme comprises four projects currently progressing through the DMRB design and assessment process (from the Pass of Birnam to Glen Garry). The majority of identified water features within this southern section were referenced sequentially from south to north. The water features within the Pass of Birnam to Tay Crossing section are therefore numbered from WF01 to WF18, with additional water features WF186 and WF187 appearing out of sequence.

19.3.4 The locations of all water features, with corresponding identification references, proposed scheme crossing locations and flood inundation extents are shown on Figures 19.1 and 19.2.

19.3.5 The baseline assessment includes consideration of river typology in line with the 'Environmental Standards for River Morphology' guidance document (SEPA, 2012b). The different types and definitions of water features identified within the study area are described in Table 19.9.

Table 19.9: Types and definitions of water features within the study area

Water Feature Type	Definition	Example within the Study Area	
Major watercourse	Natural river Width >10m	**Photograph 19.1** WF06 (River Tay) – view upstream towards Dunkeld and Birnam.	
Medium watercourse	Natural river Width 2-10m	**Photograph 19.2** WF08 (Inchewan Burn) – downstream view in Birnam.	

Water Feature Type	Definition	Example within the Study Area	
Minor watercourse	Natural or modified watercourse Width 2-5m	**Photograph 19.3** WF01 (Birnam Burn) View – Upstream of A9 looking upstream.	
Drainage channel	Artificial field, forest or road drainage channel. May be ephemeral or have intermittent flow Width <2m	**Photograph 19.4** WF12A upstream view upstream of existing A9 and Highland Main Railway Line.	

SEPA Monitored Surface Water Features

19.3.6 Flows within the majority of water features within the study area are not monitored by SEPA. Only two of the larger water features are currently monitored under WFD, as discussed in Section 19.2.49, comprising:

- WF06 (River Tay (Reach: River Tummel to River Isla confluence)); and
- WF11 (River Braan).

Licenced Abstractions and Discharges

19.3.7 As advised by SEPA (Table 19.5), there are discharges, abstractions and impoundments licenced under CAR within the study area. Licenced discharges are detailed in Table 19.10. The locations of the licenced activities are further detailed in Appendix A19.1 (Baseline Conditions).

Table 19.10: Licenced activities (abstractions, discharges and impoundments)

Water Feature	Total Number Licenced Activities	Number of Licenced Activities
WF06 (River Tay)	11	Combined Sewer Overflow (CSO) discharges (7)
		Engineering works (1)
		Private sewage treatment works discharge (2)
		Abstraction for agricultural irrigation (1)
WF11 (River Braan)	2	Engineering works (2)
WF12 (Mill Stream)	1	Private sewage treatment works discharge (1)

Water Supply

19.3.8 There is one surface water supply abstraction from the River Tay within the study area, an agricultural abstraction at Inchmagrannachan Farm for irrigation at approximately National Grid Reference (NGR) NO 00110 44479. This is considered to be of high importance.

Chapter 13 (Geology and Soils) provides a full list of septic tanks and soakaways and PWS information, including those from springs and groundwater sources, within 850m of the proposed scheme.

Existing Road Drainage Network

19.3.9 Treatment of routine runoff from the existing A9 between Pass of Birnam and Tay Crossing is generally limited, consisting of kerbs and gullies which direct untreated road runoff to an outfall into the nearest water feature. In certain areas there are lengths of filter drain in the verges that provide initial (one SuDS level) of treatment for some of the runoff from the road and/or adjacent earthworks slopes.

Existing Flood Risk

19.3.10 The characterisation of baseline flood risk is described in detail in Appendix A19.2 (Flood Risk Assessment). This includes an assessment of existing flood risk from rivers (fluvial), surface water (pluvial), groundwater, sewers and failure of water-retaining infrastructure.

19.3.11 Current fluvial flood risk is described for each watercourse in Appendix A19.1 (Baseline Conditions) and a summary of existing fluvial and pluvial flood risk from Appendix A19.2 (Flood Risk Assessment) is provided below.

Fluvial Flood Risk

19.3.12 Existing fluvial flood risk was separated into flood risk from principal watercourses (medium/major watercourses assigned as 'principal' for the purpose of the flood risk assessment) and flood risk from minor watercourses (including drainage channels) and reported in the subsequent sections. Within the proposed scheme there are four identified principal watercourses (WF06 (River Tay), WF11 (River Braan), WF08 (Inchewan Burn) and WF12 (Mill Stream)) and 12 minor watercourses which are conveyed beneath the existing A9 by culvert or bridge structures and are therefore identified as potentially being affected by the proposed scheme. The four remaining watercourses within the study area have been scoped out of the fluvial flood risk assessment as they do not cross the scheme. This means there is a total of 16 watercourses included in the scope of this assessment.

Principal Watercourses

19.3.13 The SEPA Flood Maps (SEPA, 2024b) indicate that the majority of the existing A9 road between Pass of Birnam and the Tay Crossing is located outwith the predicted 0.5% AEP (200-year) flood extent. This is except for the short section of approximately 650m from WF11 (River Braan) crossing to the WF12 (Mill Stream) crossing, which runs through the functional floodplain (area with greater than 0.5% probability of flooding in any year) of WF06 (River Tay) and WF11 (River Braan).

19.3.14 The hydraulic model of the principal watercourses indicates that during the design flood event, there is a flooding risk to the existing A9 at Inver from WF11 (River Braan) and WF06 (River Tay) between the WF11 (River Braan) crossing to north of the WF12 (Mill Stream) crossing (between ch4300-ch4970).

19.3.15 The following additional receptors have been assessed to be at flood risk from the 0.5% AEP (200-year) plus CC event:

- 20-25 properties are at risk of flooding from WF11 (River Braan) and WF12 (Mill Stream) at Inver;
- 65-70 static caravans are at risk of flooding from WF11 (River Braan) at Inver Mill Caravan Site;
- 45-55 properties and the Royal School of Dunkeld are at risk of flooding from WF06 (River Tay) in Little Dunkeld;
- 60-65 properties are at risk of flooding from WF06 (River Tay) in Dunkeld;
- Three properties may be at risk of flooding north of Oak Road and one on the opposite bank of WF06 (River Tay); and
- 10 properties at Torlee Road and the sewage treatment works are at risk of flooding from WF06 (River Tay).

19.3.16 A more detailed discussion of flood risk to properties within the modelled extent is included in Appendix A19.2 (Flood Risk Assessment).

Minor Watercourses

19.3.17 There are 16 water features within the study area assessed as being minor watercourses. These are typically smaller unnamed streams with relatively small catchment areas (<4.5km^2). Of these, 12 are minor watercourses which are culverted under the existing A9. During the design flood event, the peak flow estimates for these watercourses range from 0.10m^3/s to 3.44m^3/s, compared to a peak flow on WF06 (River Tay) of 3,162m^3/s.

19.3.18 Hydraulic assessment has been undertaken on these watercourses to identify those which may pose a direct flood risk to the existing A9 during the design flood event. The baseline culvert assessment indicates that eight culverts are predicted to surcharge during the design event and that there are two water features considered to pose a direct flood risk to the existing A9; the predicted upstream water level is less than 0.6m below the existing road level. A freeboard of 0.6m (distance between top flood level and road level) has been considered necessary, as specified in SEPA guidance (SEPA, 2022a). Three minor watercourses have been subject to hydraulic modelling, WF09, WF13 and WF16. The baseline hydraulic modelling results show WF13 surcharges during the design event, however, the WF16 headwater level remains in bank during the design event.

Surface Water (Pluvial) Flood Risk

19.3.19 The SEPA Surface Water (pluvial) Flood Map (SEPA, 2024d) shows scattered areas identified as at risk of surface water flooding in a 10% AEP (10-year) storm. These are areas with a high probability of surface water flooding. Overland flow path analysis (a methodology using topographic data to produce theoretical surface water flow paths) identified areas of particularly high surface water flood sensitivity. Surface water flooding to the existing A9 is predicted in isolated areas along the length of the study area. The general areas of the existing A9 identified as being at potential risk of pluvial flooding are:

- adjacent to Dalpowie Plantation;
- adjacent to the Birnam Sewage Treatment Works;
- adjacent to and north of the A9 Inver Rail crossing;
- adjacent to the northbound carriageway south of Dunkeld & Birnam Station between the existing road embankment and the Highland Main Line railway embankment;
- along the northbound carriageway of the north of Dunkeld & Birnam Station in an area where the carriageway is in cutting;
- in isolated areas of the carriageway adjacent to Inver between the existing River Braan crossing and the Inver Railway Crossing; and
- in isolated area of the carriageway north-west of the Inver Railway Crossing.

19.3.20 Extensive surface water ponding is also seen against the upstream embankment of the existing A9 at Dalguise Junction, within an area of farmland to the west of the A9, which has a steep hillside to the west. In addition, there are multiple areas of surface water flooding that do not directly interact with the A9 within the study area, including in Birnam, Little Dunkeld, Dunkeld and Inver.

Sewer Flood Risk

19.3.21 Scottish Water sewer records indicate that the scheme does not cause a detriment to the risk of flooding from sewers.

Infrastructure Failure Flood Risk

19.3.22 The project area is downstream of a number of reservoirs, whose failure could result in flood risk to the existing A9 and other receptors within the project area. Reservoirs where SEPA breach modelling (SEPA, 2022b) indicates flood risk to the project area include Loch Rannoch, Errochty Reservoir, Loch Derculich, Loch Tummel, Loch Faskally, Loch Broom, Loch Ordie, Glen Lyon, Loch Ericht, Loch An Daimh, Loch Garry Reservoir and Dunalastair Reservoir.

19.3.23 Stare Dam Reservoir is located to the south of the proposed scheme, upstream of the Birnam Burn sections within the project area. Failure of this reservoir could also result in flooding to the existing A9 and other receptors within the project area.

19.3.24 It should be noted that the reservoirs listed are regulated under the Reservoirs (Scotland) Act 2011 and therefore the risk of failure is considered to be low.

19.3.25 Failure or blockage of the existing road drainage network could result in flooding to receptors downstream, including the existing A9 and local properties located below road level. Flood depths as a result of such blockages are likely to be low and the risk is reduced through maintenance. Further discussion on the potential impact of blockages can be found in Appendix A19.2 (Flood Risk Assessment).

Erosion Risk

19.3.26 Erosion has been observed across a number of watercourses within the study area. For WF01, WF09, WF12A, WF14 and WF16, bank erosion is dormant and localised to either adjacent structures and/or morphological features.

19.3.27 Along WF13 and WF18, bank erosion is largely insignificant, with the exception of some headcut erosion near the existing A9 culverts, two upstream locations along WF13 and at blockwork failures at the existing A9 culvert outlet at WF18.

19.3.28 In addition, erosion and bank failure has also been observed and could pose a potential risk at the following locations:

- Along WF06 (River Tay): active to dormant bank erosion and cantilever geotechnical failures have been noted opposite to hardpoints along the channel and point bars.
- WF08 (Inchewan Burn): exhibited bank erosion, downstream of the A9, opposite a bar where reinforcement was absent. This erosion is likely derived from the steep bank gradient, cleared vegetation, impinging flows and the shallow slides already present.
- Along WF11 (River Braan): bank erosion results from local backwater effects in the channel during high-flow events with cantilever failures and shallow slides, upstream of the local access road.

- Along WF186, dormant bank erosion poses a mild to significant problem along bank toes, as well as the mid-to-upper banks, whilst geotechnical failures pose a similar problem across from steps observed in the channel.

Baseline Importance Summary

19.3.29 Table 19.11 provides a summary of the baseline importance classifications for flood risk, hydromorphology, surface water quality and surface water supply attributes for all water features within the study area. During the assessment process, four of the 20 initially identified water features within the 500m study area were screened out of the 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 a lack of hydraulic connectivity.

Table 19.11: Summary of water feature importance

Water Feature ID	Water Feature Type	Water Feature Importance			
		Flood Risk	Hydromorphology	Surface Water Quality	Scoped in or out? (Reason if scoped out)
WF06 (River Tay)	Major watercourse	very high	high	very high	Scoped in.
WF01 (Birnam Burn)	Minor watercourse	low	medium	medium	Scoped in.
WF02 (Birnam Burn secondary channel)	Minor watercourse	low	medium	medium	Scoped in.
WF04	Drainage channel	low	low	low	Scoped out for all attributes as no hydraulic connectivity with the proposed scheme.
WF05	Minor watercourse	low	medium	medium	Scoped in.
WF05A	Drainage channel	low	low	medium	Scoped in.
WF07	Drainage channel	very high	low	medium	Scoped in.
WF08 (Inchewan Burn)	Medium watercourse	very high	high	medium	Scoped in.
WF09	Minor watercourse	very high	medium	medium	Scoped in.
WF11 (River Braan)	Major watercourse	very high	very high	very high	Scoped in.
WF11A	Drainage channel	low	low	medium	Scoped out for all attributes as no hydraulic connectivity with the proposed scheme.

Water Feature ID	Water Feature Type	Water Feature Importance			
		Flood Risk	Hydromorphology	Surface Water Quality	Scoped in or out? (Reason if scoped out)
WF12 (Mill Stream)	Minor (artificial) watercourse	very high	low	medium	Scoped in.
WF12A	Drainage channel	low	medium	medium	Scoped in.
WF12B	Drainage channel	very high	low	medium	Scoped in.
WF13	Minor watercourse	low	high	medium	Scoped in.
WF14	Minor watercourse	low	medium	medium	Scoped in.
WF16	Minor watercourse	low	medium	medium	Scoped in.
WF18	Minor watercourse	low	medium	low	Scoped in.
WF186	Drainage channel	low	low	low	Scoped out for all attributes as no hydraulic connectivity with the proposed scheme.
WF187	Artificial drainage channels and ponds	low	low	low	Scoped out for all attributes as no hydraulic connectivity with the proposed scheme.
Water Feature ID	**Water Feature Type**	**Surface Water Supply**			**Scoped in or out? (Reason if scoped out)**
WF06 (River Tay)	Major watercourse	high			Scoped in.

Future Baseline

19.3.30 The SEPA Water Environment Hub (SEPA, 2024e) provides target conditions for 2027 for all WFD baseline water bodies, while yearly classification data for baseline surface water bodies is provided on the SEPA Water Classification Hub (SEPA, 2024f).

19.3.31 The predicted overall condition for WF06 (River Tay) over the WFD reach (R Tummel to R Isla Confluences), and WF11 (River Braan) baseline surface water bodies are provided in Table 19.12. Predictions for overall conditions consider assumptions of the future quality of various parameters including, but not limited to, fish access, water flows and levels, physical condition, freedom from invasive species and water quality.

Table 19.12: WFD target conditions for water bodies within the study area (SEPA, 2024e).

Parameter	Receptor (WFD Water Body)	
	River Tay (R Tummel to R Isla Confluence)	River Braan
2027 Projected Overall Condition	Poor	Good
Long-term Projected Overall Condition	Poor	Good

19.3.32 For WF11 (River Braan), there are no existing pressures noted that would prevent the water body from maintaining Good Overall Condition (or Status) in the future.

19.3.33 For WF06 (River Tay), physical condition and management of water flows and levels are the main pressures preventing the achievement of Good Overall Condition (or Status). As such, the River Tay (R Tummel to R Isla Confluences) is designated as a Heavily Modified Water Body. Due to technical feasibility issues and impacts on water storage for hydroelectricity generation and drainage of agricultural land the long-term projected condition is expected to remain Poor.. The SEPA Water Classification Hub (SEPA, 2024f) notes the Overall Status to be Poor Ecological Potential for the 2023 classification year.

19.3.34 Generally, long-term projected conditions for all watercourses (including minor watercourses) may be influenced by increases in river flow and rainfall intensity as a result of climate change.

19.3.35 The hydraulic model for baseline flood risk for WF06 (River Tay) and WF11 (River Braan) included a 53% climate change allowance (CC) to account for flood events driven by climate change, which corresponds with the peak river flow allowance applicable for the Tay River Basin Region. The hydraulic model for baseline flood risk for WF08 (Inchewan Burn), the Minor Watercourses and the baseline culvert assessment for the remaining Minor Watercourses included a 39% allowance for a climate change flood event, which corresponds with the peak rainfall intensity allowance applicable to river catchments smaller than 30km^2 within the Tay River Basin Region. The climate change allowances applied are in line with SEPA's Climate change allowances for flood risk assessment in land use planning (LUPS-CC1) (SEPA, 2024c). The climate change allowances applied are reported in full within Appendix A19.2 (Flood Risk Assessment).

19.3.36 Without the proposed scheme, existing impacts on the hydromorphology and surface water quality of watercourses crossed by and receiving runoff from the existing A9, Highland Main Line railway, local roads and other land uses are anticipated to continue and would likely be exacerbated by increases in river flows and rainfall intensity associated with climate change.

19.4 Potential Impacts and Effects

Introduction

19.4.1 This section describes the assessment of potential impacts on the surface water environment of the proposed scheme and the predicted effects. Potential impacts arising from the construction and operational phases of the proposed scheme are assessed separately for each of the flood risk, hydromorphology, surface water quality and surface water supply attributes where appropriate. All potential impacts reported are adverse, unless otherwise stated.

Embedded Mitigation

19.4.2 Embedded mitigation, as described in Chapter 6 (The Proposed Scheme), is defined within DMRB LA 104 (Highways England et al., 2020a) as *"design measures which are integrated into a project for the purpose of minimising environmental effects".*

19.4.3 Substantial environmental input has contributed to the design process to help inform the most sustainable alignment options, watercourse crossing design and drainage solutions. The resultant embedded mitigation measures adopted into the design to reduce impacts on the surface water environment are summarised in Table 19.13.

19.4.4 In line with DMRB LA 104, any potential impacts associated with the proposed scheme (with all embedded mitigation measures applied) are assessed in this section to determine the need for any further 'essential mitigation'.

Table 19.13: Summary of Embedded Mitigation relevant to this Chapter

Topic	Description
Land Made Available	Preliminary review of construction drainage requirements undertaken to inform the land required to provide adequate surface water management during construction. The results of the review were used to inform the extent of the Compulsory Purchase Orders (CPO) boundary and will form a baseline for the Contractor to develop a construction drainage strategy within a site-specific Pollution Prevention Plan (PPP). This PPP will be submitted to SEPA for approval prior to the commencement of construction as part of the CAR Construction Site Licence (CSL) authorisation process.
Culverts	All watercourse crossings (new, replacement or extended) have been designed in accordance with the appropriate design standards. An engineering solution was developed at each watercourse crossing considered to require consent under CAR based on the DMRB Stage 3 design (refer to Appendix A19.3: Watercourse Crossings Report). A

Topic	Description
	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, scour protection and other measures required to obtain authorisation.
Levels of Mainline, Junctions, Access Roads and Tracks	The proposed scheme has been 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 within design flood event extents may remain unchanged from existing ground elevations and, as a result, may have lower flood protection than the proposed scheme. It is not always possible to provide a higher standard of protection to these access routes, as they serve locations (e.g. SuDS ponds) already within the 0.5% AEP (200-year) plus CC flood extent.
SuDS	SuDS are a legal requirement in Scotland under WEWS and CAR and were included within the DMRB Stage 3 design. The proposed scheme includes 11 mainline SuDS outfalls discharging to five water features. SuDS are designed to treat pollutants and attenuate runoff to acceptable levels before discharging to the water environment. Engineering and environmental factors were considered to confirm the drainage design and the types and locations of SuDS features. Specific types/combinations of SuDS are required to achieve appropriate discharge quality at each outfall location, these are detailed as Essential Mitigation. Further detail is also provided Appendix A19.4 (SuDS and Water Quality).
Pre-earthworks drainage	Pre-earthworks drainage (PED) is likely to take the form of ditches and will be constructed at the top of cuttings and the base of embankments where surface water and sub-surface pathways from adjoining land will flow towards the proposed scheme or other receptors, thus intercepting the flow. The purpose of PED 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. An assessment of the PED design has been undertaken to demonstrate there would be no impacts on sensitive flood risk receptors resulting from in any changes in flow rates in watercourses. Further detail is provided in Appendix A19.2 (Flood Risk Assessment).

Proposed Activities

19.4.5 A summary of the proposed infrastructure, and hence construction activities associated with the proposed scheme that are considered likely to have the potential to cause significant impacts on the water environment during construction and/or operation is provided in Table 19.14. Further detail on the proposed activities is provided in Chapter 6: The Proposed Scheme.

19.4.6 The majority of activities associated with the proposed scheme are either located within the River Tay functional floodplain, within close proximity to the functional floodplain, or within close proximity to the River Tay SAC. This has been a key factor in determining the specific impacts likely to occur during construction.

Table 19.14: Summary of proposed activities that may impact on the water environment

Location of Activity	Proposed Activities	No. of Water Features Potentially Impacted
Within 50m of water feature	Mainline widening (with associated cuttings and embankments)	16
	Proposed SuDS	5
	New side roads and tier 3 access tracks	11
	New junctions (including roundabouts)	7
	New lay-by	2
	Compensatory flood storage areas	2
Location of Activity	**Proposed Activities**	**No. of New Features**
Over water feature	River Tay Bridge crossing	1
	Inchewan Burn crossing	2
	River Braan crossing	1
Within water feature	Culvert replacement/extensions	10
	Channel realignments	10
	New mainline SuDS outfalls	10

Construction

19.4.7 Table 19.15 outlines the general impacts that may occur resulting from linear infrastructure projects such as the proposed development, during construction and in the absence of mitigation.

19.4.8 Table 19.16 summarises the assessment of potential impacts of 'Moderate' or above significance likely to occur during construction for flood risk, hydromorphology, surface water quality and surface water supply specific to individual water features within the study area, with consideration of embedded mitigation measures. Full details are provided, together with all impacts, within Appendix A19.5 (Impact Assessment).

Table 19.15: Potential general impacts during construction

Type of Impact	Description
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. ▪ Increased 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, particularly 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; in-channel works; 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.
Hydromorphology	

Type of Impact	Description
Changes to sediment regime	▪ Release of sediment from: exposed bare earth surfaces; in-channel working for culvert and outfall installation and channel realignment construction; construction of clear-span bridges and vegetation clearance. ▪ Increased sediment supply from accidental damage to riverbanks 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 to 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. ▪ 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, upstream and downstream of the works. ▪ Encroachment of works in channel could result in alterations to the channel dynamics under low and high flow conditions. This could lead to changes in erosion and deposition and sediment processes. ▪ 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.
Surface Water Quality	

Type of Impact	Description
Decline in surface water quality	▪ An increase in suspended sediment concentrations in downstream water features from construction of crossing structures in-channel or on watercourse banks, soil stripping and vegetation removal, soil storage, erosion of drainage ditches and all other earthworks which could result in the mobilisation of sediment. ▪ 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. Increases 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.
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.
Surface Water Supply	
Adverse impacts on water supply	▪ 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.

Table 19.16: Potential impacts on specific water features – Construction

Water Feature	Attribute	Description of Specific Construction Impacts on/or from Water Feature	Importance	Magnitude	Significance
WF06 (River Tay)	Flood Risk	Potential for temporary increase in surface water runoff rates from site areas. Loss of floodplain storage due to construction works within the floodplain. Provision of temporary structures for the construction of the new River Tay bridge crossing may lead to constricted flows and/or loss of floodplain storage locally.	Very High	minor	Moderate
	Hydromorphology	Impacts to hydromorphology arising from works in-channel and within the floodplain (bridge construction, outfalls, scour protection and bank reinforcement/stabilisation) and cumulative impacts from work on tributaries. Construction activities may lead to loss of, or extensive adverse changes to the watercourse bed, banks and vegetated riparian corridor resulting in potential changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes.	High	major	Very Large
	Surface Water Quality	Impacts to surface water quality from works adjacent to the channel, within the floodplain and from work on multiple tributaries may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of designated aquatic species with the River Tay SAC.	Very High	major	Very Large
WF01 (Birnam Burn)	Surface Water Quality	Impacts to surface water quality from works in-channel, and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC.	Medium	major	Large
WF02	Surface Water Quality	Impacts to surface water quality from works adjacent to the channel may lead to a measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species.	Medium	moderate	Moderate

Water Feature	Attribute	Description of Specific Construction Impacts on/or from Water Feature	Importance	Magnitude	Significance
WF05	Surface Water Quality	Impacts to surface water quality from works along the flow path of the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species.	Medium	major	Large
WF05A	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a CSO runs parallel to the proposed scheme, for the construction of side roads, upstream of WF05A).	Medium	major	Large
WF07	Flood Risk	Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert extensions, deculverting and channel creation will result in in-channel works.	very high	Minor	Moderate
	Surface Water Quality	Impacts to surface water quality from works within the catchment and adjacent to the culverted watercourse may lead to a measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species.	medium	major	Large
WF08 (Inchewan Burn)	Flood Risk	Potential for temporary increase in surface water runoff rates from site areas. Construction works associated with the replacement of the Inchewan Burn crossing and right bank access roads may cause localised increase in flood risk during construction.	very high	minor	Moderate
	Hydromorphology	Impacts to hydromorphology arising from direct construction activities as part of the bridge crossing and footpath replacement, works relating to outfall locations and within the vicinity of the watercourse could lead to adverse changes to on the water feature bed, banks and vegetated riparian corridor resulting in	high	moderate	Moderate

Water Feature	Attribute	Description of Specific Construction Impacts on/or from Water Feature	Importance	Magnitude	Significance
		changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes. Impacts would be at the reach scale.			
	Surface Water Quality	Impacts to surface water quality from works adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of designated aquatic species. This may potentially impact the downstream River Tay SAC. Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a CSO crosses the proposed scheme and runs parallel to WF08).	medium	major	Large
WF09	Flood Risk	Potential for temporary increase in surface water runoff from site areas. Construction of replacement culvert and channel realignment with in-channel works may pose an increased risk to flooding locally.	very high	minor	Moderate
	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC at the River Braan. Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a CSO runs parallel to and crosses the proposed scheme, for the construction of side roads and roundabout, and runs parallel to and crosses WF09).	medium	major	Large
WF11 (River Braan)	Flood Risk	Potential for temporary increase in surface water runoff rates from site areas. Construction works associated with the replacement of the River Braan (WF11) crossing, associated footbridge and left bank access track with near channel works may increase flood risk locally.	very high	Moderate	Large
	Hydromorphology	Impacts to hydromorphology arising from indirect construction activities as part of the bridge crossing replacement and left bank access track, works relating to	very high	moderate	Large

Water Feature	Attribute	Description of Specific Construction Impacts on/or from Water Feature	Importance	Magnitude	Significance
		outfall locations and within the vicinity of the watercourse could lead to adverse changes to on the water feature bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes. Impacts would be at the reach scale.			
	Surface Water Quality	Impacts to surface water quality from works adjacent to the channel and within the floodplain may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of designated aquatic species with the River Tay SAC.	very high	major	Very Large
WF12 (Mill Stream)	Flood Risk	Potential for temporary increase in surface water runoff rates from site areas. Construction of retaining walls in vicinity of watercourse to support new carriageway embankment may increase flood risk.	very high	minor	Moderate
	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species.	medium	major	Large
WF12B	Flood Risk	Potential for increased flood risk from construction works in-channel and adjacent to the channel through increased runoff. Potential for increased flood risk to the A9.	very high	Moderate	Large
	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC.	medium	major	Large
WF13	Hydromorphology	Impacts to hydromorphology arising from works in-channel as part of the culvert replacement/extensions and any channel realignments and within the vicinity of the watercourse could lead to loss of, or extensive adverse changes to the	high	major	Large

Water Feature	Attribute	Description of Specific Construction Impacts on/or from Water Feature	Importance	Magnitude	Significance
		watercourse bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes.			
	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC.	Medium	major	Large
WF14	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC.	Medium	major	Large
WF16	Surface Water Quality	Impacts to surface water quality from works in-channel and adjacent to the channel may lead to a major measurable (temporary) shift from baseline water quality, decline in pollutant removal capacity and river ecosystem health and a loss of aquatic species. This may potentially impact the downstream River Tay SAC.	Medium	Moderate	Moderate
Surface Water Supply					
Feature					
Abstraction from River Tay for agricultural irrigation purposes (NGR NO 00449 44434)		Impacts to the abstraction from works within the study area may lead to a measurable shift from baseline water quality, temporarily causing a deterioration in water supply from increased sediment laden runoff or accidental spillage(s) of fuel, oils, cementitious material.	high	moderate	Large

Operation

19.4.9 This section describes the general and specific potential impacts on the surface water environment that could occur during operation with embedded mitigation. The assessment is based on 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 and access tracks. Further information on water feature crossings is provided in Appendix A19.3 (Watercourse Crossings Report).

19.4.10 Table 19.17 outlines the general impacts that may occur resulting from linear infrastructure projects such as the proposed development, in the absence of mitigation, during operation.

19.4.11 A summary of the specific operational impacts of **'Moderate'** or above significance for flood risk and hydromorphology, surface water quality and surface water supply where appropriate are presented in Table 19.18. Full details are provided, together with all impacts, in Appendix A19.5 (Impact Assessment), which includes reporting of all impacts and effects, including those resulting in a potential significance of effect of Neutral or Slight. The impact of the proposed scheme on the volume of available floodplain is included in Appendix A19.2 (Flood Risk Assessment).

Table 19.17: Potential general impacts during operation

Type of Impact	Description
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, potentially increasing flood risk upstream. ▪ Alteration of the 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
Hydromorphology	
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. ▪ Deposition within culverts during low flows.

Type of Impact	Description
	▪ Increased volumes entering 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 increases 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.
Surface Water Quality	

Type of Impact	Description
Decline in surface water quality	▪ 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.
Surface Water Supply	
Adverse impacts on water supply	▪ Permanent loss of a public or private water supply due to disruption of pipelines and other buried assets present along the existing A9 corridor.

Table 19.18: Potential impacts on specific water features – Operation

Water Feature	Attribute	Description of Specific Operational Impacts on/or from Water Feature	Importance	Magnitude	Significance
WF06 (River Tay)	Hydromorphology	Operational structures, including bridge crossing piers and abutments, scour protection and outfalls could result in permanent adverse changes to the water feature bed, banks and vegetated riparian corridor resulting in changes to morphological features and/or channel planform and cross section and/or natural fluvial processes.	high	moderate	Large
WF05A	Surface Water Quality	Operational discharges from mainline drainage (outfall B1). HEWRAT 'Fail' for soluble pollutants (Cu and Zn), and failure against EQS compliance (Cu), pre mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.	medium	major	Large
WF08 (Inchewan Burn)	Hydromorphology	Operational structures, including the bridge crossing and outfalls could result in minor adverse changes to/impacts on the water feature bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes.	high	minor	Moderate
WF09	Flood Risk	Flooding of the A9 and downstream receptors is predicted and works to the channel and culvert are not considered to be feasible to prevent this. This would lead to flooding of the A9 with a retained culvert size of 600mm	Very high	Major	Very Large
	Hydromorphology	Operation impacts from culvert extensions/replacements, and realignments/diversions could result in loss of, or extensive adverse changes to the watercourse bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes.	medium	moderate	Moderate
WF11	Flood Risk	The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway,) within the River	very high	moderate	Very Large

Water Feature	Attribute	Description of Specific Operational Impacts on/or from Water Feature	Importance	Magnitude	Significance
(River Braan)		Braan (WF11) floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). The area of Inver between the right bank of the Tay and the left bank of the Braan (Approximately from chainage 4370 to 5000) is split by the existing A9. In the proposed scheme the A9 will have a higher vertical alignment and this has the effect of preventing flooding from the River Braan overtopping towards the River Tay. The areas of beneficial impact on the right-bank of the River Tay upstream of the Braan confluence, reflect this reduction in flow via this overtopping mechanism. Conversely, due to the increased impoundment, there are large areas of minor and moderate adverse impact on the River Braan floodplain as the overtopping flood mechanism is prevented. This area of adverse impact extends upstream on the River Braan to Inver Bridge and extends along the Mill Lade pre-mitigation.			
	Hydromorphology	Operational structures, including bridge crossing abutments, access tracks, scour protection and outfalls could result in permanent adverse changes to the water feature bed, banks and vegetated riparian corridor resulting in changes to morphological features and/or channel planform and cross section and/or natural fluvial processes.	very high	moderate	Large
WF12 (Mill Stream)	Flood Risk	Mill Stream (WF12) is within the River Braan (WF11) and River Tay (WF06) floodplain, and so is impacted by the flood depths of both watercourses. 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 Mill Stream (WF12), River Braan (WF11) and the River Tay (WF06) floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent).The Mill Stream (WF12) floodplain is impacted by the lost floodplain volume, resulting in small areas of minor adverse impact and Large significance.	very high	minor adverse	Large

Water Feature	Attribute	Description of Specific Operational Impacts on/or from Water Feature	Importance	Magnitude	Significance
	Surface Water Quality	Operational discharges from mainline drainage (outfall F). HEWRAT 'Fail' for soluble pollutants (Zn), but passes for EQS compliance (Cu and Zn), and fails for sediment bound pollutants pre mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.	medium	moderate	Moderate
WF13	Hydromorphology	Operation impacts from culvert extensions/replacements, potential bank reinforcement and realignments/diversions could result in loss of, or extensive adverse changes to the watercourse bed, banks and vegetated riparian corridor resulting in changes to existing morphological features and/or channel planform and cross section and/or natural fluvial processes.	high	major	Large
WF16	Flood Risk	Potential alterations to flood risk due to replaced culvert and any associated channel realignment. Replaced culvert would result in a small increase in flood risk downstream of the proposed scheme due to an increase in pass forward flows. There are no sensitive receptors downstream of the proposed scheme to the confluence with the River Tay, therefore the increase in flood risk is considered negligible. Flows remain in bank with a >100mm headwater level decrease and therefore there is a major beneficial magnitude of impact to the proposed scheme and woodland. Increased impervious surfaces due to carriageway near watercourse.	low	major beneficial	Moderate beneficial
WF18	Flood Risk	Potential alterations to flood risk due to replaced culvert and any associated channel realignment. Replaced culvert would result in a small increase in flood risk downstream of the proposed scheme due to an increase in pass forward flows. There are no sensitive receptors downstream of the proposed scheme to the confluence with the River Tay, therefore the increase in flood risk is considered negligible. Flows remain in bank with a >100mm headwater level decrease and therefore there is a major beneficial magnitude of impact	low	major beneficial	Moderate beneficial

Water Feature	Attribute	Description of Specific Operational Impacts on/or from Water Feature	Importance	Magnitude	Significance
		to the proposed scheme and woodland. Increased impervious surfaces due to carriageway near watercourse.			

19.5 Mitigation

19.5.1 This section identifies essential mitigation measures to avoid/prevent, reduce or offset potential significant impacts, described in Section 19.4 (Potential Impacts and Effects), taking into account best practice, legislation and guidance, during both construction and operation. Essential mitigation for the purposes of this chapter is identified as standard mitigation and specific mitigation.

19.5.2 Essential mitigation is defined within DMRB LA 104 as those that are "*critical for the delivery of a project which can be acquired through statutory powers*". Within this chapter we define essential mitigation under two categories (standard and specific). These are measures not embedded in the scheme design, but measures committed to during later stages of the project to avoid and reduce potential impacts. Essential mitigation measures that are required to avoid, prevent, reduce or offset all potential impacts (i.e. not just impacts with a significance of Moderate or above) are discussed in this section.

19.5.3 The mitigation measures outlined in this section are also reported in Chapter 22 (Schedule of Environmental Commitments).

19.5.4 This chapter refers to overarching standard mitigation commitments applicable across the A9 Dualling projects ('SMC' mitigation item references), and also to project-specific mitigation measures ('P02' mitigation item references). Those that specifically relate to Road Drainage and the Water Environment are assigned a 'W' reference.

Standard Mitigation

19.5.5 Standard mitigation commitments during construction (SMC-S1 to SMC-S4) are set out in Chapter 22 (Schedule of Environmental Commitments) and consist predominantly of best practice measures. The standard mitigation commitments applied during construction and operation for the Road Drainage and Water Environment are detailed in Table 19.19 below and are considered applicable to all receptors potentially impacted by the proposed scheme regardless of the significance of effect outlined within this Chapter and Appendix A19.5 (Impact Assessment).

Table 19.19: Standard Mitigation Commitments

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
SMC-W1	Throughout	Construction	Main Contractor	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.	Protect the water environment during construction	SEPA	N/A
SMC-W2	Throughout	Construction	Main Contractor	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 22.1 of Chapter 22 (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	Protect the construction site against most common flood events.	SEPA	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				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.			

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
SMC-W3	Throughout	Construction	Main Contractor	The Contractor will implement appropriate controls for construction site runoff and sedimentation, including but not limited to: ▪ 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	Prevent excessive contaminated and sediment laden runoff leaving site untreated.	SEPA	Refer to Specific Mitigation Item P02-W19 (Table 19.20).

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				▪ restoration of bare surfaces (seeding and planting) throughout the construction period as soon as possible after the work has been completed.			
SMC-W4	Throughout	Construction	Main Contractor	In relation to in-channel working, the Contractor will adhere to GPPs (NRW, NIEA and SEPA, 2024) and other good practice guidance and implement appropriate measures, including but not 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; ▪ no in-channel working during the salmonid spawning seasons unless permitted within any CAR licence; ▪ 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.	Prevent excessive release of sediment from the channel or introduction of sediment from out with the channel to suspension. Protection to sediment sensitive species.	N/A	Refer to Specific Mitigation Item P02-W19 (Table 19.20).
SMC-W5	Throughout	Construction	Main Contractor	Where channel realignment is necessary the Contractor will adhere to good practice guidance and implement appropriate measures, including but not limited to: ▪ once a new channel is constructed, the flow should, where practicable, be diverted from the existing channel to	Prevent excessive erosion during higher flows, giving time for new channel to adjust.	SEPA	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				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	Throughout	Construction	Main Contractor	In relation to refuelling and storage of fuels the Contractor will adhere to GPPs (NRW, NIEA and SEPA, 2024) and other good practice guidance and implement appropriate measures, including but not 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 SMC-W7); and ▪ compliance with the Pollution Incident Response Plan (refer to Mitigation Item SMC-S1).	Prevent excessive contamination of the water environment from construction works.	SEPA	Refer to Specific Mitigation Item P02-W19 (Table 19.20).
SMC-W7	Throughout	Construction	Main Contractor	In relation to oil/fuel leaks and spillages the Contractor will adhere to GPPs (NRW, NIEA and SEPA, 2024) and other good practice guidance and implement	Prevent excessive contamination of the water	SEPA	Refer to Specific Mitigation Item P02-W19 (Table 19.20).

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				appropriate measures, including but not 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 SMC-S1); and ▪ construction activities will comply with the Pollution Incident Response Plan (refer to Mitigation Item SMC-S1).	environment from construction works.		
SMC-W8	Throughout	Construction	Main Contractor	In relation to chemical storage, handling and reuse the Contractor will adhere to GPPs (NRW, NIEA and SEPA, 2024) and other good practice guidance 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.	Prevent excessive contamination of the water environment from construction works.	SEPA	Refer to Specific Mitigation Item P02-W19 (Table 19.20).
SMC-W9	Throughout	Construction	Main Contractor	In relation to concrete, cement and grout the Contractor will adhere to GPPs (NRW, NIEA and SEPA, 2024) and other good practice guidance and implement appropriate measures, including but not limited to:	Prevent excessive contamination of the water environment from construction works.	SEPA, Scottish Water	Refer to Specific Mitigation Item P02-W19 (Table 19.20).

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				▪ 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	Throughout	Construction	Main Contractor	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 'GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer' (NRW, NIEA and SEPA, 2024).	Prevent excessive contamination to the water environment from the construction site.	SEPA, Scottish Water	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
SMC-W11	Throughout	Construction	Main Contractor	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) if services are to be disrupted or diverted by the works.	To prevent damage or disruption the water supply infrastructure.	Scottish Water	Via supervision requirements outlined in Contract Documents
SMC-W12	Throughout	Construction	Main Contractor	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 13 (Geology and Soils).	Prevent excessive contamination to the water environment.	SEPA	Refer to Specific Mitigation Item P02-W19 (Table 19.20).
SMC-W13	Throughout	Operation/ post-construction	Main Contractor Road Operating Company	In relation to bank reinforcement, design principles and mitigation measures will adhere to good practice (SEPA, 2008), including but not 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	To limit the impacts on hydromorphology. Good practical guidance followed post-construction.	SEPA	Post project appraisal.

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				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	Throughout	Operation/ post-construction	Main Contractor Road Operating Company	In relation to outfalls, specimen and detailed design will ensure compliance to good practice (e.g. CIRIA, 2015b; Highways England et al., 2021; SEPA, 2019b), including but not 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.	To limit the impacts on hydromorphology, flow and water quality. Good practical guidance followed post-construction.	SEPA	Post project appraisal.
SMC-W15	Throughout	Operation/ post-construction	Main Contractor Road Operating Company	In relation to watercourse crossings, specimen and detailed design will ensure compliance with good practice (SEPA, 2010b), including but not 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 CC design flood event.	Reduce flood risk to the scheme and to limit the impacts on hydromorphology. Good practical guidance followed post-construction.	SEPA	Post project appraisal.

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				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; ▪ 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); ▪ roughening of culvert inverts and interiors to help reduce water velocities; and ▪ post project appraisal to identify if there are issues that can be			

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				investigated and addressed at an early stage.			
SMC-W16	Throughout	Operation/ post-construction	Main Contractor Road Operating Company	In relation to channel realignments, specimen and detailed design will ensure compliance with good practice including but not 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; ▪ 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 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.	To limit the impacts on hydromorphology and flow. Good practical guidance followed post-construction.	SEPA	Post project appraisal.

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
SMC-W17	Throughout	Operation/ post-construction	Main Contractor Road Operating Company	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 including The SuDS Manual (CIRIA, 2015b) and SuDS for Roads (SCOTS, 2009); ▪ for each drainage run, wherever practicable, a minimum of two levels of SuDS treatment within a 'treatment train' 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; ▪ 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).	Regular maintenance to ensure functional operation post-construction	SEPA	N/A

Specific Mitigation

19.5.6 Specific mitigation measures are particular to the proposed scheme and specific receptors. These are not included in the SMCs and may go beyond standard industry best practice and are required to reduce potential impacts on receptors are detailed in Table 19.20 and in Appendix A19.5 (Impact Assessment). Each recommended mitigation measure is assigned a reference and a detailed description is provided, as well as providing an indication as to which water feature the specific mitigation measure applies to, including those with a pre-mitigation potential significance of effect of Neutral or Slight (as detailed in Appendix A19.5 (Impact Assessment)).

Table 19.20: Specific Mitigation Measures

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
P02-W18	Throughout	Construction	Main Contractor	Measures to prevent water quality impacts during construction by controlling sources of suspended sediment and other contaminants, and treating and managing construction drainage, will be set out within a site-specific Pollution Prevention Plan that will be submitted to SEPA for approval prior to construction. The document will comply with SEPA guidance WAT-SG-75 (SEPA, 2021), with specific measures including, but not 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 outwith 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 for erosion control and check dams. ▪ Use of an appropriate grade of material on temporary haul routes that would be clean, washed, 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. Material likely to result in metallic, sulphide rich or strongly acidic runoff will not be used. Frequent monitoring of the performance of haul routes will be undertaken, with maintenance and regrading where issues are identified. ▪ Use of biodegradable fuels, oils and chemicals on site, as far as reasonably practicable. 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. If flocculants are considered necessary to aid settlement of fine suspended sediment, such as clay particles, only natural organic flocculants would be used for surface water treatment and permission from SEPA for the use of such chemicals would be sought at an early stage prior to construction. ▪ Protocols would be developed for ceasing or reducing construction activities during periods of high rainfall to reduce the risks of erosion, sedimentation and pollution. ▪ A temporary drainage design will be developed which would take consideration of the phasing of works, topography, land available for treatment of surface water and the location of surface water features. ▪ Isolation of existing A9 drainage systems from areas construction activities to prevent pollutants from entering the drainage system and polluting downstream water bodies.	Protect the water environment during construction	SEPA	Refer to Specific Mitigation Item P02-W19.

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				▪ 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. ▪ 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 runoff that would be reasonably expected to occur on any occasion during the period of construction. ▪ 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.			
P02-W19	Throughout	Pre-Construction/ Construction / Post-Construction	Advance works Contractor Main Contractor Road Operating Company	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 not be limited to: ▪ Appointment of a suitable 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 advise the contractor 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, to be informed by pre-construction water quality monitoring and agreed in consultation with SEPA and NatureScot. The Contractor will ensure compliance with these standards through the adoption of standard mitigation (Table 19.19) and Mitigation Item P02-W18. ▪ 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	Protect the water environment from contamination from construction activities from site runoff.	SEPA, NatureScot	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
				required to confirm compliance with the limits agreed with SEPA, and allow remedial actions to be implemented at specific locations.			
P02-W20	Throughout	Construction	Main Contractor	In relation to near channel working: ▪ Maintain riparian corridor to provide additional bank stability and minimise the extent of channel disturbance and size of working corridor. Avoid in-channel works where practicable and work from one bank if possible. ▪ Restrict in channel and near channel working to preserve natural features including bars, riffles, banks and natural floodplain.	Prevent excessive geomorphological changes to water courses to maintain channel stability	SEPA	N/A
P02-W21	Throughout	Construction	Main Contractor	In relation to channel realignments and in/near channel working where the removal of existing bed and bank material is required by the proposed design. The contractor should: ▪ Remove, store and reinstate natural bed and bank material where practicable. ▪ Provide temporary scour protection where required for instance downstream outlet of over pumping. Care should be taken to preserve natural morphological features out with the working area where present. For example, these could include, but not be limited to, natural steps, pools, cascades, riffles and bars.	Prevent excessive geomorphological changes to water courses to maintain channel stability	SEPA	N/A
P02-W22	WF12B	Construction	Main Contractor	In relation to the poorly defined, ephemeral watercourse which is currently capturing overland flow during periods of sustained rainfall upstream of the existing A9, the contractor should ensure that during construction: ▪ Natural flow paths are not disturbed to ensure that overland flow reaches the intended culvert/structure to convey it below the proposed scheme.	Prevent disruptions to flow	SEPA	N/A
P02-W23	WF06, WF05A, WF08, WF11, WF12	Operation/ Post-Construction	Main Contractor Road Operating Company	▪ Re-planting of vegetation around outfall structures, tying in with natural vegetation. The planting of trees, if removed, is of particular importance for bank stability. ▪ Provide sufficient energy gradient differential for maintenance of flow and hydraulics from outfall locations. ▪ Provision of scour protection where required i.e. at outlet headwall.	Reducing bare soil to prevent excessive sediment influx from runoff and maintain stability of banks through root systems. Reducing excessive change to hydromorphology of water courses. Protect outfalls from erosion	SEPA	N/A
P02-W24	WF06, WF11, WF12	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: Management Train 1 (MT1) comprising filter drains and a detention basin. MT1 will be adopted for drainage catchments A, B2, D, F and H.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
P02-W25	WF05A	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: MT2 comprising filter drains and a retention pond. This management train will be adopted for drainage catchment B1.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W26	WF08	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: MT3 comprising filter drains, geocellular storage and a hydrodynamic vortex separator. This management train will be adopted for drainage catchment C1.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W27	WF08	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: MT4 comprising filter drains and a dry swale. This management train will be adopted for drainage catchment C2.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W28	WF06	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: MT5 comprising filter drains, a dry swale and a detention basin. This management train will be adopted for drainage catchment G.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W29	WF06	Operation/ Post-Construction	Main Contractor Road Operating Company	Operational Mainline SuDS: MT6 comprising filter drains and a wetland. This management train will be adopted for drainage catchment I.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W30	Throughout	Operation/ Post-Construction	Main Contractor Road Operating Company	Side road drainage during operation will incorporate a single level of treatment through either filter drains and/or swales. Access track drainage during operation will be provided through over-the-edge (OTE) drainage and/or soakaways.	Treat road runoff to protect water environment from excessive sediment and contaminants	SEPA	N/A
P02-W31	WF06, WF08, WF11	Operation/ Post-Construction	Main Contractor Road Operating Company	In relation to bridge crossings: ▪ Restrict length of grey bank protection and implement green bank protection measures where applicable. ▪ Re-plant with appropriate cover if vegetation is lost. ▪ Post project appraisal, which shall include an operational management and maintenance regime for sediment and debris clearance, riparian vegetation management, and structure repair or maintenance.	Reducing excessive change to hydromorphology of watercourses.	N/A	Post-construction management and maintenance regime.
P02-W32	WF01, WF05, WF05A, WF07, WF09,	Operation/ Post-Construction	Main Contractor Road Operating Company	In relation to culvert extension/ replacements: ▪ maintain natural channel width and bed gradient through the culvert where possible;	Reducing excessive change to	N/A	Post-construction management and

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
	WF12, WF12A, WF12B, WF13, WF14, WF16, WF18			▪ sediment retention system (e.g. baffles) will be installed within culverts where required energy dissipation at culvert outlets where deemed necessary; and ▪ Post project appraisal, which shall include an post-construction/operational management and maintenance should include sediment and debris clearance, riparian vegetation management, and structure repair or maintenance.	hydromorphology of watercourses.		maintenance regime.
P02-W33	WF01, WF05, WF05A, WF07, WF09, WF12, WF12A, WF12B, WF13, WF14, WF16, WF18	Operation/ Post-Construction	Main Contractor Road Operating Company	In relation to channel realignments and diversions where appropriate: ▪ maximise open-channel realignments where possible ▪ maintain natural channel width and bed gradient where possible ▪ provide suitably sized sediment to be reinstated in the channel ▪ banks should be re-graded to replicate existing bank conditions, where practicable. Bank slopes of at least 1 in 2 are typically considered to be stable. Reinstated banks would be further stabilised with biodegradable geotextile and re-planted with suitable riparian vegetation ▪ incorporate fence-lines to protect banks and establishing planting where required	Reducing excessive change to hydromorphology of watercourses.	N/A	N/A
P02-W34	WF05, WF05A, WF07	Operation/ Post-Construction	Main Contractor Road Operating Company	Appropriate realignment design should be undertaken at the specimen design stage to design new channel downstream of the existing A9 if it is not going to be tied into drainage system. This should include calculation of sediment sizes to be reinstated, appropriate grade control, though provision of morphological features should also be provided to ensure channel stability. Further design required during specimen and detailed design stages.	To retain watercourses potentially impacted by the scheme	SEPA	N/A
P02-W35	WF12B	Operation/ Post-Construction	Main Contractor Road Operating Company	Currently WF12B is an ephemeral channel upstream. Steps should be taken to ensure the design captures overland flow during periods of high rainfall and directs it downstream from the side road and mainline. This might mean incorporating this watercourse into the road drainage or piping it to the existing culvert downstream. Methods will be determined during specimen design.	To maintain overland flow paths	SEPA	Post-construction management and maintenance regime.
P02-W36	WF06, WF11	Operation/ Post-Construction	Main Contractor Road Operating Company	In relation to scour protection associated with access tracks/ embankments specimen design should consider best practice which would include but not be limited to: ▪ Restrict length of bed and bank protection and implement green bank protection measures where applicable. ▪ Re-plant with appropriate cover if vegetation is lost. ▪ If grey bank protection is required minimise extent through design. Where applicable if scour protection is required, and if deemed necessary by a suitably qualified geomorphologist, provide rock armour/boulder toe protection downstream of the scour protection on to minimise impact of flow deflection. This should cover at least 1-2 channel widths (approximately 60 – 120 m).	Reducing excessive change to hydromorphology of water courses.	N/A	N/A
P02-W37	Ch4350-4700	Operation/ Post-Construction	Main Contractor Road Operating Company	Compensatory Flood Storage Area (CSFA 1) providing 31,198m^3 of storage.	To provide storage of floodwater from floodplain lost by encroachment of	SEPA	N/A

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Responsible Party for implementation	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Monitoring measure for the suggested mitigation
					the proposed scheme		
P02-W38	Ch4890	Operation/ Post-Construction	Main Contractor Road Operating Company	Mill Lade Flood Relief Culverts: 3no. 1.5m diameter Flood Relief Culverts proposed to convey additional floodwater within the Inver floodplain through the A9 carriageway into the River Tay.	To provide flow pathway for flood water under the proposed scheme to replicate existing flooding mechanism	SEPA	N/A
P02-W39	Ch 4400-4560	Operation/ Post-Construction	Main Contractor Road Operating Company	Embankment culverts to replicate current A9 overtopping - 14no. 3.6m x 1.2m Flood Relief Culverts constructed through proposed embankment (level of culverts set to existing carriageway level (52.1mAOD)). The culverts will only operate during the Run 1 0.5% AEP + CC flood event, replicating the existing flood path over the A9 carriageway.	To provide flow pathway for flood water under the proposed scheme to replicate existing flooding mechanism	SEPA	N/A
P02-W40	Ch 4100-4300	Operation/ Post-Construction	Main Contractor Road Operating Company	WF9 flood relief culvert – c.1.0mx1.2m box culvert running from the roundabout outlet culvert for 200m to the River Braan. The culvert will operate when the 600mm main culvert is close to surcharging.	To provide flow pathway for flood water to ensure flood risk is not increased downstream	SEPA	N/A
P02-W41	Ch 8300-8400	Operation/ Post-Construction	Road Operating Company	Preparation of an Emergency Response Plan in the event that the A9 is flooded during the 0.5%AEP (200-year) plus 53% CC event at chainage 8300 to 8400, north of the Tay Crossing, to manage the flood risk. The flooding occurs very close to the peak of the hydrograph and the inundation is relatively small in volume and extent. This residual flood risk at the design event will be managed through an Emergency Response Plan. The Emergency Response Plan would include measures that would be considered in advance of an extreme event, during the event as well as measures to deal with the clean up after the event.	To ensure safety of A9 road users during the 0.5%AEP plus 53% CC event	N/A	N/A

19.6 Residual Effects

19.6.1 Following implementation of the essential mitigation measures outlined in Section 19.5 (Mitigation), potentially significant impacts on the surface water environment would be prevented, reduced or offset.

19.6.2 Table 19.21 provides details of the potential significant effects on the surface water environment identified in Section 19.4 (Potential Impacts and Effects), and the relevant Essential Specific mitigation measures applicable to each receptor. The residual effects detailed below are considered to include the application of all essential standard mitigation commitments as detailed in Table 19.19.

Table 19.21: Residual Effects – Construction

Water Feature	Attribute	Importance	Pre-Mitigation Magnitude	Significance	Essential Specific Mitigation*	Residual Magnitude	Residual Significance
WF06 (River Tay)	Flood Risk	very high	minor	Moderate	Standard Mitigation Commitments	negligible	Slight
	Hydromorphology	high	major	Large	P02-W20, P02-W21	negligible	Slight
	Surface Water Quality	very high	major	Very Large	P02-W18, P02-W19	negligible	Slight
WF01 (Birnam Burn)	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF02	Surface Water Quality	medium	moderate	Moderate	P02-W18, P02-W19	negligible	Neutral
WF05	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF05A	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF07	Flood Risk	very high	Minor	Moderate	Standard Mitigation Commitments	negligible	Slight
	Surface Water Supply	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF08 (Inchewan Burn)	Flood Risk	very high	minor	Moderate	Standard Mitigation Commitments	negligible	Slight
	Hydromorphology	high	moderate	Moderate	P02-W20, P02-W21	minor	Slight
	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF09	Flood Risk	very high	minor	Moderate	Standard Mitigation Commitments	negligible	Slight
	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF11 (River Braan)	Flood Risk	very high	Moderate	Large	Standard Mitigation Commitments	negligible	Slight
	Hydromorphology	very high	moderate	Large	P02-W20, P02-W21	negligible	Slight

Water Feature	Attribute	Importance	Pre-Mitigation Magnitude	Significance	Essential Specific Mitigation*	Residual Magnitude	Residual Significance
	Surface Water Quality	very high	major	Very Large	P02-W18, P02-W19	negligible	Slight
WF12 (Mill Stream)	Flood Risk	very high	minor	Moderate	Standard Mitigation Commitments	negligible	Slight
	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF12B	Flood Risk	very high	moderate	Large	Standard Mitigation Commitments	negligible	Slight
	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF13	Hydromorphology	high	major	Large	P02-W20, P02-W21	negligible	Slight
	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF14	Surface Water Quality	medium	major	Large	P02-W18, P02-W19	negligible	Slight
WF16	Surface Water Quality	medium	moderate	Moderate	P02-W18, P02-W19	negligible	Neutral
Surface Water Supply							
Feature		**Importance**	**Pre-Mitigation Magnitude**	**Significance**	**Essential Specific Mitigation***	**Residual Magnitude**	**Residual Significance**
Abstraction from River Tay for agricultural irrigation purposes (NGR NO 00449 44434)		high	moderate	Large	P02-W18, P02-W19	negligible	Slight

* Standard Mitigation Commitments (Table 19.19) are considered to be applicable to all receptors potentially impacted by the proposed scheme.

Table 19.22: Residual Effects – Operation

Water Feature	Attribute	Importance	Pre- Mitigation Magnitude	Significance	Essential Specific Mitigation*	Magnitude	Significance
WF06 (River Tay)	Hydromorphology	high	moderate	Large	P02-W23, P02-W31, P02-W36	minor	Slight
WF05A	Surface Water Quality	medium	major	Large	P02-W25	minor	Slight
WF08 (Inchewan Burn)	Hydromorphology	high	minor	Moderate	P02-W23, P02-W31	negligible	Slight
WF09	Flood Risk	Very high	major	Very Large	P02-W40	Major (beneficial)	Beneficial
	Hydromorphology	medium	moderate	Moderate	P02-W32, P02-W33.	minor	Slight
WF11 (River Braan)	Flood Risk	very high	moderate	Very large	P02-W37, P02-W38, P02-W39	negligible	Neutral
	Hydromorphology	very high	moderate	Large	P02-W23, P02-W31	minor	Moderate
WF12 (Mill Stream)	Flood Risk	very high	minor	Large	P02-W38	minor (beneficial)	Beneficial
	Surface Water Quality	medium	moderate	Moderate	P02-W24	negligible	Slight
WF13	Hydromorphology	high	major	Large	P02-W33, P02-W34	moderate	Moderate
WF16	Flood Risk	low	major (beneficial)	Moderate (beneficial)	N/A	Major (beneficial)	Beneficial
WF18	Flood Risk	low	major (beneficial)	Moderate (beneficial)	N/A	Major (beneficial)	Beneficial

* Standard Mitigation Commitments (Table 19.19) are considered to be applicable to all receptors potentially impacted by the proposed scheme.

19.7 Compliance Against Plans and Policy

19.7.1 DMRB LA 104, Environmental Assessment and Monitoring, states that environmental assessment, reporting and monitoring shall meet the requirements of the national planning policy for each relevant overseeing organisation.

19.7.2 Appendix 3.1 (Assessment of Policy Compliance) provides a review of national and local policy documents which are of relevance to the assessment undertaken and reported in this chapter in accordance with DMRB guidance. The compliance assessment undertaken in Appendix 3.1 focuses principally on the long-term effects of the proposed scheme rather than the short term, temporary effects from construction.

19.7.3 National policy objectives of relevance to this assessment are provided in the National Planning Framework 4 (Scottish Government 2023). In addition, the Perth and Kinross Local Development Plan 2 (Perth and Kinross Council 2019) Policies 52 (New Development and Flooding) and 53 (Water Environment and Drainage) and the Scottish Government's Flood risk: planning advice (22 June 2015) (Scottish Government, 2015a) are of relevance.

Summary of Policy Compliance

19.7.4 Overall, the design and assessment of the proposed scheme has had regard to, and is compliant with, policy objectives relating to flood risk and water management. A full policy compliance assessment can be found in Table A3.1-12 of Appendix 3.1 (Assessment of Policy Compliance).

19.8 Statement of Significance

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

Flood Risk

19.8.2 No significant effects on flood risk are anticipated during the construction phase, provided prescribed mitigation is adhered to. There are no adverse significant effects on flood risk anticipated during operation after the implementation of prescribed mitigation measures.

Hydromorphology

19.8.3 No significant effects on hydromorphology are anticipated during the construction phase, provided prescribed mitigation is adhered to. There are residual significant effects on hydromorphology during the operational phase, associated with WF11 and WF13 after the implementation of prescribed mitigation measures. To offset these significant effects on hydromorphology it is proposed to remove 170m of existing culvert and create an open channel on WF07. There is also an offsite compensation area which will include river restoration and enhancement of a previously straightened watercourse at Muir of Thorn and Gelly Woods in an area of compensatory woodland planting (habitat creation of Ancient Woodland and non-ancient woodland).

Surface Water Quality

No significant effects on surface water quality are anticipated during the construction and operational phases, provided prescribed mitigation is adhered to.

19.9 References

National Legislation and EU Directives

Directives:

Urban Wastewater Treatment Directive (91/271/EEC) to protect the water environment from the adverse effects of discharges of urban waste water and from certain industrial discharges

Nitrates Directive (91/676/EEC) concerning the protection of waters against pollution caused by nitrates from agricultural sources

Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora

Water Framework Directive (2000/60/EC) establishing a framework for Community action in the field of water policy

Environmental Liability Directive (2004/35/EC) on environmental liability with regard to the prevention and remedying of environmental damage

Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration

Floods Directive (2007/60/EC) on the assessment and management of flood risks

EIA Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment

Drinking Water Directive (2015/1787/EU) on the quality of water intended for human consumption

Primary Legislation:

Scottish Government (2003) Water Environment and Water Services (Scotland) Act 2003 (WEWS Act). Available at: https://www.legislation.gov.uk/asp/2003/3/contents (Accessed October 2024).

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Scottish Government (2006b) Private Water Supplies (Scotland) Regulations 2006. Available at: https://www.legislation.gov.uk/ssi/2006/209/contents/made (Accessed October 2024).

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Scottish Government (2014) Public Water Supplies (Scotland) Regulations 2014. Available at: https://www.legislation.gov.uk/sdsi/2014/9780111024782/contents (Accessed October 2024).

Scottish Government (2017a) Water Environment (Miscellaneous) (Scotland) Regulations 2017. Available at: https://www.legislation.gov.uk/ssi/2017/389/contents/made (Accessed October 2024).

Scottish Government (2017b) Roads (Scotland) Act 1984 (Environmental Impact Assessment) Regulations 2017. Available at: https://www.legislation.gov.uk/sdsi/2017/9780111034941 (Accessed October 2024).

Policy:

Scottish Government (2023) National Planning Framework 4 (NPF4). Available at: https://www.gov.scot/publications/national-planning-framework-4/ (Accessed October 2024).

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BLOM (2013) Aerial Imagery. Available at: https://blominternationaloperations.com/services/photogrammetry/ (Accessed January 2024).

(BGS) British Geological Survey (2024) GeoIndex Onshore. Available at: https://www.bgs.ac.uk/map-viewers/geoindex-onshore/ (Accessed October 2024).

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CIRIA (2006a) Control of water pollution from linear construction projects: Technical Guidance, CIRIA C648.

CIRIA (2006b) Control of water pollution from linear construction projects: Site guide, CIRIA C649.

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